

CITY OF WEST JORDAN, UTAH

CONTRACT DOCUMENTS FOR
**WELL NUMBER 8 PUMP BUILDING
(RON WOOD PARK WELL)**

PROJECT NUMBER CW 20-02

WJPU23032701



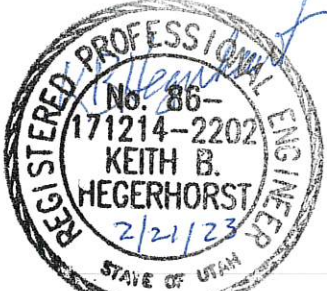
MARCH 2023



CITY OF WEST JORDAN
Public Works Department
7960 South 4000 West
West Jordan, UT 84088

ACKNOWLEDGEMENT

These specifications have been prepared under the direction of the following engineers, licensed by the State of Utah:

 <p>Mark Atencio Civil Engineer</p>	 <p>Robert Conder Structural Engineer</p>	 <p>Keith Hegerhorst Electrical Engineer</p>
<p>Not used</p>	<p>Not used</p>	<p>Not used</p>

The City of West Jordan has reviewed these documents for compliance with its' standards and specifications:



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CITY OF WEST JORDAN
8000 S. Redwood Road
West Jordan, Utah

NOTICE INVITING BIDS

For constructing

**WELL NUMBER 8 PUMP BUILDING
(RON WOOD PARK WELL)**

PROJECT NUMBER CW 20-02

For the
CITY OF WEST JORDAN
Public Works Department
7960 South 4000 West
West Jordan, Utah

N-1 NOTICE IS HEREBY GIVEN that bids will be received electronically through the Utah Public Procurement Place for the construction of Well Number 8 Pump Building, and all appurtenant work, in strict accordance with the Contract Documents on file at the office of the Director of Public Works.

N-2 DATE OF OPENING BIDS Submit your bid electronically through the Utah Public Procurement Place (U3P) website by 2:00 p.m. current Mountain Time on April 26, 2023.

N-3 DESCRIPTION OF THE WORK: The Work includes Mobilization, Construction Surveying and SWPPP controls, Pump House Structural construction, Generator Screening Walls and concrete pad, Pump, Shaft, and Motor, Pump Station Piping, Valving, and Chlorination System, Pipeline (including Discharge, Floor Drain, Sewer, Pump to Waste) and Pump to Waste Discharge structure, Site Improvements (including Landscaping, Fencing, Pavement and Curb), Electrical Power Supply, Electrical Systems, Instrumentation, Control Panels, Generator and Transfer Switch, and HVAC System.

N-4 LOCATION OF THE WORK: The Work to be constructed is located at 6183 West 8600 South in West Jordan, UT.

N-5 COMPLETION OF WORK: Time is of the essence. The Work must be completed within 365 calendar days after the commencement date stated in the Notice to Proceed.

N-6 BID SECURITY: If the bid is awarded as the winning bid, the bidder will promptly obtain the required bonds and insurance and will prepare the required submittal documents and execute the Contract.

N-7 GUARANTEE OF BID PRICE: The Bidder shall guarantee the Total Bid Price for a period of sixty (60) calendar days from the date of Bid opening.

N-8 CONTRACTOR'S LICENSE CLASSIFICATION: The City has determined the Contractor shall possess the following contractor licenses at the time of the bid submittal: Utah General Contractor License with E-100 General Engineering classification. In accordance with this requirement, bidders must provide proof of their Utah General Contractor's License by submitting the Bidder's Licensing Statement included in this bid packet. Any bid that does not have the bidder's licensing statement included in the bid submittal shall be deemed as non-responsive and shall act as a bar to an award of the bid and contract.

N-9 BIDDER'S LICENSING STATEMENT: The Bidder shall list in the bid, his or her contractor's license number and date of expiration of the contractor's license.

N-10 FEDERAL NON-DISCRIMINATION PROVISION: If applicable, Bidders on this Work shall be required to comply with the President's Executive Order No. 11246, as amended.

N-11 MANDATORY PRE-BID CONFERENCE [AND SITE VISIT]: Prospective bidders are required to attend a scheduled pre-bid conference [and site visit], if any, to address issues of special concern to bidders. The pre-bid conference [and site visit] will begin at 2:00 p.m. on Wednesday, April 12, 2023 at the project site. Any bidder arriving fifteen minutes after the above noted time shall be disqualified from submitting a bid and any bid submitted by them shall be considered non-responsive and will not be evaluated further. Attention is directed to the condition that questions relating to the technical content of the drawings and specifications cannot be responded to orally, but must be submitted to the City in writing, and all responses will be in the form of written Addenda, which will be sent to all bidders. Meet at the Northwest corner of Ron Wood Park.

N-12 OBTAINING OR INSPECTING CONTRACT DOCUMENTS: Each bidder may obtain bidding information and documentation electronically through the Utah Public Procurement Place (U3P) site

Alteration of the bid documents is prohibited. The City of West Jordan is not responsible for content that is duplicated, copied, distributed, disseminated, published or forwarded by others. Use of the bid documents, or any part thereof, for construction other than the intended project is prohibited; any such user shall be solely liable for such use.

N-13 ADDRESS AND MARKING OF BIDS: Submit your bid electronically through the Utah Public Procurement Place. Bids submitted electronically through the Utah Public Procurement Place may require uploading of electronic attachments. The Utah Public Procurement Place will accept a wide variety of document types as Word, Excel, and PDF attachments but not all. You **MAY NOT** submit documents that are embedded (zip files), movies, wmp and mp3 files or password protected files, etc. Such actions may cause your proposal(s) to be deemed as “Non-responsive”.

When submitting an offer electronically through the Utah Public Procurement Place please allow sufficient time to complete the online forms and upload documents. The solicitation will end at the closing time listed in the offer. If you are in the middle of uploading your documents at the closing time, the system will stop the process and your offer will not be received by the system. It is recommended that the submission process be completed the day prior to the due date, with the knowledge that any changes/updates will be accepted through the due date and time.

Jaggaer customer support may be contacted at (800) 233-1121 for guidance on the Utah Public Procurement Place site.

Vendors are responsible for ensuring that their Utah Public Procurement Place registration information is current and correct. Stakeholders shall not be responsible for missing or incorrect information contained in the vendor registration in the Utah Public Procurement Place. Incorrect or missing vendor registration information may result in failure to receive notification from the Utah Public Procurement Place regarding this procurement.


Bids received after this deadline will be late and ineligible for consideration. Following the deadline, the names of those responding to the Bid will be made public.

N-14 PROJECT ADMINISTRATION: All communications relative to this Work shall be directed to the Purchasing Manager, joe.bryant@westjordan.utah.gov until a contract has been awarded and executed by the City. All questions relating to the interpretation of the Contract Documents or products or any requirements for submission must be submitted in writing at least 7 days prior to the opening of bids. Any responses by the City, if any, will be in the form of a written addendum or clarification. The City is not required to respond to any questions submitted by bidders and will not be liable for any result of such action or inaction of the City.

**BY ORDER OF CITY OF WEST
JORDAN**

Date March 27 _____ 2023

CITY OF WEST JORDAN

By 
Authorized Representative
City of West Jordan
State of Utah

CITY OF WEST JORDAN

INSTRUCTIONS TO BIDDERS

1. DEFINED TERMS - Terms used in these Instructions to Bidders and the Notice Inviting Bids, which are defined in the General Conditions, have the meanings assigned to them in the General Conditions. The term "Bidder" means one who submits a Bid directly to the City, as distinct from a sub-bidder, who submits a Bid to a Bidder. The terms "Engineer" or "Architect", or both, are further defined in the Supplementary General Conditions.

2. COMPETENCY OF BIDDERS - In determining a responsible Bidder, consideration will be given to the quality, fitness, and capacity of the Bidder which include, but are not limited to, financial standing and the general competency of the Bidder for the performance of the Work covered by the Bid. In selecting a responsible Bidder, consideration will be given, but not limited to the following:

(a) The Bidder's financial standing.

(b) The Bidder's general competence for performance of Work, including past performance of the same or similar Work with the City or other entities. The City shall have the right to investigate and discuss the Bidder's past performance with outside entities;

(c) The Bidder's Bid, Bid Schedule and General Information bound herein. Bidder shall submit evidence by written Prime Contractor's certified statement listing projects, owners, descriptions, values and completion dates showing that Bidder has provided similar services required pursuant to these Bidding Documents in at least three projects in the last three years.

(d) Bidders may be required to present satisfactory evidence that Bidder has been regularly engaged in the business, or are reasonably familiar therewith, and that Bidders are fully prepared with the necessary capital, materials, and machinery to complete the Work, to the satisfaction of the City.

(e) The Bidder shall furnish the City any further information for the above purposes as may be requested by the City.

(f) At the time of submitting its Bid, Bidder must hold a valid Contractor's license in the State of Utah for the classifications named in the Notice Inviting Bids.

3. 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. If the City believes that any Bidder is interested in more than one Bid for the Work contemplated, all Bids in which such Bidder is interested will be rejected. Bidder shall check for addenda on the Utah Public Procurement Place website at <https://solutions.sciquest.com/apps/Router/SupplierLogin?CustOrg=StateOfUtah>. If the Bidder fails to acknowledge all addenda published for this project by signature on City forms by the submission deadline date, Bidder's bid will be considered non-responsive and will be rejected.

Upon award of the bid, the City may request additional documents (Contractors E-100 License, Non-Collusion Affidavit, Certificates of Insurance, Performance and Payment Bonds, and other necessary documents) to which Bidder must provide to the City within 24

hours from the time of request. If Bidder does not submit these documents within 24 hours, Bidder may be disqualified and the Contract may be awarded to the next lowest responsible and responsive Bidder.

4. BIDDER'S EXAMINATION OF CONTRACT DOCUMENTS AND THE SITE - (a) It is the responsibility of each Bidder before submitting a Bid to examine the Contract Documents thoroughly; visit the site to become familiar with local conditions that may affect cost, progress, or performance of the Work; consider federal, state, and local laws and regulations that may affect cost, progress, or performance of the Work; study and carefully correlate the Bidder's observations with the Contract Documents; and notify the Engineer or Architect of all conflicts, errors, or discrepancies noted in the Contract Documents.

(b) Reference is made to the Supplementary General Conditions for identification of those reports of explorations and tests of subsurface conditions at the site which have been utilized by the Engineer or Architect in the preparation of the Contract Documents. Although such reports are not a part of the Contract Documents, the Bidder may rely upon the accuracy of the technical data contained in such reports. However, the interpretation of such technical data, including any interpolation or extrapolation thereof, together with non-technical data, interpretations, and opinions contained therein or the completeness thereof is the responsibility of the Bidder.

(c) Copies of such reports and drawings will be made available for inspection by the City to any Bidder upon request. Those reports and drawings are not part of the Contract Documents, but the technical data contained therein upon which the Bidder is entitled to rely on, as provided in the Supplementary General Conditions, may be incorporated herein by reference.

(d) Information and data reflected in the Contract Documents with respect to underground utilities at or contiguous to the site is based upon information and data furnished to the City and the Engineer or Architect by the owners of such underground utilities or others, and the City does not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary General Conditions or the Section entitled "Protection and Restoration of Existing Facilities" of the technical specifications.

(e) Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, underground utilities, and other physical conditions, and possible changes in the Contract Documents due to differing conditions appear in Articles 4.2 and 4.3 of the General Conditions of the Contract.

(f) Before submitting a Bid, each Bidder must, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests, and studies and obtain any additional information and data which pertain to the physical conditions (surface, subsurface, and underground utilities) at or contiguous to the site or otherwise which may affect cost, progress, or performance of the Work and which the Bidder deems necessary to determine its Bid for performing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents.

(g) Where feasible, upon request in advance, the City will provide each Bidder access to the site to conduct such explorations and tests as each Bidder deems necessary for submittal of a Bid. The Bidder shall fill all exploration and test holes made by the Bidder and shall clean up and restore the site to its former condition upon completion of such exploration.

(h) The lands upon which the Work is to be performed, the rights-of-way and easements for access thereto, and other lands designated for use by the Contractor in performing the Work are identified in the

Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by the Contractor. Easement for permanent structures or permanent changes in existing structures will be obtained and paid for by the City unless otherwise provided in the Contract Documents.

(i) The submittal of a Bid will constitute an incontrovertible representation by the Bidder that the Bidder has complied with every requirement of Article 4, herein, entitled: "Bidder's Examination of Contract Documents and the Site"; that without exception the Bid is premised upon performing the Work required by the Contract Documents and such means, methods, techniques, sequences, or procedures of construction as may be indicated in or required by the Contract Documents; and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all the terms and conditions for performance of the Work.

5. INTERPRETATIONS - All questions about the meaning or intent of the Contract Documents are to be directed to the Purchasing Agent. In the City Project Manager's sole discretion, the City Project Manager shall issue any interpretations or clarifications by official Addenda, which shall be mailed, emailed, or personally delivered to all parties having received the Contract Documents. Questions received less than 7 calendar days prior to the date of opening Bids may not be answered. Only questions that have been resolved by official written Addenda will be binding. Oral and other interpretations or clarifications will be without legal or contractual effect.

6. BONDS, AND INSURANCE - The Bidder, if awarded the Work, will enter into a Contract with the City and will furnish the necessary insurance certificates, Payment Bond, and Performance Bond. Each of said bonds shall be in the amount stated in the Supplementary General Conditions. In case of refusal or failure of the Bidder to enter into said Contract, the Bid Bond shall be forfeited to the City; The Bidder shall use the Bid Bond form bound herein, or one conforming substantially to it in form.

7. RETURN OF BID SECURITY – n/a

8. BID FORM - The Bid shall be made on the Bid Schedule sheets attached herein. In the event there is more than one Bid Schedule, the Bidder may Bid on any individual schedule or on any combination of schedules. **Bids shall be submitted electronically through the Utah Public Procurement Place by 2:00 p.m. current Mountain Time on April 26, 2023.** Bids submitted electronically through the Utah Public Procurement Place may require uploading of electronic attachments. The Utah Public Procurement Place will accept a wide variety of document types as Word, Excel, and PDF attachments but not all. You **MAY NOT** submit documents that are embedded (zip files), movies, wmp and mp3 files or password protected files, etc. Such actions may cause your proposal(s) to be deemed as "Non-responsive".

When submitting an offer electronically through the Utah Public Procurement Place please allow sufficient time to complete the online forms and upload documents. The solicitation will end at the closing time listed in the offer. If you are in the middle of uploading your documents at the closing time, the system will stop the process and your offer will not be received by the system. It is recommended that the submission process be completed the day prior to the due date, with the knowledge that any changes/updates will be accepted through the due date and time.

Jaggaer customer support may be contacted at (800) 233-1121 for guidance on the Utah Public Procurement Place site.

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information contained in the vendor registration in the Utah Public Procurement Place. Incorrect or missing vendor registration information may result in failure to receive notification from the Utah Public Procurement Place regarding this procurement.

Bids received after this deadline will be late and ineligible for consideration. Following the deadline, the names of those responding to the Bid will be made public.

9. PROCESS OF SUBMITTAL OF BIDS - The Bids 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 its Bid is received in proper time. Bids, or any portion thereof, will not be accepted after the appointed time for opening of bids, regardless of the reason.

9.1 Protected Information

(a) The Government Records Access and Management Act (GRAMA), codified as Utah Code Ann., Subsection 63G-2-101, et seq., as amended, allows for limited protection of disclosure of certain confidential records. Subject to Subsection (b), all information contained in any Bids submitted to the City shall be classified as public, but only after the City has awarded and executed a Contract with the winning Bidder.

(b) Any Claim of Business Confidentiality submitted pursuant to Utah law and in accordance with GRAMA may, in the sole discretion of the City, be classified as protected information. By submitting this Bid, Bidder agrees to be bound by the City's classification of its information submitted with its Bid and releases from liability and agrees to indemnify the City for any disclosure of confidential information.

(c) All materials submitted become the property of the City, including originals, and will not be returned. Materials may be evaluated by anyone designated by West Jordan as part of the proposal evaluation committee.

10. DISCREPANCIES IN BIDS - In the event that there is more than one bid item in the Bid Schedule, the Bidder shall furnish a price for all bid items in the Bid Schedule, and failure to do so may render the Bid as non-responsive and may cause its rejection. In the event that there are unit price Bid Items in a Bid Schedule and the "amount" indicated for a unit price Bid Item does not equal the product of the unit price and quantity listed, the unit price shall govern and the amount will be corrected accordingly, and the Contractor shall be bound by such correction. In the event that there is more than one Bid Item in a Bid Schedule and the total indicated for the schedule does not agree with the sum of 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.

11. QUANTITIES OF WORK

11.1 General: (a) The quantities of work or material stated in unit price items of the Bid are supplied only to give an indication of the general scope of the Work; the City does not expressly or by implication agree that the actual amount of work or material will correspond therewith.

(b) In the event of an increase or decrease in a bid item quantity of a unit price contract, the total amount of work actually done or materials or equipment furnished shall be paid for according to the unit prices established for such work under the Contract Documents; provided, that increases of more than 25 percent, decreases of more than 25 percent, and eliminated items shall be adjusted as provided in Article 10 of the General Conditions.

12. WITHDRAWAL OF BID - The Bid may be withdrawn by the Bidder by means of a written request,

INSTRUCTIONS TO BIDDERS

signed by the Bidder or a properly authorized representative. Such written request must be delivered to the place stipulated in the Notice Inviting Bids prior to the scheduled closing time for receipt of Bids.

13. MODIFICATIONS AND UNAUTHORIZED ALTERNATIVE BIDS - Unauthorized conditions, limitations, or provisos attached to the Bid will render it informal and may cause its rejection as being non-responsive. The completed Bid forms shall be without interlineations, alterations, or erasures. Alternative Bids will not be considered unless expressly called for in the Notice Inviting Bids. Oral, telegraphic, or telephone Bids or modifications will not be considered.

14. LIQUIDATED DAMAGES - Provisions for liquidated damages, if any, shall be as set forth in the Contract.

15. SUBSTITUTE OR "OR-EQUAL" ITEMS - The Work, if awarded, will be on the basis of materials and equipment described in the Drawings or specified in the Technical Specifications without consideration of possible substitute or "or-equal" items. Whenever it is indicated in the Drawings or specified in the Technical Specifications that a substitute or "or-equal" item of material or equipment may be furnished or used by the Contractor if acceptable to the Engineer or Architect, application for such acceptance will not be considered by the Engineer or Architect until after the Effective Date of the Contract. The procedure for submittal of any such application by the Contractor and consideration by the Engineer or Architect is set forth in Section 01 33 00 entitled: "Contractor Submittals" of the Technical Specifications.

16. AWARD OF CONTRACT - Award of Contract, if it is awarded, will be based primarily on the lowest overall cost to the City, and will be made to a responsive, responsible Bidder whose Bid complies with all the requirements prescribed. Unless otherwise specified, any such award will be made within the period stated in the Notice Inviting Bids that the Bids are to remain open, unless extended by mutual agreement of the bidders. Any or all bids may be rejected, in whole or in part, when it is determined to be in the best interests of the City.

Unless otherwise indicated, a single award will not be made for less than all the Bid Items of an individual Bid Schedule. In the event the Work is contained in more than one Bid Schedule, the City may award schedules individually or in combination. In the case of 2 or more Bid Schedules, which are alternative to each other, only one of such alternative schedules will be awarded.

17. EXECUTION OF CONTRACT - The Bidder to whom the award is made shall execute a written Contract with the City on the contract form provided, shall secure all insurance, and shall furnish all certificates and bonds required by the Contract Documents within 14 days after receipt of the contract forms from the City. 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 an annulment of the award and forfeiture of the Bid Security. If the lowest responsive, responsible bidder refuses or fails to execute the Contract within 14 days, the City may award the Contract to the second lowest responsive, responsible Bidder. If the second lowest responsive, responsible Bidder refuses or fails to execute the Contract, the City may award the Contract to the third lowest responsive, responsible Bidder. On the failure or refusal of such second or third lowest Bidder to execute the Contract, each such bidder's Bid Security shall be likewise forfeited to the City.

18. WORKER'S COMPENSATION REQUIREMENT - The Bidder should be aware that in accordance with laws of the State of Utah, the Bidder shall if awarded the Contract, be required to secure the payment of compensation to its employees and execute the Worker's Compensation Certification.

PART I

BIDDING AND CONTRACT FORMS AND BONDS



**WELL NUMBER 8 PUMP BUILDING
(RON WOOD PARK WELL)**

PROJECT NUMBER CW 20-02

BID SUBMITTAL CHECKLIST

BID INFORMATION

Bidder: _____.

BIDDER'S CHECKLIST

In an effort to assist the Bidder in properly completing all documentation required, the following checklist is provided for the Bidder's convenience. The Bidder is solely responsible for verifying compliance with bid submittal requirements, including those not specifically stated below.

Attach this completed checklist to the outside of the Submittal envelope.

- Indicate on the Bid Form Addenda received.
- Sign Bid Form
- Attach to the Bid Form: Bid Supplement Form - Bid Schedule
- Attach to the Bid Form: Bid Supplement Form -List of Subcontractors
- Attach to the Bid Form: Bid Supplement Form -Bidder's Licensing Statement
- Attach to the Bid Form: Bid Supplement Form - Equipment or Material Proposed to be furnished under the Bid.
- Attach to the Bid Form: Bid Supplement Form -Bidder's General Information

B I D FORM

BID TO: CITY OF WEST JORDAN, UTAH

The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Contract with the City in the form included in the Contract Documents (as defined in Article 4 of the Contract) to perform the Work as specified or indicated in said Contract Documents entitled:

**WELL NUMBER 8 PUMP BUILDING
(RON WOOD PARK WELL)
PROJECT NUMBER CW 20-02**

Bidder accepts all of the terms and conditions of the Contract Documents, including without limitation those in the Notice Inviting Bids and Instructions to Bidders, dealing with the disposition of the Bid Security.

This Bid will remain open for the period stated in the Notice Inviting Bids unless otherwise required by law. The bidder will enter into a Contract within the time and in the manner required in the Instructions to Bidders, and will furnish the insurance certificates, Payment Bond, Performance Bond, and Permits required by the Contract Documents once the Contract has been awarded.

Bidder has examined copies of all the Contract Documents including the following Addenda (receipt of which is acknowledged by signing the Acknowledgment of the Addendum):

Number _____ Date _____
Number _____ Date _____
Number _____ Date _____

Bidder has familiarized itself with the nature and extent of the Contract Documents, the Work, the site, the locality where Work is to be performed, the legal requirements (federal, state, and local laws, ordinances, rules, and regulations), and the conditions affecting cost, progress or performance of the Work and has made such independent investigations as Bidder deems necessary.

In conformance with current statutory requirements of the State of Utah, the Bidder shall be insured against liability for worker's compensation before commencing the performance of the work of this contract.

Bidder agrees to all the foregoing, including all Bid Schedule(s), List of Subcontractors, Non-collusion Affidavit, Equipment or Material Proposed, Bidder's General Information, and Bid Bond contained in these Bid Forms, and said Bidder further agrees to complete the Work required under the Contract Documents within the Contract Time stipulated in said Contract Documents, and to accept in full payment, therefore, the Contract Price based on the Lump Sum or Unit Bid Price(s) named in the aforementioned Bid Schedule(s).

Dated: _____ Bidder: _____

By: _____
(Signature)

Title: _____

BID SCHEDULE
Schedule of Prices for Construction of
WELL NUMBER 8 PUMP BUILDING
(RON WOOD PARK WELL)

PROJECT NUMBER CW 20-02

In West Jordan, Utah

- A. The bid includes all materials, labor, and incidental items associated with the proposed improvements. Refer to Section 01 29 00, Measurement and Payment for additional information.

BASE BID

Item No.	Specification Reference Number Classification of Unit Price Work	Quantity Unit	Unit Price	Amount
1	Mobilization	1 Lump Sum	\$	\$
2	Construction surveying and SWPPP	1 Lump Sum	\$	\$
3	Pump house structure, generator screening walls and concrete pad	1 Lump Sum	\$	\$
4	Pump, shaft and motor	1 Lump Sum	\$	\$
5	Pump station piping, valving, and chlorination system	1 Lump Sum	\$	\$
6	Pipeline (discharge, floor drain sewer, pump-to-waste) and pump-to-waste discharge structure	1 Lump Sum	\$	\$
7	Site improvements (landscaping, fencing, pavement, and curb)	1 Lump Sum	\$	\$
8	Electric power supply, electrical systems, instrumentation, control panels, generator and transfer switch	1 Lump Sum	\$	\$
9	HVAC system	1 Lump Sum	\$	\$

Total work; Base Bid = \$ _____

END DOCUMENT

INFORMATION REQUIRED OF BIDDER

LIST OF SUBCONTRACTORS

The Bidder shall list below the name and business address of each subcontractor who will perform Work under this Bid in excess of \$5,000.00 and shall also list the portion of the Work which will be done by such subcontractor. After the opening of bids, no changes or substitutions will be allowed except as otherwise provided by law. The listing of more than one subcontractor for each item of Work to be performed with the words "and/or" will not be permitted. The Bidder's attention is directed to the provisions of Article 6.1 of the Supplementary General Conditions, entitled: "Subcontract Limitations," which stipulates the percentage of the Work to be performed with the Bidder's own resources, labor, and materials. Failure to comply with this requirement may render the Bid as nonresponsive and may cause its rejection.

Work to be Performed	Contractor License Number	Percent of Total Contract	Subcontractor's Name and address
1. _____	_____	_____	_____ _____ _____
2. _____	_____	_____	_____ _____ _____
3. _____	_____	_____	_____ _____ _____
4. _____	_____	_____	_____ _____ _____
5. _____	_____	_____	_____ _____ _____
6. _____	_____	_____	_____ _____ _____
7. _____	_____	_____	_____ _____ _____
8. _____	_____	_____	_____ _____ _____

Add additional sheets, if necessary.

BIDDER'S GENERAL INFORMATION

The Bidder shall furnish the following information. Additional sheets shall be attached as required. Failure to complete Item Nos. 1, 3, and 8 may cause the Bid to be non-responsive and may cause its rejection. In any event, no award will be made until all of the Bidder's General Information (i.e. Items 1 through 9, inclusive) is provided to the City.

1. BIDDER'S name and street address:

Name of Responsible Managing Officer (RMO) or Responsible Managing Employee (RME)

RMO or RME E-mail address _____

2. BIDDER'S telephone number and fax number:

Phone _____ Fax: _____

3. CONTRACTOR'S license: Primary Classification _____

State License Number _____

Supplemental license classifications: _____

Name of licensee and RMO or RME:

4. Name of person who inspected the site of the proposed Work for the Bidder:

Name: _____ Date of inspection: _____

5. Surety Company and Agent who will provide the required Bonds on this Contract:

Name of Surety _____

Address _____

Surety Company Agent _____

Telephone Numbers: Agent _____ Surety _____

BIDDER'S GENERAL INFORMATION (Continued)

- 6. ATTACH TO THIS BID the experience resume of the person who will be designated as General Construction Superintendent or on-site Construction Manager for the Contractor.
- 7. PROVIDE IF REQUESTED a financial statement, references, and other information, sufficiently comprehensive to permit an appraisal of Contractor's current financial condition.
- 8. ATTACH TO THIS BID a list of 3 projects completed within the last 3 years involving work of similar type and complexity, listing the following data for each project:

(1) Project Name _____

Owner _____

Superintendent _____

Contract Price _____

Change Order Costs _____

Description of Project _____

Completion Date _____

Name, Address, and Telephone Number of Owner's Representative

(2) Project Name _____

Owner _____

Superintendent _____

Contract Price _____

Change Order Costs _____

Description of Project _____

Completion Date _____

Name, Address, and Telephone Number of Owner's Representative

(3) Project Name _____

Owner _____

Superintendent _____

Contract Price _____

Change Order Costs _____

Description of Project _____

Completion Date _____

Name, Address, and Telephone Number of Owner's Representative

BID BOND (NOT REQUIRED)

KNOW ALL MEN BY THESE PRESENTS,

That _____ as Principal,
and _____ as Surety, are held and firmly bound
unto City of West Jordan, hereinafter called the "City" in the sum of _____
_____ dollars
(not less than 5 percent of the total amount of the bid)

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

WHEREAS, said Principal has submitted a bid to said City to perform the Work required under the bid
schedule of the Contract Documents entitled:

**WELL NUMBER 8 PUMP BUILDING
(RON WOOD PARK WELL)
PROJECT NUMBER CW 20-02**

NOW THEREFORE, if said Principal is awarded a contract by said City, and, within the time and in the
manner required in the "Notice Inviting Bids" and the "Instructions to Bidders" enters into a written
Contract on the contract form bound with said Contract Documents, furnishes the required Certificates of
Insurance, and furnishes the required Performance Bond and Payment Bond, then this obligation shall be
null and void, otherwise it shall remain in full force and effect. In the event suit is brought upon this bond
by said City and City prevails, said Surety shall pay all costs incurred by said City in such suit, including
a reasonable attorney's fee to be fixed by the court.

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

(SEAL)

(SEAL)

(Principal)

(Surety)
(SEAL)

By: _____
(Signature)

(SEAL AND NOTARIAL
ACKNOWLEDGMENT OF SURETY)

By: _____
(Signature)

CONTRACT

THIS CONTRACT made this ___ day of _____ in the year 2023, by and between the City of West Jordan, a legal entity organized and existing in Salt Lake County, under and by virtue of the laws of the State of Utah, herein designated as the CITY, and _____, hereinafter designated as the CONTRACTOR.

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

ARTICLE 1 - THE WORK

The CONTRACTOR shall complete the Work as specified or indicated under the Bid Schedule(s) of the CITY's Contract Documents entitled:

WELL NUMBER 8 PUMP BUILDING (RON WOOD PARK WELL) PROJECT NUMBER CW 20-02

The Work is generally described as follows: Replacing irrigation controllers for the city's Parks, Streetscapes and Medians throughout the city and replacing with the new central control controllers.

ARTICLE 2 - COMMENCEMENT AND COMPLETION

The Work to be performed under this Contract shall be commenced on the date specified in the Notice to Proceed by the CITY, and the Work shall be fully completed within 180 calendar days from the date of the Notice to Proceed.

The CITY and the CONTRACTOR recognize that time is of the essence of this CONTRACT and that the CITY will suffer financial loss if the Work is not completed within the time specified in Article 2. They also recognize the delays, expense, and difficulties involved in proving in a legal proceeding the actual loss suffered by the CITY if the Work is not completed on time. Accordingly, instead of requiring any such proof, the CITY and the CONTRACTOR agree that as liquidated damages for the delay (but not as a penalty) the CONTRACTOR shall pay the CITY the sum of **\$500** for each calendar day that expires after the time specified above.

ARTICLE 3 - CONTRACT PRICE

The CITY shall pay the CONTRACTOR for the completion of the Work the sum of **\$xxxx** in accordance with the Contract Documents and the CONTRACTOR's Bid and Bid Schedule(s). The parties understand and agree that this represents full compensation for the Work, and CONTRACTOR accepts all risk, whether known or unknown, anticipated or unanticipated, of the increased cost of performance, including but not limited to increased materials cost, regardless of amount.

ARTICLE 4 - THE CONTRACT DOCUMENTS

The Contract Documents consist of: Notice Inviting Bids, Instructions to Bidders, Bidder's Licensing Statement, the accepted Bid and Bid Schedule(s), List of Subcontractors, Equipment or Material Proposed, Bidder's General Information, Bid Security or Bid Bond, this Contract, Worker's Compensation Certificate, Performance Bond, Payment Bond, Notice of Award, Notice to Proceed, Notice of Completion, General Conditions of the Contract, Supplementary General Conditions of the Contract, Technical Specifications, Standard Specifications, Drawings listed in The Schedule of Drawings in the Supplementary General Conditions or on the Cover Sheet of the Drawings, Addenda numbers xx to xx inclusive, and all Change Orders, and Work Directive Changes which may be delivered or issued after the Effective Date of the Contract and are not attached hereto, all of which are incorporated herein by reference.

ARTICLE 5 - PAYMENT PROCEDURES

The CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions

and the Supplementary General Conditions. Applications for Payment will be processed by the Engineer or Architect or the CITY as provided in the General Conditions and shall include the CITY's purchase order number.

ARTICLE 6 - NOTICES

Whenever any provision of the Contract Documents requires the giving of written notice, it shall 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.

ARTICLE 7 - MISCELLANEOUS

Terms used in this Contract which are defined in Article 1 of the General Conditions and Supplementary General Conditions will have the meanings indicated in said General Conditions and Supplementary General Conditions. 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 monies that may become due and monies 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.

The CITY and the CONTRACTOR each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect of all covenants, contracts, and obligations contained in the Contract Documents.

REPRESENTATION REGARDING ETHICAL STANDARDS FOR CITY OFFICERS AND EMPLOYEES AND FORMER CITY OFFICERS AND EMPLOYEES: The bidder, offeror, or contractor represents that they have not: (1) provided an illegal gift or payoff to a city officer or former city officer or employee, or his or her relative or business entity; (2) retained any person to solicit or secure this contract upon an agreement or understanding for a commission, percentage, brokerage or contingent fee, other than as exempted in the City's Conflict of Interest ordinance; or (3) knowingly influenced (and hereby promises that it will not knowingly influence) a city officer or employee or former city officer or employee to breach any of the ethical standards set forth in the City's Conflict of Interest ordinance, Title1, Chapter 11, Section 15 of the City of West Jordan Municipal Code.

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

CITY OF WEST JORDAN, UTAH

By:

Mayor

Attest:

City Recorder

Address for giving Notice:

City of West Jordan
Public Works Department
7960 South 4000 West
West Jordan, Utah 84088

Approved as to Legal Form:

City Attorney

CONTRACTOR:

By: _____

Title: _____

Address for giving Notice:

License No. _____

Agent for service of process:

STATE OF)
 : SS
COUNTY OF)

On this ____ day of _____, 20____, personally appeared before me,

_____, who being by me duly sworn did say that he/she is the _____ of _____ corporation, and that the foregoing instrument was signed in behalf of said corporation by authority of its Board of Directors, and he/she acknowledged to me that said Corporation executed the same.

NOTARY PUBLIC

My Commission Expires: _____

Residing in _____ County, _____

WORKER'S COMPENSATION CERTIFICATE

I am aware that every employer in the State of Utah is required to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of Utah Law, and I will fully comply with such provisions before commencing the performance of the work of this contract. I will provide evidence of the above-mentioned insurance.

Contractor: _____

By: _____

Title: _____

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That

(Name of Contractor)

(Address of Contractor)

a * _____, hereinafter called Principal, and
*insert "state of incorporation", " corporation", "partnership", or "individual"

(Name of Surety)

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto:

City of West Jordan
8000 S. Redwood Rd.
West Jordan, UT 84088

hereinafter called OWNER, in the penal sum of _____ Dollars (\$ _____)
in lawful money of the United States, for the payment of which sum well and truly to be made, we bind
ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain
contract with the OWNER, dated the _____ day of _____, 20__ , a copy of which is hereto
attached and made a part hereof for the construction of:

**WELL NUMBER 8 PUMP BUILDING
(RON WOOD PARK WELL)
PROJECT NUMBER CW 20-02**

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the
undertakings, covenants, terms, conditions, and representations of said contract during the original term
thereof, and any extensions thereof which may be granted by the OWNER, with or without notice to the
Surety and during the one year guaranty period, and if the Principal shall satisfy all claims and demands
incurred under such contract, and shall fully indemnify and save harmless the OWNER from all costs and
damages which it may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all

outlay and expense which the OWNER may incur in making good any default, then this obligation shall be void; otherwise to remain in full force and effect.

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

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

IN WITNESS WHEREOF, this instrument is executed in ___ counterparts, each one of which shall be deemed an original, this the _____ day of _____, 20__.

ATTEST:

(Principal Secretary)

(Seal)

(Witness as to Principal)

(Address)

(Surety)

(Principal)

BY: _____

(Address)

BY: _____
(Attorney-in-Fact)

(Address)

ATTEST:

Witness as to Surety)

(Address)

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

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

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: That

_____, a Utah Corporation
(Name of Contractor)

(Address of Contractor)

a * _____, hereinafter called Principal, and
*insert "state of incorporation", "corporation", "partnership", or "individual"

(Name of Surety)

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto:

City of West Jordan
8000 S. Redwood Rd.
West Jordan, UT 84088

hereinafter called OWNER, in the penal sum of _____ Dollars (\$)
in lawful money of the United States, for the payment of which sum well and truly to be made, we
bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a
certain contract with the OWNER, dated the _____ day of _____, 20__, a copy of which is
hereto attached and made a part hereof for the construction of:

**WELL NUMBER 8 PUMP BUILDING
(RON WOOD PARK WELL)
PROJECT NUMBER CW 20-02**

NOW, THEREFORE, if the Principal shall promptly make payment to all person, firms,
SUBCONTRACTORS, and corporations furnishing materials for or performing labor in the
prosecution of the WORK provided for in such contract, and any authorized extension or
modification thereof, including all amounts due for materials, lubricants, oil, gasoline, coal and coke,
repairs on machinery, equipment, and tools, consumed or used in connection with the construction of
such WORK, and all insurance premiums on said WORK, and for all labor performed in such WORK

whether by SUBCONTRACTOR or otherwise, then this obligation shall be void; otherwise to remain in full force and effect.

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

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

IN WITNESS WHEREOF, this instrument is executed in ___ counterparts, each one of which shall be deemed an original, this the _____ day of _____, 20 ____.

ATTEST:

(Principal Secretary)

(Seal)

(Witness as to Principal)

(Address)

(Surety)

(Principal)

BY: _____

(Address)

BY: _____
(Attorney-in-Fact)

(Address)

ATTEST:

Witness as to Surety)

(Address)

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

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



NOTICE OF INTENT TO AWARD

		Date:
To:	Owner: City of West Jordan Capital Projects Group 7960 South 4000 West West Jordan, Utah 84088 Attn:	
Reference:	Project:	

You are hereby notified that your Bid dated _____ for the above Contract has been reviewed by City staff and that we will be making a recommendation to the City Council of the City of West Jordan to award the Contract for this project to you. You are the apparent successful bidder; however, the actual award of the project is only finalized by approval of the City Council in a regularly scheduled meeting of the City Council.

The purpose of providing you with this Notice of Intent to Award is to satisfy any of your insurance and/or bonding companies who need such a Notice in order to process their documents. City staff will not process a request to approve this Contract and issue a Notice of Award until the following documents have been provided:

1. You must deliver to the City a fully executed counterpart of the Contract.
2. You must deliver at least one set of the original Payment Bond, Performance Bond, and Insurance Certificate as specified in the Instructions to Bidders, the General Conditions (Article 5), and the Supplementary General Conditions.

You must comply with the following conditions precedent within 14 days of the date of this Notice of Intent to Award; that is, by: _____.

Failure to comply with these conditions within the time specified will entitle the City to consider your Bid abandoned, to annul this Notice of Award, and to declare your Bid Security forfeited.

Within 10 days after you comply with the foregoing conditions, the City will return to you one fully executed counterpart of Contract Documents.

CITY OF WEST JORDAN

By Krista Smith
Title Contracts Specialist



NOTICE OF AWARD

	Date:
To:	Owner: City of West Jordan Capital Projects Group 7960 South 4000 West West Jordan, Utah 84088 Attn:
Reference:	Project:

You are hereby notified that your Bid dated _____ for the above Contract has been considered. You are the apparent successful bidder and have been awarded a contract for the above-named project.

The Bid Price of your contract is \$ _____

You must comply with the following conditions within 10 days of the date of this Notice of Award.

1. You must prepare to attend a pre-construction meeting with the City.
2. You must prepare all needed submittals to begin construction.
3. You must prepare and submit to the Engineer a Preliminary CPM Construction Schedule, with verifiable job logic, per the provisions of Section 01 32 16 Bar Chart Schedule and Section 01 33 00 Contractor Submittals.

Failure to comply with these conditions within the time specified will entitle the City to consider your Bid abandoned, to annul this Notice of Award, and to declare your Bid Security forfeited.

CITY OF WEST JORDAN

By _____,
Project Manager



NOTICE TO PROCEED

		Date:
To:	Owner:	
Attn:	City of West Jordan Capital Projects Group 7960 South 4000 West West Jordan, Utah 84088 Attn	
Reference:	Project:	

You are hereby notified that the Contract Time under the above Contract will commence to run on: _____.

By that date, you are to start performing your obligations under the Contract Documents. In accordance with the provisions for "Beginning and Completion of the Work" in the section of the technical specifications entitled, "Summary of Work" the Time or Date of Completion is: 180_calendar days after the date of commencement of the Work specified above, or not later than _____.

Article 2 of the Contract provides for an assessment of liquidated damages for each and every calendar day after the above established contract completion date that the Work remains incomplete at the rate of **\$XXX per day.**

Before you start any Work at the site, the Contractor is required to have studied the Contract Documents and verified figures and field dimensions and must report any observed errors or discrepancies to the Project Manager.

Also, before you may start any Work at the site, you must:

- Submit complete material specification documents for all components of the project for review and approval.
- Submit to the Engineer or Architect the Proposed CPM Schedule called for in Section 01 33 00 "Contractor Submittals" and Section 01 32 16 Bar Chart Schedule."

CITY OF WEST JORDAN

By:
Title:



CHANGE ORDER

Project:		No.:
Project No.:	Orig. Contract Amt.:	Page 1 of
Contractor:	Prev. Appvd. Changes \$	Days:
Owner: City of West Jordan	This Change:	Days:
City's Res. Project Rep.:	Revised Contract Amt: \$	Days:
Engineering Inspector:	Total Change Order %	

This Change Order covers changes to the subject contract as described herein. The Contractor shall construct, furnish equipment and materials, and perform all work as necessary or required to complete the Change Order Items for a lump sum price agreed upon between the Contractor and City of West Jordan, otherwise referred to as Owner.

Description of Changes	Increase in Contract Amount (\$)	(Decrease) in Contract Amount (\$)	Contract Time Extension (days)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Totals			
Net Change in Contract Amount (Increase or Decrease)			

The amount of the Contract will be **increased/decreased** by the sum of \$ and the contract time shall be extended by 0 calendar days. The undersigned Contractor approves the foregoing Change Order as to the changes, if any, in the contract price specified for each item including any and all supervision costs and other miscellaneous costs relating to the change in work, and as to the extension of time allowed, if any, for completion of the entire work on account of said Change Order. The Contractor agrees to furnish all labor and materials and perform all other necessary work, inclusive of that directly or indirectly related to the approved time extension, required to complete the Change Order items. This document will become a supplement to the Contract and all provisions will apply hereto. It is understood that the Change Order shall be effective when approved by the Owner.

RECOMMENDED: _____ DATE: _____
 (Engineer)

ACCEPTED: _____ DATE: _____
 (Contractor)

APPROVED: _____ DATE: _____
 (Contracts Administrator)

ACCEPTED: _____ DATE: _____
 (Director of Public Works)

APPROVED: _____ DATE: _____
 (City Manager)

CHANGE ORDER

INSTRUCTIONS

A. GENERAL INFORMATION

This document was developed to provide a uniform format for handling contract changes that affect Contract Price or Contract Time. Changes that have been initiated by a Work Directive Change must be incorporated into a subsequent Change Order if they affect Price or Time.

Changes that affect Contract Price or Contract Time should be promptly covered by a Change Order. The practice of accumulating change order items to reduce the administrative burden may lead to unnecessary disputes.

For supplemental instructions and minor changes not involving a change in the Contract Price or Contract Time, a Field Order may be used.

B. COMPLETING THE CHANGE ORDER FORM

Engineer or Architect initiates the form, including a description of the changes involved and attachments based upon documents and proposals submitted by Contractor, or requests from Owner, or both.

Once Engineer or Architect has completed and signed the form, all copies should be sent to the Contractor for approval. After approval by the Contractor, all copies should be sent to the Owner for approval. The Engineer or Architect should make the distribution of executed copies after approval by Owner.

If a change only applies to price or to time, cross out the part of the tabulation that does not apply.



WORK DIRECTIVE CHANGE

No. _____

Project:

Date of Issuance:

Contractor:

Owner:
City of West Jordan
8000 South Redwood Road
West Jordan, UT 84088

Engineer / Architect:

Contract For:

You are directed to proceed promptly with the following change(s):

Description:

Purpose of Work Directive Change:

Attachments: (list documents supporting change)

If a claim is made that the above change(s) have affected Contract Price or Contract Time, any claim for a Change Order based thereon will involve one of the following methods of determining the effect of the change(s):

Method of determining the change in Contract Price:

- Time and Materials
Unit Prices
Cost plus fixed fee
Other

Estimated increase (decrease) in Contract Price: \$

If the change involves an increase, the estimated amount is not to be exceeded without further authorization.

Method of determining change in Contract Time:

- Contractor's records
Engineer's records
Other

Estimated increase (decrease) in Contract Time: days. If the change involves an increase, the estimated time is not to be exceeded without further authorization.

CITY OF WEST JORDAN

RECOMMENDED:

By
Engineer

By
Title

WORK DIRECTIVE CHANGE INSTRUCTIONS



A. GENERAL INFORMATION

This document was developed for use in situations involving changes in the Work, which, if not processed expeditiously, might delay the Project. These changes are often initiated in the field and may affect the Contract Price or the Contract Time. This is not a Change Order, but only a directive to proceed with Work that may be included in a subsequent Change Order. For supplemental instructions and minor changes not involving a change in the Contract Price or the Contract Time, a Field Order may be used.

B. COMPLETING THE WORK DIRECTIVE CHANGE FORM

Engineer or Architect initiates the form, including a description of the items involved and attachments. Based on conversations between Engineer or Architect and Contractor, Engineer or Architect completes the following:

METHOD OF DETERMINING CHANGE, IF ANY, IN CONTRACT PRICE: Mark the method to be used in determining the final cost of Work involved and the net effect on the Contract Price. If the change involves an increase in the Contract Price and the estimated amount is approached before the additional or changed Work is completed, another Work Directive Change must be issued to change the price or Contractor may stop the changed Work when the estimated price is reached. If the Work Directive Change is not likely to change the Contract Price, the space for the estimated increase (decrease) should be marked "Not Applicable".

METHOD OF DETERMINING CHANGE, IF ANY, IN CONTRACT TIME: Mark the method to be used in determining the change in Contract Time and the estimated increase or decrease in Contract Time. If the change involves an increase in the Contract Time and the estimated time is approached before the additional or changed Work is completed, another Work Directive Change must be issued to change the time or Contractor may stop the changed Work when the estimated time is reached. If the Work Directive Change is not likely to change the Contract Time, the space for the estimated increase (decrease) should be marked "Not Applicable".

Once the Engineer or Architect has completed and signed the form, all copies should be sent to the Owner for authorization because Engineer or Architect alone does not have the authority to authorize changes in Price or Time. Once authorized by Owner, a copy should be sent by Engineer or Architect to Contractor.

Once the work covered by this directive is completed or final cost and time determined, the Contractor should submit documentation for inclusion in a Change Order.

THIS IS A DIRECTIVE TO PROCEED WITH A CHANGE THAT MAY AFFECT THE CONTRACT PRICE OR THE CONTRACT TIME. A CHANGE ORDER, IF ANY, SHOULD BE CONSIDERED PROMPTLY.



NOTICE OF COMPLETION

		Date:
To:	Owner:	
	City of West Jordan	
	Capital Projects Group	
	7960 South 4000 West	
	West Jordan, Utah 84088	
Attn:	Attn:	
Project Name	Notice of Completion Date:	

The work performed under this contract has been inspected by authorized representatives of the City, Contractor, and Engineer or Architect, and the Project (or specified part of the Project, as indicated above) is hereby accepted by the City and declared to be substantially completed on the above date.

Completion of the Work shall be the date of such acceptance of the Work by the City. Completion shall mean substantial performance of the contract as such is defined in Black's Law Dictionary, Revised Fourth Edition, West Publishing Company.

A list of all items remaining to be completed or corrected is appended hereto. All such work shall be completed or corrected to the satisfaction of the City within _____ calendar days after the above Notice of Completion Date; otherwise, the Contractor does hereby waive any and all claims to all monies withheld by the City under the Contract to cover the value of such uncompleted or uncorrected items.

By: _____
(Engineer/Architect)

By _____
(Authorized Representative/Date)

The Contractor hereby accepts the above Notice of Completion and agrees to complete and correct all of the items on the appended list within _____ calendar days or waives all rights to any monies withheld therefore.

By: _____
(Contractor)

By _____
(Authorized Representative/Date)

The City accepts the project or specified area of the project as substantially completed and will assume full possession of the Project or specified area of the Project at _____ (time), on _____ (date). The City will assume the responsibility for heat, utilities, security, and insurance under the Contract Documents after that date.

FOR CITY OF WEST JORDAN

By _____
(Authorized Representative/Date)

REMARKS: The following or supplementary sheets listing such items remaining to be completed or connected, are hereby made part of this document by this reference.



**CONTRACTOR'S
CERTIFICATION
OF COMPLETION**

		Date:
To:	Owner:	
Attention: Resident Project Representative	City of West Jordan Capital Projects Group 7960 South 4000 West West Jordan, Utah 84088	
Project Name	Attn:	
	Project No:	

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:

1. I know of my own personal knowledge, and do hereby certify, that the work on the contract described above has been performed, and materials used and installed in every particular, in accordance with, and in conformity to, the contract drawings and specifications.
2. The contract work is now complete in all parts and requirements, and ready for your final inspection.
3. I understand that neither the determination by the Engineer/Architect that the work is complete nor the acceptance thereof by the Owner shall operate as a bar to claim against the Contractor under the terms of the guarantee provisions of the contract documents.

By: _____

Title: _____
(Signature)

For: _____

Distribution:
Project Manager
Field Office
File



DESIGN ENGINEER'S CERTIFICATE

		Date:
To:	Owner:	
Attention: Resident Project Representative	City of West Jordan Capital Projects Group 7960 South 4000 West West Jordan, Utah 84088 Attn:	
Project Name:	Project No:	

This is to certify that I, _____ am an authorized official of _____ working in the capacity of THE design engineer for the subject project and have been properly authorized by said firm or corporation to sign the following statements pertaining to the subject project:

1. I know of my own personal knowledge, and do hereby certify, that the work on the project described above has been constructed in accordance with, and in conformity to, the contract drawings and specifications.

By: _____

Title: _____

For:

(Design Engineer's Stamp
and Signature Affixed Here)



CONSENT OF SURETY
For Final Payment

Project:
Project No.:
Amount of Contract: \$

In accordance with the provisions of the above-mentioned 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 _____, 200__.

(Affix corporate seal here)

(Name of Surety Company)

(Signature of Authorized Representative)

(Title)

Distribution:

- Contractor
Project Manager
Field Office
File



**FINAL WAIVER OF LIEN –
CONDITIONAL
WAIVER AND RELEASE
UPON FINAL PAYMENT**

Upon receipt of the undersigned of a check from _____
(Maker of Check)
in the sum of \$ _____ payable to _____ ---
(Amount of Check) (Payee or Payees of Check)
and when the check has been properly endorsed and has been paid by the bank upon which it is drawn, this document shall become effective to release any mechanic's lien, stop notice, or bond right the undersigned has on the job of _____
(Owner)
located at _____.
(Location)

This release covers the final payment to the undersigned for all labor, services, equipment or material furnished on the job, except for disputed claims for additional work in the amount of \$ _____. Before any recipient of this document relies on it, the part should verify evidence of payment to the undersigned.

Dated: _____

(Company Name)

(Title)



**FINAL WAIVER OF LIEN -
UNCONDITIONAL WAIVER AND RELEASE
UPON FINAL PAYMENT**

The undersigned has been paid in full for all labor, services, equipment or material furnished to _____

(Your Customer)

on the job of _____

(Owner)

located at _____

(Job Description)

and does hereby waive and release any right to a mechanic's lien, stop notice, or any right against a labor and material bond on the job, except for disputed claims for extra work in the amount of

\$ _____.

Dated: _____

(Company Name)

(Title)

NOTICE TO PERSONS SIGNING THIS WAIVER: THIS DOCUMENT WAIVES RIGHTS UNCONDITIONALLY AND STATES THAT YOU HAVE BEEN PAID FOR GIVING UP THOSE RIGHTS. THIS DOCUMENT IS ENFORCEABLE AGAINST YOU IF YOU SIGN IT, EVEN IF YOU HAVE NOT BEEN PAID. IF YOU HAVE NOT BEEN PAID, USE A CONDITIONAL RELEASE FORM.



AFFIDAVIT OF RELEASE OF LIENS

Project:
Project No.:
Type of Contract: Construction
Amount of Contract:

TO ALL WHOM IT MAY CONCERN:

WHEREAS, the undersigned has been employed by West Jordan City to furnish labor and materials for construction work, under a contract for the improvement of the property described as in the City of West Jordan, County of Salt Lake, State of Utah, of which West Jordan City is the Owner.

NOW, THEREFORE, this day of, 201, the undersigned, as the Contractor for the above-named Contract pursuant to the conditions of the Contract hereby certifies that to the best of his knowledge, information and believe, except as listed below, the Release of Waivers of Lien attached hereto include the Contractor, all Subcontractors, all suppliers of materials and equipment, and all performers of Work, labor or services, who have or may have liens against any property of the Owner arising in any manner out of the performance of the Contract reference above.

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

ATTACHMENTS:

- 1. Contractor's Release of Waiver of Liens, conditional upon receipt of final payment.
2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers.

IN WITNESS WHEREOF, the Company has hereunto set its hand and seal this day of, 200.

(Affix corporate seal here)

(Name of Contractor) (SEAL)
(Signature of Authorized Representative) (SEAL)
(Title)



AFFIDAVIT OF PAYMENT

Project:
Amount of Contract

TO ALL WHOM IT MAY CONCERN:

WHEREAS, the undersigned has been employed by West Jordan City to furnish labor and materials for water system work, under a contract _____ for the improvement of the property described as _____ in the City of West Jordan, County of Salt Lake, State of Utah, of which West Jordan City is the Owner.

NOW, THEREFORE, this _____ day of _____, 2009, 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 a bond satisfactory to the Owner for each exception.)

ATTACHMENTS:

- 3. Consent of Surety to Final Payment. (Whenever Surety is involved, Consent of Surety is required.)
- 4. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
- 5. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers.
- 6. Contractor's Affidavit of Release of Liens.

IN WITNESS WHEREOF, the Company has hereunto set its hand and seal this _____ day of _____, 200__.

(Affix corporate seal here)

(Name of Contractor) (SEAL)

(Signature of Authorized Representative) (SEAL)

(Title)



ADJACENT PROPERTY OWNER
RELEASE

Project:
Project No.:
Contract No.:
Contractor:

To: CITY OF WEST JORDAN
 Engineering Department
 8000 S. Redwood Road
 West Jordan, Utah 84088
 Attention: *(Resident Project Representative)*

We (I), the undersigned, hereby acknowledge that the firm of _____, a construction company employed by the City of West Jordan, has satisfactorily restored the surface of the following described property, owned by us (me) upon, across, or under which said Contractor has performed work pursuant to their contract with the City of West Jordan, or has otherwise utilized said property as a temporary easement or trespass.

(Property Description – Lot ___ of the _____ Subdivision as recorded in Book _____, Page _____, of Maps, Office of the County Recorder of Salt Lake County, Utah, for the City of West Jordan, Utah.)

IN WITNESS WHEREOF, we (I) have hereunto set our (my) hand(s) and seal this _____ day of _____, 2019.

 (Owner of Property)

 (Owner of Property)

 (Address of Property Owner(s))

 (City, State, and Zip Code)



APPLICATION AND CERTIFICATE FOR PAYMENT

PROJECT: Project No.: Contract Dates (Begin/End): No. Contract Days:	FROM CONTRACTOR:	TO OWNER: City of West Jordan Capital Projects Group 7960 South 4000 West West Jordan, Utah 84088	DATE RECEIVED:															
Payment Application No.:	Contact Person:	Contact Person:																
Pay Period (From/To):	Phone Nos.:	Phone Nos.:																
CONTRACTOR'S APPLICATION FOR PAYMENT This application is made for payment as shown below, in connection with the Contract. Continuation Sheet is attached.		The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief of the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due. CONTRACTOR: By: _____ Date: _____ State of: County of: Subscribed and sworn to before Me this ____ day of _____, 20 ____. Notary Public: My Commission expires:																
1. ORIGINAL CONTRACT SUM	\$																	
2. Net change by Change Order	\$																	
3. CONTRACT SUM TO DATE	\$																	
4. TOTAL COMPLETED & STORED TO DATE	\$																	
5. RETAINAGE a. 5% of Completed Work: \$ _____ b. ____% of Store Material: \$ _____ Total Retainage	\$																	
6. TOTAL EARNED, LESS RETAINAGE	\$																	
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT	\$																	
8. CURRENT PAYMENT DUE	\$																	
8. BALANCE TO FINISH, INCLUDING RETAINAGE	\$																	
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><i>CHANGE ORDER SUMMARY</i></th> <th style="text-align: center;"><i>ADDITIONS</i></th> <th style="text-align: center;"><i>DEDUCTIONS</i></th> </tr> </thead> <tbody> <tr> <td>Total changes approved in previous months by the Owner</td> <td style="text-align: right;">\$</td> <td style="text-align: right;">\$</td> </tr> <tr> <td>Total approved this Month</td> <td style="text-align: right;">\$</td> <td style="text-align: right;">\$</td> </tr> <tr> <td style="text-align: right;">TOTALS</td> <td style="text-align: right;">\$</td> <td style="text-align: right;">\$</td> </tr> <tr> <td>NET CHANGE by Change Order</td> <td style="text-align: right;">\$</td> <td style="text-align: right;">\$</td> </tr> </tbody> </table>		<i>CHANGE ORDER SUMMARY</i>	<i>ADDITIONS</i>	<i>DEDUCTIONS</i>	Total changes approved in previous months by the Owner	\$	\$	Total approved this Month	\$	\$	TOTALS	\$	\$	NET CHANGE by Change Order	\$	\$	ENGINEER'S/ARCHITECT'S CERTIFICATE FOR PAYMENT In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Engineer/Architect certifies to the Owner that to the best of Engineer's/Architect's knowledge, information and belief the Work has progressed as indicated, the quality of Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED. AMOUNT CERTIFIED: \$ _____ <i>(Attach explanation if amount certified differs from the amount applied for. Initial all figures on this Application and on the Continuation Sheet that are change to conform to the amount certified.)</i> ENGINEER/ARCHITECT: By: _____ Date: _____ This certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment, and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.	
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Total changes approved in previous months by the Owner	\$	\$																
Total approved this Month	\$	\$																
TOTALS	\$	\$																
NET CHANGE by Change Order	\$	\$																
CITY PAYMENT AUTHORIZATION:																		

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CONDITIONS OF THE CONTRACT

GENERAL CONDITIONS

ARTICLE 1 - DEFINITIONS

Wherever used in these General Conditions or in other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

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

Agreement - The written agreement between the City and the Contractor covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

Application for Payment - The form approved by the Engineer which is to be used by the Contractor in requesting progress or final payments and which includes such supporting documentation as is required by the Contract Documents.

Asbestos - Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

Beneficial Use or Occupancy - Placing all or any portion of the Work in service for the purpose for which it is intended (or a related purpose) before reaching completion for all of the Work.

Bid - The offer or proposal of the bidder submitted on the prescribed form setting forth the price or prices for the Work to be done.

Bidding Documents - Invitation for Bid, Instructions to Bidders, the Bid Form, and the accompanying Bid Schedules or Bid Sheets, List of Subcontractors, Equipment and Material Proposed (where required), Bidder's General Information, Affirmative Action Program, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

Bidding Requirements - The Notice Inviting Bids, Instructions to Bidders, and the Bid Form and the accompanying Bid Schedule or Bid Sheets.

Bonds - Bid, Performance, and Payment Bonds and other instruments which protect against loss due to inability or refusal of the Contractor to perform its Contract.

Change Order - A document recommended by the Engineer which is signed by the Contractor and the City and authorizes an addition to, deletion from, or revision of the Work, issued on or after the Effective Date of the Agreement.

City - The City of West Jordan, organized and existing in Salt Lake and Utah counties, State of Utah, sometimes referred to as the Owner.

Completion - Completion of the Work shall be the date of such acceptance of the Work by the City. Completion shall mean Substantial performance of the Contract, which shall have the definition given in Black's Law Dictionary, Revised Fourth Edition, West Publishing Company.

Contract Documents - Unless otherwise defined in the Supplementary General Conditions, the Contract Documents shall include the Notice Inviting Bids, Instructions to Bidders, the prevailing rate of per diem wages as determined by the State of Utah, the accepted Bid and Bid Schedule, the Schedule of Values or Cost-loaded CPM, List of Subcontractors, Equipment or Material Proposed, Bidder's General Information, Affirmative Action Program, the Agreement, Worker's Compensation Certificate, Performance Bond,

Payment Bond, Notice of Award, Notice to Proceed, Notice of Completion, General Conditions of the Contract, Supplementary General Conditions, Technical Specifications, Standard Specifications, Drawings, and all Addenda, Change Orders, and Work Directive Changes executed pursuant to the provisions of the Contract Documents. Shop drawing submittals approved pursuant to Article 6.10 and the reports and drawings referred to in Article 4.2a are not Contract Documents.

Contract Price - The total money payable by the City to the Contractor under the terms and conditions of the Contract Documents.

Contract Time - The number of successive calendar days as stated in the Contract Documents for the completion of the Work.

Contract Unit Price - The price quoted by the Bidder for performing or furnishing each item of work to be paid for on the basis of unit prices.

Contractor - The person, firm, or corporation with whom the City has executed the Agreement.

Contractor's Project Representative - Contractor's representative for the project through whom all matters addressed to the Contractor regarding the project shall be directed. This individual and the City's or Engineer's Resident Project Representative shall be the only two individuals who shall have the authority to provide direction/receive authorization on matters pertaining to the Project.

Cost of Work - The term Cost of Work (determined as provided in Articles 11.2, 11.3 and 11.4, herein) shall mean the sum of all costs necessarily incurred and paid for by the Contractor for labor, materials, and equipment in the proper performance of the Work, plus the Contractor's fee for overhead and profit.

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

Daily Work Reports - Cost isolation reports detailing all costs of extra work, disputed work, emergency work, or other work paid for on a force account basis and the cost of other operations. A record of daily costs separate and distinct from the daily costs of other work on the project for which a contract price has been established.

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

Drawings/Contract Drawings - The drawings, plans, maps, profiles, diagrams, and other graphic representations which show the character, location, nature, extent, and scope of the Work to be performed.

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

End of Contract - The End of the Contract shall be identified as being that day when the Work should be completed based upon the predefined contract period as indicated in the Contract Documents plus any time extensions granted by the City and when punchlist items are completed and close-out documents are submitted.

Engineer - The person, firm, or corporation named as such in the Supplementary General Conditions. References herein to Engineer shall be deemed to include the Resident Project Representative as the authorized representative of the City and Consulting Engineers, where applicable.

Engineer's Estimate - On unit-price contracts, the list of estimated quantities and prices of the individual line items of work to be performed as contained in the Bid Schedule(s). On lump-sum projects, the estimated contract price of the completed project.

Field Order - A written order issued by the Engineer, which in the opinion of the Engineer does not involve a change in the Contract Price or the Contract Time.

General Requirements - Sections of Division 1 of the Technical Specifications.

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.

Liquidated Damages - The dollar amount per day specified in the Agreement that the Contractor shall pay to the City for each and every day that the Work remains incomplete following the date of Completion of the Work or designated portions of the Work as specified in the Contract Documents.

Notice of Award - The written notice by the City to the apparent successful bidder stating that upon compliance by the apparent successful bidder with the conditions precedent enumerated therein, within the time specified, the City will enter into an Agreement. This Notice will only be issued after City Council Approval.

Notice of Completion - The legal document completed by the City after the City of West Jordan Council has accepted the project. This document begins the notification period when those firms or individuals that have submitted a Preliminary Notice for the project will be on notice that the City has accepted the project as complete.

Notice to Proceed - A written notice issued by the City to the Contractor authorizing the Contractor to proceed with the Work and establishing the date of commencement of the Contract Time.

Owner - The City of West Jordan, or any subdivision thereof, herein referred to as the City, with whom the Contractor has entered into the Agreement and for whom the Work will be performed.

Project Representative - The person named in the Supplementary General Conditions as the authorized representative of the City or the Engineer, who is assigned to the site or any part thereof. All liaisons between the Contractor and the City shall be directed through the Project Representative.

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 all the Work. A Notice of Partial Utilization will be issued to the Contractor when such occurs.

PCB's - Polychlorinated biphenyls

Petroleum - Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-hazardous wastes and crude oils.

Samples - Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

Schedule of Values - Cost value of activities; A breakdown of a lump sum project into unit values to serve as a basis for estimating the value of the Work completed to facilitate the making of progress payments to the Contractor. The unit values in a schedule of values are for convenience only and are not intended for the purpose of pricing change orders.

Shop Drawings - All drawings, diagrams, illustrations, schedules, and other data which are specifically prepared by or for the Contractor to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams, and other information prepared by a supplier or manufacturer and submitted by the Contractor to illustrate material or equipment for some portion of the Work.

Specifications - Those portions of the Contract Documents consisting of Part I, Notice Inviting Bids, Instructions to Bidders, Bid Forms, Agreement; Part II, General and Supplementary General Conditions of the Contract; and Part III, Technical Specifications, including the General Requirements and those Technical Sections consisting of the written technical descriptions of materials, equipment, construction systems, methods, standards, and workmanship as applied to the Work and certain administrative details applicable thereto.

Standard Specifications - The Standard Specifications, where applicable, shall be as named in the Supplementary General Conditions.

Subcontractor - An individual, firm, or corporation having a direct contract with the Contractor or with any other Sub-contractor for the performance of a part of the Work at the site. A subcontractor is any individual or firm, which has contracted with the prime Contractor to perform any portion of the Work on the site in an amount exceeding 1/2 of one percent of the total contract amount.

Substantial Completion - Refers to the Work (or a specified part thereof) that has progressed to the point where, in the opinion of the Engineer, as evidenced by the Notice of Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended; or if there is no such certificate issued, when final payment is due in accordance with the provisions of the Contract Documents, and where the Engineer can recommend that the Work be accepted by the City. The terms "Substantial Completion" and "substantially complete" and "substantially completed" as applied to any Work shall mean Substantial Performance of the Contract, hereunder. (See definition of "Completion," herein, and in Black's Law Dictionary, Revised Fourth Edition, West Publishing Company.)

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

Supplier - A manufacturer, fabricator, retailer, wholesaler, distributor, material man, or vendor having a direct contract with the Contractor or with any subcontractor or with the City to furnish materials or equipment to be incorporated in the Work by the Contractor or any Subcontractor.

Technical Specifications - The technical sections of the Specifications, comprising all sections contained in Part III of the Specifications defined herein.

Underground Facilities - 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 underground to furnish any of the following services or materials: electricity, water, sewage and drainage removal, gases, steam, liquid petroleum products, telephone or other communications, cable television, traffic or other control systems.

Unit Price Work - Work to be paid for on the basis of unit prices.

Work - The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. The 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.

Work Directive Change - A written directive to the Contractor, issued on or after the Effective Date of Agreement and signed by the City and recommended by the Engineer, ordering an addition, deletion, or revision of the Work or responding to differing or unforeseen physical conditions under which the Work is to be performed or to emergencies as provided in the Contract Documents. A Work Directive Change may not be used to change the Contract Price nor the Contract Time, but shall be evidence that the parties expect that the change directed or documented by a Work Directive Change will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or

Contract Time as provided in the Contract Documents.

ARTICLE 2 -- PRELIMINARY MATTERS

2.1 Delivery of Bonds:

When the Contractor delivers the executed Agreements to the City, the Contractor shall also deliver to the City such Bonds and insurance policies or certificates as the Contractor may be required to furnish in accordance with the Contract Documents.

2.2 Copies of Documents:

The City shall furnish to the Contractor up to 10 copies (unless otherwise specified in the Supplemental Conditions) of the Contract Documents as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

2.3 Commencement of Contract Time; Notice to Proceed:

The Contract Time shall commence to run on the date specified in the Notice to Proceed.

2.4 Starting the Work:

The Contractor shall start to perform the Work on the date when the Contract Time commences to run but no Work shall be done at the site prior to the date on which the Contract Time commences to run.

ARTICLE 3 -- CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.1 Contract Documents:

a. The Contract Documents comprise the entire agreement between the City and the 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. Any Work, materials or equipment that may reasonably be inferred from the Contract Documents, as being required to produce the intended result will 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.

c. Reference to standard specifications, manuals, or codes of 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 City, the Contractor, or the Engineer or any of their consultants, agents, or employees from those set forth in the Contract Documents.

d. If during the performance of the Work, the Contractor finds a conflict, error, or discrepancy in the Contract Documents, the Contractor shall so report to the Engineer in writing at once and, before proceeding with the Work affected thereby shall obtain a written interpretation, clarification, or correction from the Engineer.

3.2 Amending and Supplementing Contract Documents:

The Contract Documents may be amended after execution of the Agreement to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

1. A Change Order, or
2. A Work Directive Change.
3. A written amendment or modification executed by the parties hereto.

3.3 Order of Precedence of Contract Documents:

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

1. Change Orders or Work Directive Changes
2. Agreement
3. Addenda
4. Contractor's Bid (Bid Forms)
5. Supplementary General Conditions
6. Notice Inviting Bids
7. Instructions to Bidders
8. General Conditions of the Contract
9. Technical Specifications
10. Referenced Standard Specifications
11. Contract Drawings
12. Referenced Standard Drawings

b. With reference to the Drawings the order of precedence shall be as follows:

1. Figures govern over scaled dimensions
2. Detail drawings govern over general drawings
3. Addenda or Change Order drawings govern over Contract Drawings
4. Contract Drawings govern over standard drawings
5. Contract Drawings govern over shop drawings

3.4 Reuse of Documents:

Neither the Contractor, nor any Subcontractor or Supplier, nor any other person or organization performing or furnishing any of the Work under a direct or indirect contract with the City shall have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of the Engineer; and they shall not reuse any of them on extensions of the Project or any other project without written consent of the City and the Engineer and specific written verification or adaptation by the Engineer.

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

4.1 Availability of Lands:

The City will furnish, as indicated in the Contract Documents, the lands upon which the Work is to be performed, rights-of-way and easements for access thereto, and such other lands which are designated for the use of Contractor. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by the City 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; provided, that the Contractor shall not enter upon nor use any property not under the control of the City until a written temporary construction easement agreement has been executed by the Contractor and the property owner, and a copy of said easement furnished to the Engineer prior to said use; and, neither the City nor the Engineer shall be liable for any claims or damages resulting from Contractor's unauthorized trespass or use of any such properties.

4.2 Physical Conditions:

a. Explorations and Reports: Reference is made to the Article entitled "Physical Conditions" of the Supplementary General Conditions for identification of those reports of explorations and tests of subsurface conditions at the site that have been utilized by the Engineer in the preparation of the Contract Documents. The Contractor may rely upon the general accuracy of the "technical data" data contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary General Conditions. Except for such reliance on such "technical data," the Contractor may not rely on or make claims against the City, the Engineer, or their Consultants or Subconsultants with respect to:

1. The completeness of such reports or drawings for the Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by the Contractor and safety precautions and programs incidental thereto; or
2. Other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
3. Any Contractor interpretation of or conclusion drawn from any "technical data" or any such data, interpretations, opinions, or information.

b. Existing structures: Reference is made to the Article entitled "Physical Conditions" of the Supplementary General Conditions for identification of those drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Utilities referred to in Article 4.4, 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 may rely upon the accuracy of the factual data contained in such drawings; however, the interpretation of such factual data, including any interpolation or extrapolation thereof, together with nonfactual data, interpretations, and opinions contained in such drawings or the completeness thereof is the responsibility of the Contractor.

4.3 Differing Site Conditions:

a. The Contractor shall notify the Engineer in writing of the following unforeseen conditions, hereinafter called differing site conditions, promptly upon their discovery (but in no event later than 3 days) and before they are disturbed:

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 Article 4.2; and
2. Unknown 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 Article 4.2.

b. The Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as permitted by Article 6.9), notify the City and the Engineer in writing about such condition. The Contractor shall not further disturb such conditions or perform any Work in connection therewith (except as aforesaid) until receipt of written orders.

c. The Engineer will review the pertinent conditions, determine the necessity of obtaining additional explorations or tests with respect thereto and advise the City in writing of the Engineer's findings and conclusions. If the City concludes that because of newly discovered conditions a change in the Contract Documents is required, a Work Directive Change will be issued to initiate the work, pending issuance of a formal Change Order as provided in Article 10 to reflect and document the consequences of the difference.

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 any such difference. If the City and the Contractor are unable to agree as to the amount or length thereof, 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 3 days of their discovery or before they are disturbed shall constitute a waiver of all claims in connection therewith, whether direct or consequential in nature.

f. Nothing herein shall be deemed to require the City to indicate the presence of existing service laterals or appurtenances whenever the presence of such utilities on the site of the construction project can be inferred from the presence of other visible facilities, such as buildings, meter, and junction boxes, on or adjacent to the site of the construction.

4.4 Physical Conditions - Underground Utilities:

a. Shown or Indicated: The information 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 City or the Engineer by the owners of such Underground Utilities or by others. Unless it is expressly provided in the Supplementary General Conditions and/or the Section "Protection of Existing Facilities" of the General Requirements, the City, and the Engineer shall not be responsible for the accuracy or completeness of any such information or data, and the Contractor shall have full responsibility for reviewing and checking all such information and data, for locating all Underground Utilities shown or indicated in the Contract Documents, for coordination of the Work with the owners of such Underground Utilities during construction, for the safety and protection thereof and repairing any damage thereto resulting from the Work, the cost of which will be considered as having been included in the Contract Price.

b. Not Shown or Indicated: If an Underground Utility is uncovered or revealed at or contiguous to the site which was not shown or indicated in the Contract Documents and which the Contractor could not reasonably have been expected to be aware of, the Contractor shall identify the owner of such Underground Utility and give written notice thereof to that owner and shall notify the Engineer in accordance with the requirements of the Supplementary General Conditions and Section entitled "Protection of Existing Facilities" of the General Requirements of the Technical Specifications.

4.5 Reference Points:

a. The Engineer will provide one benchmark, near or on the site of the Work, and will provide 2 points near or on the site to establish a baseline for use by the Contractor for alignment control. Unless otherwise specified in the General Requirements of the Technical Specifications, the Contractor shall furnish all other lines, grades, and benchmarks required for proper execution of the Work.

b. The Contractor shall be responsible for laying out the Work (unless otherwise specified in the General Requirements of the Technical Specifications) and shall preserve all benchmarks, stakes, and other survey marks, and 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 such reference points by professionally qualified personnel at no additional cost to the City.

4.6 Hazardous Waste

a. As provided, herein, in any public works contract of the City which involves digging of trenches or other excavations that extend deeper than four feet below the surface, the Contractor shall promptly, and before the following conditions are disturbed, notify the public entity, in writing, of any:

1. Material that the Contractor believes may be material that is hazardous waste that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with the provisions of existing law.
2. Subsurface or latent physical conditions at the site differing from those indicated.
3. Unknown physical conditions at the site of an unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract.

b. The City shall promptly investigate the conditions, and if it finds that the conditions do materially so differ, or do involve hazardous waste, and cause a decrease or increase in the Contractor's cost of, or the time required for, performance of any part of the Work shall issue a Change Order under the procedures described in the Contract.

c. That, in the event that a dispute arises between the City and the Contractor whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase in the Contractor's cost of, or the time required for, performance of any part of the Work, the Contractor shall not be excused from any scheduled completion date provided for by the Contract, but shall proceed with all work to be performed under the Contract. The Contractor shall retain any and all rights provided either by Contract or by law, which

pertains to the resolution of disputes and protests between the contracting parties.

ARTICLE 5 -- BONDS AND INSURANCE

5.1 Performance and Other Bonds:

a. Upon receiving a Notice of Award, 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. The Performance Bond and Payment Bond shall be written to remain in effect at least until one year after the date of Notice of Completion as applicable, except as otherwise provided by Law or Regulation or by the Contract Documents; provided, that after the date of Notice of Completion, as applicable, the amount of said Performance Bond and Payment Bond, at the discretion of the City, may be reduced to the amount set forth in the Supplementary General Conditions.

b. The City will approve any surety company which, at the time of execution of this Contract is listed in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in the U.S. Department of the Treasury Department Circular 570. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

c. 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 thereafter substitute another Bond and Surety, which must be acceptable to the City.

5.2 Insurance:

a. The Contractor shall purchase and maintain the insurance required under this Article. Such insurance shall include the specific coverages set forth herein and shall 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. All insurance shall be maintained continuously during the life of the Agreement up to the date of Notice of Completion, as applicable, pursuant to acceptance of the Work by the City, but the Contractor's liabilities under this Agreement shall not be deemed limited in any way to the insurance coverage required.

b. The Contractor shall furnish the City with certificates showing the type, amount, class of operations covered, effective dates and dates of expiration of policies for each of the following listed insurance coverages. In addition, each party named as an additional insured shall be provided with an original copy of the policy endorsement naming them as an additional insured under the Contractor's policies of insurance required under the Contract. All of the policies of insurance so required to be 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 City by Certified Mail. All such insurance shall remain in effect until the date of Substantial Completion and at all times thereafter when the Contractor may be correcting, removing, or replacing defective work in accordance with Article 13.6, herein. In addition, the Insurance required herein (except for Worker's Compensation and Employer's Liability) shall name the City, the Engineer, and their Consultants and Subconsultants for the project and their officers, agents, and employees as "additional insureds" under the policies:

1. Worker's Compensation Insurance
2. Commercial General Liability
3. BusinessAutomobile Liability
4. Builder's Risk

c. Policy Requirements: The insurance provided by the Contractor hereunder shall be (1) with companies licensed to do business in the state of Utah, (2) with companies with a Best's Financial Size Category of XI or greater, and (3) with companies with a Best's Financial Strength Rating of not less than A, except that in case of Worker's Compensation Insurance, participation in the State Fund, where applicable, is acceptable.

ARTICLE 6 -- THE CONTRACTOR'S RESPONSIBILITIES

6.1 Supervision and Superintendence:

The Contractor shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be 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, but the Contractor shall not be responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence or procedure of construction which is indicated in and required by the contract documents. The Contractor shall be responsible to see that the finished Work complies accurately with the Contract Documents.

6.2 Labor, Materials, and Equipment:

a. The Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. The Contractor shall at all times maintain good discipline and order at the site. Except in connection with the safety or protection of persons or the Work or property at the site or adjacent thereto, and except as otherwise indicated in the Contract Documents, 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 City's written consent given after prior written notice to the Engineer. If the Contractor performs any work after regular working hours, or on Saturday, Sunday, or any legal holiday, it shall pay the City any additional cost incurred by the City as a result of such work.

b. Except as otherwise provided in this Article, 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 to the Contractor for overtime work only in the event that extra work is ordered by the Engineer, and the Change Order specifically authorizes the use of overtime work and then only to such extent as overtime wages are regularly being paid by the Contractor for overtime work of a similar nature in the same locality.

c. All costs of inspection and testing performed by the City or its authorized representatives before 7:00 am or after 4:00 pm on any regular workday or all day on Saturdays, Sundays, and legal holidays by the Contractor which is allowed solely for the convenience of the Contractor shall be borne by the Contractor at the City's standard overtime rates. The City shall have the authority to deduct the cost of all such inspection and testing from any partial payments otherwise due to the Contractor.

d. Unless otherwise specified in the Contract Documents, the Contractor shall furnish and assume full responsibility for all materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities, and incidentals necessary for the furnishing, performance, testing, startup, and completion of the Work.

e. All materials and equipment to be incorporated in the Work shall be of good quality and new, 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. All materials and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the instructions of the applicable Supplier except as otherwise provided in the Contract Documents; but no provision of any such instructions will be effective to assign to the Engineer, nor any of the Engineer's consultants, agents, or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Articles 9.9c or 9.9d.

6.3 Concerning Subcontractors, Suppliers, and Others:

a. The Contractor shall be fully responsible to the City 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 Article shall create any contractual relationship between the City or the Engineer and any sub-contractor, nor shall it relieve the Contractor of any liability or obligation under the Prime Contract.

b. The Divisions and Sections of the Specifications and identifications of any Drawings shall not control the Contractor in dividing the Work among Subcontractors or Suppliers or in delineating the Work to be performed by any specific trade.

6.4 Permits, License Fees, and Royalties:

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 the furnishing of insurance and bonds if required by such agencies.

b. The Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. The Contractor shall indemnify and hold harmless the City from and against all claims, damages, losses, and expenses (including attorney's fees and court and arbitration 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, and shall defend all such claims in connection with any alleged infringement of such rights.

6.5 Laws and Regulations:

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.

6.6 Taxes:

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.

6.7 Use of Premises:

The Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to (1) the Project site, (2) the land and areas identified in and permitted by the Contract Documents, and (3) the other land and areas permitted by Laws and Regulations, rights-of-way, permits and easements. The Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any land or areas contiguous thereto, resulting from the performance of the Work. Should any claim be made against the City by any such owner or occupant because of the performance of the Work, the Contractor shall promptly attempt to settle with such other party by agreement or otherwise resolve the claim by arbitration or at law. The Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold the City harmless from and against all claims, damages, losses, and expenses (including, but not limited to, fees of architects, engineers, attorneys, and other professionals and court and arbitration costs) arising directly, indirectly, or consequently out of

any action, legal or equitable, brought by any such other party against the City to the extent based on a claim arising out of the Contractor's performance of the Work.

6.8 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 the following:

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, utilities, and Underground Facilities 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. The Contractor shall designate in writing a responsible representative at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent or project manager unless otherwise designated in writing by the Contractor to the City.

d. Materials that contain hazardous substances or mixtures may be required on the Work. A Material Safety Data Sheet shall be requested by the Contractor from the manufacturer of any hazardous product used.

e. Material usage shall be accomplished with strict adherence to State of Utah safety requirements and all manufacturers' warnings and application instructions listed on the Material Safety Data Sheet and on the product container label.

f. The Contractor shall be responsible for coordinating any exchange or material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the site in accordance with Laws or Regulations.

g. The Contractor shall notify the Engineer if it considers a specified product or its intended usage to be unsafe. This notification must be given to the Engineer prior to the product being ordered, or if provided by some other party, prior to the product being incorporated in the Work.

6.9 Emergencies:

In emergencies affecting the safety or protection of persons or the Work or property at the site thereto, the Contractor, without special instructions from the Engineer or the City, is obligated to act to prevent threatened damage, injury, or loss.

6.10 Shop Drawings and Samples:

a. The Contractor shall submit to the Engineer for review all Shop Drawings in accordance with the accepted schedule of Shop Drawing submittals specified in the General Requirements of the Technical Specifications.

b. The Contractor shall also submit to the Engineer for review all samples in accordance with the accepted schedule of sample submittals specified in the General Requirements of the Technical Specifications.

6.11 Indemnification:

a. To the fullest extent permitted by Laws and Regulations, the Contractor shall indemnify, defend, and hold harmless the City, the Engineer, and their Consultants and Subconsultants for the project and their agents, and employees from and against all claims and liability arising under or by reason of the Contract or any performance of the Work, but not from the sole negligence or willful misconduct of the City or the Engineer or their Consultants or Subconsultants for the project. 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 bodily injury, occupational sickness or disease, or death of the Contractor's or Subcontractor's own employees engaged in the Work resulting in actions brought by or on behalf of such employees against the City, the Engineer, and/or their Consultants or Subconsultants.

3. 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;
4. Liability or claims arising directly or indirectly from the use or manufacture by the Contractor, its agents, or the City in the performance of this Contract of any copyrighted or uncopied composition, secret process, patented or unpatented invention, article, or appliance, unless otherwise specifically stipulated in this Contract;
5. Liability or claims resulting directly or indirectly from the breach of any warranties, whether express or implied, made to the City or any other parties by the Contractor or its agents;
6. 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 City, the Engineer, and their Consultants and Subconsultants for the Project for all costs and expenses, (including but not limited to fees and charges of architects, engineers, attorneys, and other professionals and court costs, including all costs of appeals) incurred by said City, the Engineer, and their Consultants and Subconsultants for the project in enforcing the provisions of this Article.

c. The indemnification obligation under this Article shall not be limited in any way by any limitation on 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 the workers' compensation act, disability benefit acts, or other employee benefit acts.

6.12 Contractor's Daily Reports:

The Contractor shall complete consecutively numbered daily reports indicating manpower and narrative description of work performed, serviceable major equipment in use, serviceable major equipment idled, serviceable major equipment down for repairs, subcontractors working at the site, weather conditions, and date. In addition, when required by the Engineer, the Contractor shall complete and submit to the Engineer Daily Work Reports. 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 workday.

6.13 Assignment of Contract:

The Contractor shall not assign, sublet, sell, transfer, or otherwise dispose of the Contract or any portion thereof or its right, title, or interest therein, or obligations thereunder, without the written consent of the City, except as imposed by law. If the Contractor violates this provision, the Contract may be terminated at the option of the City. In such event, the City 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

7.1 Related Work at Site:

a. The City may perform other work related to the Project at the site by the City's own forces, have other work performed by utility owners, or let other direct contracts therefore which shall contain General Conditions similar to these. If the fact that such other work is to be performed was not noted in the Contract Documents, written notice thereof will be given to the Contractor prior to starting any such other work.

b. The Contractor shall afford each utility owner and other contractor who is a party to such a direct contract (or the City, if the City is performing the additional work with the City'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 such work, and shall properly connect and coordinate the Work with theirs. 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 such other work. The Contractor shall not endanger any work of others by cutting,

excavating or otherwise altering their work and will only cut or alter their work with the written consent of the Engineer and the others whose work will be affected.

c. If any part of the Contractor's work depends on proper execution or results upon the work of any such other contractor or utility owner (or the City), the Contractor shall inspect and promptly report to the Engineer in writing any delays, defects, or deficiencies in such work that render it unavailable or unsuitable for such proper execution and results. The Contractor's failure to so report will constitute an acceptance of the other work as fit and proper for integration with the Contractor's Work except for latent or nonapparent defects and deficiencies in the other work.

7.2 Coordination:

If the City contracts with others for the performance of other work on the Project at the site, the person or organization who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified in the Supplementary General Conditions. The specific matters to be covered by such authority and responsibility will be itemized, and the extent of such authority and responsibilities will be provided in the Supplementary General Conditions. Unless otherwise provided in the Supplementary General Conditions, neither the City nor the Engineer shall have any authority or responsibility in respect of such coordination.

ARTICLE 8 -- THE CITY'S RESPONSIBILITIES

8.1 Communications:

The City shall issue all its communications to the Contractor through the Engineer.

8.2 Payments:

The City shall make payments to the Contractor as provided in Article 14.

8.3 Lands, Easements, and Surveys:

The City's duties in respect of providing lands and easements and providing engineering surveys to establish reference points are set forth in Article 4. The City shall identify and make available to the Contractor copies of reports of explorations and tests of subsurface conditions at the site and in existing structures, which have been utilized by the Engineer in preparing the Drawings and Specifications.

8.4 Change Orders and Work Directive Changes:

The City shall execute Change Orders and Work Directive Changes as indicated in Article 10.1, herein.

8.5 Inspections and Tests:

The City's responsibility in respect to certain inspections, tests, and approvals is set forth in Article 13.3b, herein.

8.6 Suspension of the Work:

In connection with the City's right to stop work or suspend work, see Articles 13.4 and 15.1, herein. Articles 15.2 and 15.3 deal with the City's right to terminate services of the Contractor under certain circumstances.

ARTICLE 9 -- THE ENGINEER'S STATUS DURING CONSTRUCTION

9.1 City's Representative:

The Engineer will be the City's representative during the construction period acting through the authorized Resident Project Representative. Where provided in the Supplementary General Conditions, the duties and responsibilities and the limitations of authority of the Engineer as the City's representative during construction shall be as set forth in the Supplementary General Conditions.

9.2 Visits to Site:

The Engineer will make visits to the site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed Work and to determine, in general, if the Work is proceeding in accordance with the Contract Documents. The Engineer will not be required to make exhaustive or

continuous on-site inspections to check the quality or quantity of the Work. However, the authorized Resident Project Representative will provide continuous or intermittent observation of the Work if so specified in the Supplementary General Conditions.

9.3 Project Representation:

The City or the Engineer may furnish a Resident Project Representative to assist in observing the performance of the Work. The duties, responsibilities, and limitations of authority of any such Resident Project Representative and assistants shall be as provided in the Supplementary General Conditions.

9.4 Clarifications and Interpretations:

The Engineer will issue with reasonable promptness such 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.

9.5 Authorized Variations in Work:

The Engineer may authorize minor variations in the Work from the requirements of the Contract Documents, which 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 may be accomplished by a Field Order and will be binding on the City, and also on the Contractor who shall perform the Work involved promptly. If the Contractor believes that a Field Order justifies a change in the Contract Price or an adjustment of the Contract Time and the parties are unable to agree as to the amount or extent thereof, the Contractor may make a claim therefore as provided in Article 11 or Article 12, herein.

9.6 Rejecting Defective Work:

The Engineer will have authority to disapprove or reject Work, which the Engineer believes to be defective, and will also have authority to require special inspection or testing of the Work as provided in Article 13.3g, herein, whether or not the Work is fabricated, installed or completed.

9.7 Contractor Submittals, Change Orders, and Payments:

a. The Engineer will review all the Contractor submittals, including shop drawings, samples, substitutes, or "or equal" items, etc., in accordance with the procedures set forth in the General Requirements of the Technical Specifications.

b. In connection with the Engineer's responsibilities as to Change Orders, see Articles 10, 11 and 12, herein.

c. In connection with the Engineer's responsibilities in respect of Applications for Payment, see Article 14, herein.

9.8 Decisions or Disputes:

a. The Engineer shall be the initial interpreter of the requirements of the Contract Documents and the judge of the acceptability of the Work thereunder. Claims, disputes, and other matters relating to the acceptability of the Work; the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work; and those claims under Articles 11 and 12, herein, in respect to changes in the Contract Price or the Contract Time will be referred initially to the Engineer in writing with a request for formal decision in accordance with this Article, which the Engineer will render in writing within 30 days of receipt of the request. Written notice of each such claim, dispute, and other matter shall be delivered by the Contractor to the Engineer promptly (but in no event later than 30 days) after the occurrence of the event giving rise thereto. Written supporting data shall be submitted to the Engineer within 60 days after such occurrence unless the Engineer allows an additional period of time to ascertain more accurate data in support of the claim.

b. When functioning as initial interpreter and judge, the Engineer will not show partiality to the City or the Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity. The rendering of a decision by the Engineer with respect to any such claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment as provided in Article 14.14) will be a condition precedent to any exercise by the City or the Contractor of such rights or

remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any such claim, dispute, or other matter.

9.9 Limitations on the Engineer's Responsibilities:

a. Neither the Engineer's authority to act under this Article 9 or other provisions of the Contract Documents nor any decision made by the Engineer in good faith either to exercise or not exercise such authority shall give rise to any duty or responsibility of the Engineer to the Contractor, any Subcontractor, any Supplier, any surety for any of them, or for any other person or organization performing any 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 judgment 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 Articles 9.9c or 9.9d, herein.

c. Except as may be otherwise specified in the Technical Specifications, the Engineer will not be responsible for the Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, and the Engineer will not be responsible for the Contractor's failure to perform or furnish the Work in accordance with the Contract Documents.

d. The Engineer shall 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.

ARTICLE 10 -- CHANGES IN THE WORK

10.1 General:

a. Without invalidating the Agreement and without notice to any surety, the City may, at any time or from time to time, order additions, deletions, or revisions in the Work; these will be authorized by a Change Order or a Work Directive Change issued by the Engineer or the City. Upon receipt of either such document, the Contractor shall promptly proceed with the Work involved, which will be performed under the applicable conditions of the Contract Documents.

b. If the City and the Contractor are unable to agree as to the extent, if any, of an increase or decrease in the Contract Price or an extension or shortening of the Contract Time that should be allowed as a result of a Work Directive Change, a claim may be made as provided in Article 11 or Article 12, herein.

c. The Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Time with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented by Change Order, except in the case of an emergency and except in the case of uncovering Work as provided in Article 13.3, herein.

d. If notice of any change is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be the Contractor's responsibility, and the amount of each applicable bond shall be adjusted accordingly.

10.2 Allowable Quantity Variations on Unit Price Contracts:

In the event of an increase or decrease in a bid item quantity of a unit price contract, the total amount of work actually done or materials or equipment furnished shall be paid for according to the unit price established for such work under the Contract Documents, wherever such unit price has been established; provided, that an adjustment in the Contract Unit Price may be made for changes which result in an increase or decrease in the quantity of any unit price bid item of the Work in excess of 25 percent, or for eliminated items of work.

ARTICLE 11 -- CHANGE OF CONTRACT PRICE

11.1 General:

a. The Contract Price constitutes the total compensation (subject to City-authorized adjustments) payable to the Contractor for performing the Work. All duties, responsibilities, and obligations assigned to or undertaken by the Contractor shall be at its expense without a change in the Contract Price.

b. The Contract Price may only be changed by a Change Order. Any claim for an increase or decrease in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and 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 within 60 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 claimant's written statement that the amount claimed covers all known amounts (direct, indirect, and consequential) to which the claimant is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Price shall be determined by the Engineer in accordance with Article 9.8, herein if the City and the Contractor cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this Article 11.1b.

c. The value of any Work covered by a Change Order or Work Directive Change or of any claim for an increase or decrease in the Contract 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 Article 11.4, herein).
3. On the basis of the Cost of the Work (determined as provided in Articles 11.2 and 11.3, herein), plus the Contractor's Fee for overhead and profit (determined as provided in Article 11.4, herein).

11.2 Cost of Work (Based on Time, Materials, and Equipment and Contractor's Overhead and Profit):

a. General: The term "Cost of Work" shall mean the sum of all costs necessarily incurred and paid by the Contractor for labor, materials, and equipment plus Contractor's overhead, and profit in the proper performance of work. Except as otherwise may be agreed to in writing by the City, 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 wages paid to foremen when determined by the Engineer that the services of foremen do not constitute a part of the overhead allowance as defined in Article 11.4, herein.
2. To the actual wages, as defined in Article 11.2b.(1), herein, will be added a labor surcharge set forth in the Utah Department of Transportation publication entitled Labor Surcharge and Equipment Rates, which is in effect on the date upon which the Work is accomplished and which is hereby included as a part of these General Conditions by this reference thereto. Said labor surcharge shall constitute full compensation for all payments imposed by the State and Federal laws and for all other payments made to, or on behalf of, the workers, other than actual wages as defined in Article 11.2b(1), herein, and subsistence and travel allowance as specified in Article 11.2b(3), herein.
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 purchaser shall be credited to the City 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 said sources on extra work items or the current wholesale price for such materials delivered to the work site, whichever price 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 such 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 City reserves the right to furnish materials for the extra work and no claim shall be made by the Contractor for costs, overhead, and profit on such materials.

d. Equipment: The Contractor will be paid for the use of equipment at the rental rate listed for such equipment specified in the Supplementary General Conditions. Such 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 City for the total period of use. If it is deemed necessary by the Contractor to use equipment not listed in the foregoing publication, 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 establishment of 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, manufacturer's 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 \$500 or less, whether or not consumed by use, shall be considered to be small tools and no payment will be made.
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 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 requiring no more time than that required to return it to its original location; except, that 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, except that no payment will be made for loading

and transporting costs when the equipment is used at the site of the extra work on other than 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 greater than 30 minutes will be considered one hour of operation.
2. When daily rates are listed, any part of a day less than 4 hours of operation shall be considered to be 1/2-day of operation.
3. 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 Subparagraphs (4), (5), and (6), following:
4. Payment for the equipment will be made in accordance with the provisions in Article 11.2d, herein.
5. 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 Article 11.2b, herein, which surcharge shall constitute full compensation for payments imposed by state and federal laws and all other payments made to on behalf of workers other than actual wages.
6. 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 Article 11.4, herein.

11.3 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 determination 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 costs.
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 for 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 11.4, 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 thereto as under the original Agreement. Copies of all amendments to surety bonds or supplemental surety bonds shall be submitted to the City for review prior to the performance of any work hereunder.

11.4 Contractor's Overhead and Profit:

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 expense, and all other items of expense or cost not included in the cost of labor, materials, or equipment provided for under Paragraphs 11.2b, 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	20 percent
Materials	15 percent
Equipment	15 percent

To the sum of the costs and markups provided for in this Article, one percent shall be added as compensation for bonding.

b. It is understood that labor, materials, and equipment may be furnished by the Contractor or by the subcontractor on behalf of the Contractor. When all or any part of the extra work is performed by a 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. No markup allowance will be made for sub-subcontractors or below.

11.5 Records:

a. The Contractor shall maintain its records in such a manner as to provide a clear distinction between the direct costs of each separate item of extra work, disputed work, emergency work, or other work paid for on a Cost of Work basis and the costs of other operations.

b. From the foregoing records, the Contractor shall furnish the Engineer completed Daily Work Reports, on forms furnished by the City, for each day's work or a portion of each day's work to be paid for on a Cost of Work basis. The Daily Work Reports shall itemize the materials used, and shall cover the direct cost of labor and the charges for equipment rental, whether furnished by the Contractor, subcontractor, or other forces, except for charges described in Article 11.3, "Special Services." The Daily Work Reports shall provide names or identifications and classifications of all workmen, the hourly rate of pay and hours worked by each, and also the size, type, and identification number of equipment, and the hours operated.

c. Material charges shall be substantiated by valid copies of the vendor's invoices. Such invoices shall be submitted with the Daily Work Reports, or if not available, they shall be submitted with subsequent Daily Work Reports. Should said vendor's invoices not be submitted within 60 days after the date of delivery of the material or within 15 days after the acceptance of the Contract, whichever occurs first, the City reserves the right to establish the cost of such materials at the lowest current wholesale prices at which said materials were available in the quantities concerned delivered to the location of work less any discounts as provided in Article 11.2(c), herein.

d. Said Daily Work Reports shall be signed by the Contractor or its authorized representative.

e. The Engineer will compare his or her records with the completed Daily Work Reports furnished by the Contractor and make any necessary adjustments. When these Daily Work Reports are agreed upon and signed by both parties, said reports shall become the basis of payment for the work performed, but shall not preclude subsequent adjustment based on a later audit by the City.

f. The Contractor's cost records pertaining to work paid for on a Cost of Work basis shall be open to inspection or audit by representatives of the City, during the life of the contract and for a period of not less

than 3 years after the date of acceptance thereof, and the Contractor shall retain such records for that period. Where payment or labor is based on the cost thereof to forces other than the Contractor, the Contractor shall make every reasonable effort to ensure that the cost records of such other forces will be open to inspection and audit by representatives of the City on the same terms and conditions as the cost records of the Contractor. If an audit is to be commenced more than 60 days after the acceptance date of the contract, the Contractor will be given reasonable notice of the time when such an audit is to begin.

ARTICLE 12 -- CHANGE OF CONTRACT TIME

12.1 General:

a. The Contract Time may only be changed by a Change Order. Any claim for an extension or shortening of the Contract Time shall be based on written notice delivered by the party making the claim to the other party and 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 60 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 claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant 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 Article 9.8 if the City 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 Article 12.1a.

b. The Contract Time will be extended in an amount equal to the time lost on the critical path due to delays beyond the control of the Contractor if a claim is made as provided in Article 12.1a, herein. Such delays shall include acts or neglect by the City or others performing additional work as contemplated by Article 7, herein, 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 of the Agreement.

12.2 Extensions of 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 the conditions resulting from the weather, or 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 said day and the major portion of the day could be considered to be suitable for such construction operations.

c. The Contractor shall base its construction schedule upon the inclusion of the number of days of inclement weather specified in 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 said number of days of inclement weather has been reached. However, no reduction in Contract Time will be made if said number of days of inclement weather is not reached.

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

13.1 Warranty and Guarantee:

The Contractor warrants and guarantees to the City and the Engineer that all work will be in accordance with the Contract Documents and will not be defective. Prompt notice of all defects known to the City or the Engineer shall be given to the Contractor. Neither the right to inspect, nor the presence of inspectors, the Engineer, consultants, or testing agencies hired by the City or the Engineer, nor their general review or approval shall relieve the Contractor from its obligations to perform the Work in accordance with the Contract

Documents. All defective Work, whether or not in place, may be rejected, corrected, or accepted as provided in this Article 13.

13.2 Access to Work:

The Engineer and the Engineer's representatives, other representatives of the City, 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 such access.

13.3 Tests and Inspections:

a. The Contractor shall give the Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals, but in no event less than 24 hours notice.

b. If Laws or Regulations of any public body having jurisdiction other than the City require any Work (or part thereof) to specifically be inspected, tested, or approved, the Contractor shall pay all costs in connection therewith and shall furnish the Engineer the required certificates of inspection, testing, or acceptance. The Contractor shall also be responsible for and shall pay all costs in connection with any inspection or testing required in the City's or the Engineer's acceptance of a Supplier of materials or equipment proposed as a substitution or "or equal" to be incorporated in the Work, or of materials or equipment submitted for approval prior to the Contractor's purchase thereof for incorporation in the Work. The cost of all inspections, tests, and approvals in addition to the above which are required by the Contract Documents will be paid by the City (unless otherwise specified).

c. The Engineer may make or have made, such inspections and tests, as the Engineer deems necessary to see that the Work is being accomplished in accordance with the requirements of the Contract Documents. This testing by the City will be in addition to the testing required by the contract documents. Unless otherwise specified in the Supplementary General Conditions, the cost of such inspection and testing will be borne by the City. In the event such inspections or tests reveal noncompliance 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 organizations acceptable to the Engineer and the Contractor.

e. If any Work (including the work of others) that is to be inspected, tested, or approved is covered without the written concurrence of the Engineer, it shall, if requested by the Engineer, be uncovered for observation. Such uncovering shall be at the Contractor's expense unless the Contractor has given the Engineer timely notice of the Contractor's intention to perform such test or to cover the same and the Engineer has not acted with reasonable promptness in response to such notice.

f. If any work is covered contrary to the written request of the Engineer, it shall, 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 by the Engineer or inspected or tested by others, the Contractor, at the Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing, as the Engineer may require, that portion of the Work in question and shall furnish all necessary labor, material, and equipment. If it is found that such work is defective, the Contractor shall bear all direct, indirect, and consequential costs of such uncovering, exposure, observation, inspection, and testing and of satisfactory reconstruction, including but not limited to fees and charges of engineers, architects, attorneys, and other professionals. However, if such work is not found to be defective, the Contractor shall be allowed an increase in the Contract Price for such uncovering, exposure, observation, inspection, testing, and reconstruction; and, if the parties are unable to agree as to the amount or extent thereof, the Contractor may make a claim therefore as provided in Articles 11 and 12, herein.

h. The Contractor shall permit on-site videotaping, still photography, or motion picture photography of the construction project. The City will notify the Contractor prior to the commencement of any videotaping and/or photography by the City personnel and/or its agents and shall make a reasonable effort to give the Contractor at least 24 hours of its intent to videotape or photograph the project. The Contractor shall cooperate with and shall coordinate with City personnel or their authorized representatives in its efforts to carry out such videotaping and or photography. The Contractor shall give notice to all employees and subcontractors of such videotaping and/or photography to be out of view of the camera, if requested to do so, during videotaping and or photographing of the construction project.

13.4 City May Stop the Work:

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

13.5 Correction or Removal of Defective Work:

If required by the Engineer, the Contractor shall promptly either correct all defective Work, whether or not fabricated, installed or completed, or, if the Work has been rejected by the Engineer, the Contractor shall remove it from the site and replace it with non-defective Work. The Contractor shall bear all direct indirect and consequential costs of such correction or removal, including but not limited to fees and charges of architects, engineers, attorneys, and other professionals, made necessary thereby.

13.6 One Year Correction Period:

a. If within one year after the date of Completion or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Work is found to be defective, the Contractor shall promptly, without cost to City and in accordance with City's written instructions, either correct such defective Work, or, if it has been rejected by City, remove it from the site and replace it with non-defective Work. If the Contractor does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, City may have the defective Work corrected or the rejected Work removed and replaced, and all direct, indirect and consequential costs of such removal and replacement, including but not limited to fees and charges of architects, engineers, attorneys, and other professionals, shall be paid by the Contractor. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Contract Documents.

b. Unless otherwise provided in the Supplementary General Conditions, the Contractor shall provide a post-construction extension of the performance and payment bonds in the amount of 100 percent of the Contract Price to cover all correction and repairs or other corrective work required hereunder, and shall maintain such Bond in full force and effect for one full year following the Notice of Completion.

13.7 Acceptance of Defective Work:

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

ARTICLE 14 -- PAYMENTS TO THE CONTRACTOR AND COMPLETION

14.1 Schedule of Values (Lump-Sum Price Breakdown):

The schedule of values or lump-sum price breakdown established as provided for in the Contract Documents shall serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to the Engineer.

14.2 Unit Price Bid Schedule:

Progress payments on account of unit-price work will be based on the number of units completed.

14.3 Application for Progress Payment:

a. Unless otherwise prescribed by law, on the 25th of each month, the Contractor shall submit to the Engineer for review an Application for Payment filled out and signed by the Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

b. The Application for Payment shall identify, as a subtotal, the amount of the Contractor's Total Earnings to Date, plus the Value of Materials at the site which have not yet been incorporated into the Work, and less a deductive adjustment for materials installed which were not previously incorporated into the Work, but for which payment was allowed under the provisions for 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 subtotal from which shall be deducted the amount of retainage specified in the Contract Documents, and the total amount of all previous payments made to the Contractor.

d. Except as otherwise provided in the Supplementary General Conditions, the value of Materials Stored at the Site shall be an amount equal to the specified percentage of the value of such materials as set forth in the Supplementary General Conditions. Said amount shall be based upon the value of all acceptable materials and equipment not incorporated in the Work but delivered and suitably stored at the site or at another location agreed to in writing; provided, each such individual item of material or equipment has a value of more than \$5000 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 claims, charges, security interests, and other encumbrances. and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect the City's interest therein, all of which must be satisfactory to the City.

14.4 Retainage from Monthly Payments:

The Contractor may substitute securities for any money withheld by the City to ensure performance under the Contract. At the request and expense of the Contractor, securities equivalent to the amount withheld shall be deposited with the City or with a state or federally chartered bank as the escrow agent, who shall return such securities to the Contractor upon satisfactory completion of the Contract. Deposit of securities with an escrow agent shall be subject to a written agreement for in-lieu construction payment retention provided by the City between the escrow agent and the City which provides that no portion of the securities shall be paid to the Contractor until the City has certified to the escrow agent, in writing, that the Contract has been satisfactorily completed. The City will not certify that the Contract has been satisfactorily completed until at least 30 days after filing by the City of a Notice of Completion.

14.5 Contractor's Warranty of Title:

The Contractor warrants and guarantees that title to all Work, materials, and equipment covered by an Application for Payment, whether incorporated in the Project or not, will pass to the City no later than the time of final payment free and clear of all claims.

14.6 Review of Applications for Progress Payments:

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 City, or return the Application to the Contractor indicating in writing the Engineer's reasons for refusing to recommend payment. In the latter case, the Contractor may make the necessary corrections and promptly resubmit the Application. Thirty-five days after presentation of the Application for Payment with the Engineer's recommendation, the amount recommended will (subject to the provisions of Article 14.6b) become due and when due will be paid by the City to the Contractor.

b. The City may refuse to make payment of the full amount recommended by the Engineer because claims

have been made against the City on account of the Contractor's performance of the Work or claims have been filed in connection with the Work, or there are other items entitling the City to a credit against the amount recommended, as provided in Article 14.11(b), herein, but the City must give the Contractor written notice within 7 days (with a copy to the Engineer) stating the reasons for such action.

14.7 Beneficial Use or Occupancy and Partial Utilization:

a. Partial Utilization: The City shall have the right to utilize or place into service any item of equipment or other usable portion of the Work prior to completion of the Work. Whenever the City plans to exercise said right, the Contractor will be notified in writing by the City, identifying the specific portion or portions of the Work to be so 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 issuance of said written notice of partial utilization, the City will accept responsibility for the protection and maintenance of all such items or portions of the Work described in the written notice.

c. Beneficial Use or Occupancy: The City shall have the right, at its option and convenience, to occupy or otherwise make use of all or any part of the project premises at any time prior to substantial completion, upon 14 days written notice to the Contractor.

14.8 Substantial Completion:

a. When the Contractor considers the Work ready for its intended use, the Contractor shall notify the City and the Engineer in writing that the Work is substantially complete and request that the Engineer prepare a Notice of Completion. Within a reasonable time thereafter, the City, 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 Contractor in writing, giving the reasons. If the Engineer considers the Work substantially complete, the Engineer will prepare and deliver to the City for its execution and recordation the Notice of Completion signed by the City, the Engineer, and the Contractor, which shall fix the date of Substantial Completion. As applicable, there shall be attached to said Notice a list of items to be completed or corrected before the release of retainage or funds withheld to secure payment for such items remaining to be completed or corrected.

b. Completion shall mean Substantial completion, which shall mean substantial performance of the Contract as defined in Black's Law Dictionary 4th Edition, by West Publishing Co., St. Paul Minn., See definition of "Completion" and "Substantial Completion" in Article 1, herein.

14.9 Notice of Completion:

Within 10 days after the date of acceptance of the Work by the City's governing body, the City will file, in the City Recorder's office, a Notice of Completion of the Work.

14.10 Final Application for Payment:

After the Contractor has completed all such correction work referred to in Article 14.8, herein, and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked-up record documents (as provided in the General Requirements) 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, together with complete and legally effective releases or waiver, which include Contractor's Certificate of Completion, Consent of Surety for Final Payment, Final Waiver of Lien-Conditional Waiver and Release, Final Waiver of Lien-Unconditional Waiver and Release, Affidavit of Release of Liens and any Adjacent Property Owner Release forms (satisfactory to the City) of all liens arising out of or filed in connection with the Work.

14.11 Final Payment and Acceptance:

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 substantially completed, and the

Contractor's other obligations under the Contract Documents have been fulfilled, the Engineer will, within 14 days after receipt of the final Application for Payment, indicate in writing the Engineer's recommendation of payment and present the Application to the City for payment.

b. After acceptance of the Work by the City's governing body, the City will make final payment to the Contractor of the amount remaining after deducting all prior payments and all amounts to be kept or retained under the provisions of the Contract Documents, including the following items:

1. Liquidated damages, as applicable.
2. Two times the value of outstanding items of correction work or punch list items indicated on the Notice of Completion as being yet uncompleted or uncorrected, as applicable. All such work shall be completed or corrected to the satisfaction of the City within the time stated on the Notice of Completion, otherwise, the Contractor does hereby waive any and all claims to all monies withheld by the City to cover the value of all such uncompleted or uncorrected items.

14.12 Release of Retainage and Other Deductions:

The Contractor shall have 30 days to complete any outstanding items of correction work remaining to be completed or corrected as listed on a final punch list made a part of the Notice of Completion. Upon expiration of the 45 days referred to in Article 14.12a, the amounts withheld pursuant to the provisions of Article 14.11b, herein, except for liquidated damages in Article 14.11b, for all remaining work items will be returned to the Contractor; provided, that said work has been completed or corrected to the satisfaction of the City within said 30 days. Otherwise, the Contractor does hereby waive any and all claims for all monies withheld by the City under the Contract to cover 2 times the value of such remaining uncompleted or uncorrected items.

14.13 Contractor's Continuing Obligation:

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 Notice of Completion, nor any payment by the City to the Contractor under the Contract Documents, nor any use or occupancy of the Work or any part thereof by the City, nor any act of acceptance by the City nor any failure to do so, nor any review and approval of a Shop Drawing or sample submittal, will constitute an acceptance of work 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.

14.14 Final Payment Terminates Liability of the City:

Final payment is defined as the last progress payment made to the Contractor for earned funds, less retainage or other withheld funds, as applicable, including the deductions listed in Article 14.11b, herein. The acceptance by the Contractor of the final payment referred to in Article 14.11 herein, shall be a release of the City 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 City or of any person relating to or affecting the Work, except demands made against the City for the remainder, if any, of the amounts kept or retained under the provisions of Article 14.11, herein; and excepting all pending, unresolved claims filed prior to the date of the Notice of Completion.

ARTICLE 15 -- SUSPENSION OF WORK AND TERMINATION

15.1 Suspension of Work by City:

The City, acting through the Engineer, may, at any time and without cause, suspend the Work or any portion thereof for a period of not more than 90 days by notice in writing to the Contractor. The Contractor shall resume the Work on receipt from the Engineer of a Notice of Resumption of Work. The Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if the Contractor makes an approved claim therefore as provided in Articles 11 and 12, herein.

15.2 Termination of Agreement by City (Contractor Default):

a. In the event of default by the Contractor, the City may give 10 days written notice to the Contractor of City's intent to terminate the Agreement and provide the Contractor an opportunity to remedy the conditions constituting the default.

b. In the event that the Agreement is terminated in accordance with Article 15.2a, herein, the City shall have the right to take possession of the Work and may complete the Work by whatever method or means the City 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 that balance which would have been due, the Contractor shall pay the excess amount to the City. If such cost is less than the balance, which would have been due, the Contractor shall not have a claim to the difference.

15.3 Termination of Agreement by City (For Convenience):

a. The City may terminate the Agreement at any time if it is found that reasons beyond the control of either the City or the Contractor make it impossible or against the City's interests to complete the Work. In such a case, the Contractor shall have no claims against the City except: (1), for the value of the work performed 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 have been needed in the Work and which meet the requirements of the Contract 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 for the making of the final application for payment and payment under Articles 14.10 and 14.11, herein.

15.4 Termination of Agreement by Contractor:

The Contractor may terminate the Agreement upon 14 days written notice to the City, whenever:

1. The Work has been suspended under the provisions of Article 15.1, herein, 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 City within this time period; or
2. The City should fail to pay the Contractor any monies due him in accordance with the terms of the Contract Documents and within 60 days after presentation to the City by the Contractor of a request unless within said 14-day period the City shall have remedied the condition upon which the payment delay was based.

In the event of such termination, the Contractor shall have no claim against the City except for those claims specifically enumerated in Article 15.3, herein, and as determined in accordance with the requirements of said Article.

ARTICLE 16 -- RESOLUTION OF CONSTRUCTION CLAIMS

a. Any question about interpretation or clarification, disagreement, or claim that has been timely referred to the Engineer in accordance with Article 9.8, except any which have been waived by the making or accepting of final payment, shall upon timely demand of either party be subject to resolution under the following provisions herein.

b. No demand for arbitration or litigation may be made until the earlier of the following listed times:

1. The date on which the Engineer has issued a written decision as provided in Article 9.8a.
2. The sixty-first day after the date of the Engineer's receipt of a claim or dispute, or for an adjustment of contract terms, or both, if a decision has not been issued by that date.

c. Pending a resolution of the claim or dispute, the Contractor shall proceed diligently with the performance of the contract and in accordance with the Engineer's decision unless the parties to this contract otherwise agree in writing.

ARTICLE 17 -- MISCELLANEOUS

17.1 Giving Notice:

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.

17.2 Title to Materials Found on the Work:

The City shall have 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.

17.3 Right to Audit:

If the Contractor submits a claim to the City for additional compensation, the City 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 to the extent they are relevant. 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 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 rights to examine and inspect herein provided for shall be exercisable through such representatives, as the City deems desirable during the Contractor's normal business hours at the office of the Contractor. The Contractor shall make available to the City for auditing, all relevant accounting records and documents, and other financial data, and upon request, shall submit true copies of requested records to the City.

*** END OF GENERAL CONDITIONS ***

CONDITIONS OF THE CONTRACT

SUPPLEMENTARY GENERAL CONDITIONS

GENERAL

These Supplementary General Conditions make additions, deletions, or revisions to the General Conditions, as indicated herein. All provisions which are not so added, deleted, or revised remain in full force and effect. Terms used in these Supplementary General Conditions which are defined in the General Conditions have the same meanings assigned to them in the General Conditions.

ARTICLE 1 - SUPPLEMENTARY DEFINITIONS

In addition to the definitions in the provisions of Article 1 of the General Conditions, the following respective supplemental definitions shall apply:

Engineer – the ENGINEER is further defined as Hansen, Allen & Luce, Inc. located at 859 W. South Jordan Pkwy, Suite 200, South Jordan, Utah, 84095.

Owner – the OWNER is defined as the City of West Jordan located at 8000 South Redwood Road, West Jordan Utah 84088.

City's Project Representative- The City Project Representative (Construction Manager) shall be David Murphy, P.E., Utility Engineering Manager.

Resident Project Representative (RPR) – A Resident Project Representative (RPR) shall be assigned for on-site observation of the work in progress and performance of the work of the CONTRACTOR.

Specifications - In addition to the scope as defined in the General Conditions, the term "Project Manual," if used herein shall mean "Specifications." Standard Specifications shall include the following referenced standard specifications: "APWA Manual of Standard Specifications 2017 Edition", including all sections referenced in these contract documents and those specifications found in Part III Technical Specifications, and "City Standard Specifications".

Project Manual - The Specifications, as they are defined in the General Conditions.

ARTICLE 2 - PRELIMINARY MATTERS

2.1 Legal Address of the City:

The official address of the City of West Jordan shall be 8000 S. Redwood Road, West Jordan, Utah 84088, or such other address as the City may subsequently designate in a written notice to the Contractor.

2.2 Legal Address of the Engineer or Architect:

2.3 Legal address of the City's Project Representative:

The name and address of the City's Project Representative shall be David Murphy located at 7960 South 4000 West, West Jordan, Utah 84088, or such other address as the Project Representative may subsequently designate in writing to the Contractor.

ARTICLE 3 - CONTRACT DOCUMENTS; INTENT, AMENDING, AND REUSE

3.1 Scope:

a. The work to be performed under this Contract shall consist of furnishing all plant, tools, equipment, materials, and manufactured articles and for furnishing all transportation services, and all fuel, power, water, and essential communications, and for the performance of all labor, work, or other operations required for the fulfillment of the Contract in strict accordance with the Specifications, Drawings, Schedules, and other Contract Documents as defined in the Contract, all of which are made a part hereof and including such detail sketches as may be furnished by the Engineer or Architect from time to time during construction in explanation of said Drawings or other Contract Documents.

b. The Work shall be complete and operable, and all work, materials, and services not expressly called for or shown in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be performed, furnished, and installed by the Contractor as though originally so specified or shown, at no additional cost to the City.

3.2 Contract Drawings:

a. The location of the Work, its general nature and extent, and the form and general dimensions of the Project and appurtenant works are shown on the Drawings, hereby made a part of these Contract Documents. The Drawings entitled, "XXXXX," are dated prior to the date of opening bids. Drawing changes made subsequent to the date of opening bids shall only be issued under a Change Order, as provided in Article 10 of the General Conditions.

ARTICLE 4 – AVAILABILITY OF LAND; PHYSICAL CONDITIONS; REFERENCE POINTS

4.2 Physical Conditions:

a. There were no geotechnical investigations or soil borings or other explorations of subsurface conditions performed for the preparation of the design of this project. The CONTRACTOR shall perform his own investigations, as he considers necessary to become familiar with the physical conditions of what may be encountered during construction of this project.

ARTICLE 5 - BONDS AND INSURANCE

5.1 Performance and other Bond Amounts:

The Contractor shall furnish a satisfactory Performance Bond and a Payment Bond, each in the amount of 100 percent of the Contract Price.

5.2 Insurance Amounts:

The limits of liability for insurance as required by Article 5.2 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

- 1) Workers' Compensation Insurance: Statutory workers' compensation insurance (Part A). Such insurance shall also include employer's liability (Part B) insurance in a limit of no less than \$1,000,000 for each: accident, disease, employee. No owner or officer may be excluded.
- (1) General Liability Insurance: General Liability Insurance: Commercial general liability insurance on an occurrence basis arising out of claims for bodily injury (including death) and property damage. Such insurance shall provide coverage for ongoing operations and products-completed operations, blanket contractual, broad form property damage, personal and advertising injury, independent contractors and sudden and accidental pollution liability [pollution liability arising out of a hostile fire] with a \$2,000,000 minimum per occurrence limit combined bodily injury and property damage, with a \$3,000,000 minimum aggregate limit, provided the general policy aggregate shall apply separately to the Contractor on a per project basis. Any aggregate limit that does not apply separately to the premises shall be at least double the required per occurrence limit.
- 2)
- 3) Automobile Liability Insurance: Automobile liability insurance for the Contractor's liability arising out of the use of owned (if any), leased (if any), non-owned and hired vehicles of the Contractor, with a \$5,000,000 minimum limit per accident for combined bodily injury and property damage and containing appropriate no-fault insurance provisions wherever applicable. All owned and/or leased automobiles shall be covered using symbol "1" (any auto).
- 4) Builder's Risk: (required for above ground construction)
N/A
5. Insurance policies need to list as additionally insured the following: "The City of West Jordan, Utah, its elected officials, officers, employees, agents, and volunteers."
6. In the lower right-hand corner of the ACORD insurance form under Cancellation, the following statement should be included: "This policy shall not be subject to cancellation, change, or reduction of coverage by the other party or parties hereto, unless notice, as defined herein, is sent to the OWNER, with a copy to the ENGINEER and the OWNER's attorney at least 30 days prior to conclusion."

Insurance Provisions

- (1) Additional Insured Endorsements: All policies of liability insurance required to be maintained by the Contractor shall be endorsed to name the City as additional insured for ongoing operations (ISO CG 20 10 or equivalent) and completed operations (ISO CG 20 37 or equivalent) (except for insurance policies required in this Section [1,4,5,7,8,9]).

- (2) Primary and Non-Contributory Endorsements: The Contractor's insurance coverage shall be primary insurance as respects to the City, its officers, officials, employees, and volunteers. Any insurance or self-insurance maintained by the City, its officers, officials, employees or volunteers shall be in excess of the contracting party's insurance and shall not contribute with it.
- (3) Waiver of Subrogation Endorsements: The Contractor hereby waives any and every claim for recovery from the City, Lenders and their respective offices and employees for any and all loss or damage covered by any of the insurance policies to be maintained under this Contractor agreement to the extent that such loss or damage is recovered under any such policy. To the extent the foregoing waiver would preclude coverage under any insurance required by this Section, the Contractor shall give written notice of the terms of such waiver to each insurance company which has issued, or which may issue in the future, any such policy of insurance (if such notice is required by the insurance policy) and shall cause each such insurance policy to be properly endorsed, or to otherwise contain one or more provisions that prevent the invalidation of the insurance coverage by reason of such a waiver.
- (4) Severability of Interests: The contracting party's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respects to the limits of the insurer's liability.
- (5) Deductibles and Self-Insured Retentions: Any deductibles or self-insured retention, exceeding 5% limit of policy, must be declared to and approved by the City. At the option of the City, either; the insurer may be required to reduce or eliminate such deductibles or self-insured retention as respects the City, its officers, officials, and employees; or the contracting party may be required to procure a bond guaranteeing payment of losses and related investigations, claim distribution and defense expenses.
- (6) Notice of Incident or Accident: Contracting party shall agree to disclose to the City, all incidents or occurrences of accident, injury, and/or property damage, regardless of whether such incidents are submitted as claims under the contractor's insurance policies.
- (7) Evidence and Verification of Insurance: On or before the effective date of each policy and on an annual basis at least 10 days prior to each policy anniversary, the Contractor shall furnish the City with (1) certificates of insurance or binders, in a form acceptable to the City, evidencing all of the insurance required by the provisions of this Section. Contractor shall provide a certificate of insurance verifying completed operations coverage for a period of not less than two years after project completion. Certificates and endorsements are to be signed by a person authorized by that insurer to bind coverage on its behalf. The certificates and endorsements are to be furnished to and accepted by the City before work commences. The City reserves the right to require complete, certified copies of all required insurance policies, with all endorsements, at any time.
- (8) Claims-Made Policies: If any policy is a claims-made policy, the policy shall provide the Contractor the right to purchase, upon cancellation or termination by refusal to renew the policy, an extended reporting period of not less than two years. The Contractor agrees to purchase such an extended reporting period if needed to ensure continuity of coverage. The Contractor's failure to purchase such an extended reporting period as required by this paragraph shall not relieve it of any liability under this Contract. If the policy is a claims-made policy, the retroactive date of any such policy shall be not later than the date this Contract is executed by the parties hereto. If the Contractor purchases a subsequent claims-made policy in place of any prior claims-made policy,

the retroactive date of such subsequent policy shall be no later than the date this Contract is executed by the parties hereto.

- (9) Policy Cancellation and Change: All insurance policies shall be endorsed so that if at any time they are canceled, such cancellation shall not be effective for the City for 30 days, except for non-payment of premium which shall be for 10 days. If any material change in coverage should occur, the Contractor shall provide notice of any material change in coverage to the City immediately.
- (10) Liability Limits: The liability limits shown in this Section are minimum requirements. To the extent the Contractor maintains, or causes to be maintained on its behalf, liability limits which are higher than the minimum limits stated in this Section, the higher liability shall be required of the Contractor.
- (11) Failure to Maintain Insurance: In the event the Contractor fails, or fails to cause others on their behalf, to take out or maintain the full insurance coverage required by this Section, the City, upon 30 days' prior notice (unless the required insurance would lapse within such period, in which event notice will be given as soon as reasonably possible) to the Contractor of any such failure, may (but shall not be obligated to) take out the required policies of insurance and pay the premiums on the same. All amounts so advanced thereof by the City shall become an additional obligation of the Contractor to the City, and the Contractor shall pay such amounts to the City, together with interest thereon from the date so advanced. Any failure to comply with reporting provisions of the policies shall not affect coverage provided to the City, its officers, officials, employees or volunteers.
- (12) No Duty to Verify or Review: No provision of this Section or any provision of any Document related to this agreement shall impose on the City any duty or obligation to verify the existence or adequacy of the insurance coverage maintained by the Contractor, nor shall City be responsible for any representations or warranties made by or on behalf of the Contractor to any insurance company or underwriter. Any failure on the part of the City to pursue or obtain the evidence of insurance required by this agreement from the Contractor and/or failure of the City to point out any non-compliance of such evidence of insurance shall not constitute a waiver of any of the insurance requirement in this agreement.
- (13) Subcontractors: Contractor shall include all subcontractors as an insured under its policies or shall furnish separate certificates and endorsements for each subcontractor. All coverages for subcontractors shall be subject to all of the requirements stated herein.
- (14) Indemnification/Liability: Contractor shall indemnify and hold harmless the City, its officers, agents, employees and volunteers from all damages, costs or expenses in law or equity, including attorney's fees, that may at any time arise or be set up because of damages to property, bodily injury or personal injury received by reason of or in the course of providing services to the City but only to the extent caused by any willful, negligent or wrongful act or omission of the contracting party, any of their employees or any subcontractors.

ARTICLE 6 - THE CONTRACTOR'S RESPONSIBILITIES

6.1 Subcontract Limitations:

In addition to the provisions of Article 6.5 of the General Conditions, the Contractor shall perform not less than 20 percent of the Work included in the original Contract Price with its own forces (i.e., without subcontracting), except that any designated "Specialty Items" may be performed by subcontract and the amount of any such "Specialty Items" so performed may be deducted from the original total Contract Price before computing the amount of work required to be performed by the Contractor with its own forces. When items of work in the Bid Schedule are preceded by the letter "S," such items are designated as "specialty Items." Where an entire item is subcontracted, the value of the work subcontracted will be based upon the contract item bid price. When a portion of an item is subcontracted, the value of the work subcontracted will be the estimated percentage of the contract item bid price, determined from the information submitted by the Contractor, subject to approval of the Architect. The 20 percent requirement shall be understood to refer to the Work, the value of which totals not less than the full Contract Price.

6.2 Laws and Regulations:

The Work is located in the City of West Jordan, state of Utah. The Contractor shall comply with all ordinances, regulations, and other lawful requirements of said City, County, and State governing the work on public property. In particular, the Contractor's attention is directed to Section 01 57 00 entitled "Temporary Environmental Controls."

ARTICLE 9 - THE ENGINEER'S STATUS DURING CONSTRUCTION

a. The Resident Project Representative (RPR), who is the City's and the Architect's onsite representative, will act as directed by and under the supervision of the Construction Manager of City of West Jordan and will confer with the Architect and the City regarding its actions. The Resident Project Representative's dealings in matters pertaining to onsite work shall in general only with the Architect and the Contractor, and dealings with subcontractors shall only be through or with the full knowledge and consent of the Contractor. Written communication with the City shall only be addressed to the Architect or the Construction Manager and shall be submitted or delivered through the Resident Project Representative.

b. The Duties, Responsibilities, and Limitations of Authority of the Resident Project Representative shall be as specified in EJCDC Document No. 1910-1-A (1984 Edition) entitled "Suggested Listings of Duties, Responsibilities and Limitations of Authority of Resident Project Representative," a copy of which is placed at the end of this document, and is hereby included as a part of these Supplementary General Conditions by this reference thereto.

ARTICLE 11 – CHANGE OF CONTRACT PRICE

11.1 Equipment Rental Rates:

Whenever under the terms of this Contract the Contractor is entitled to additional payment for the use of rental equipment, the Contractor will be paid for the use of the Equipment at the rental rate listed for such equipment specified in the current edition of the following reference publication:

"Rental Rates and Specifications" [The "Green Book"] as published by Associated Equipment Distributors, 615 West 22nd Street, Oakbrook, IL 60521, Phone (312) 654-0650.

ARTICLE 12 - CHANGE OF CONTRACT TIME

12.1 Inclement Weather Delays:

The Contractor's construction schedule shall be based upon the inclusion of an estimated number of days of inclement weather expected to be encountered during the specified contract term, based upon the U.S. Weather Bureau records for the preceding 3-year period. Inclement weather shall be as defined in Article 12.2a of the General Conditions. Except for weather conditions encountered due to a delay caused by the City, which moves the construction term into a period of more severe weather, no request for an extension of contract time due to such weather delays will be considered until the actual number of such inclement weather days exceeds the number of days computed from the U.S. Weather Bureau 3-year average preceding this project.

ARTICLE 14 - PAYMENTS TO THE CONTRACTOR AND COMPLETION

14.1 Amount of Retainage:

The following provision shall be added to Article 14.3c of the General Conditions:

"In addition to the provisions of Article 14.11 of the General Conditions for withholding of funds from the Final Payment, the City may retain a portion of the amount of each progress payment otherwise due to the Contractor, as follows:

1. The City may retain 5 percent of each approved progress payment until the Work is 50 percent complete; then, the City may at its option suspend further retainage until the final progress payment.
2. The City reserves the right to reinstate up to 5 percent retainage of the total of the Work done if the City determines, at its discretion, that the Contractor is not performing the Work satisfactorily, or there is other specific cause for such retainage.

*** END OF SUPPLEMENTARY GENERAL CONDITIONS ***

PART III

TECHNICAL SPECIFICATIONS

SECTION 01 11 00

SUMMARY OF WORK

1.01 GENERAL

- A. The Work to be performed under this Contract shall consist of furnishing all plant, tools, equipment, materials, supplies, and manufactured articles for the Project. It shall also include the furnishing of all transportation and services, including fuel, power, water, and essential communications, and for the performance of all labor, work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of this Contract generally includes but is not limited to construction of a new well house pump building, piping and valving, electrical, landscaping, and site work.
- B. The Work is located in the City of West Jordan at locations identified on the construction plan map.

1.03 BEGINNING AND COMPLETION OF THE WORK

- A. Time is the essence of the Contract. In accordance with the provisions of Article 2 of the Agreement, the Contractor shall begin the Work on the date specified in the written Notice to Proceed from the City, and shall complete all of the Work included in the Contract within the time specified in said Notice. Time stated for completion shall include final cleanup of the premises.

1.04 CONTRACT METHOD

- A. The Work hereunder will be constructed under a unit-price contract.
- B. The Contractor shall include the requirements of the General Conditions and Supplementary General Conditions of the Contract as a part of all of its subcontract agreements.

1.05 ORDER OF THE WORK

- A. The Work shall be carried on at such places on the project and also in such order or precedence as may be found necessary by the Engineer or Architect to expedite completion of the Project. After work has begun on any portion of a designated part of the Project, it shall be carried forward to its final completion as rapidly as practicable. The order and time to complete shall conform to the requirements of the approved Contractor's schedule as submitted under the provisions for *"Contractor's Schedules" in Section 01 33 00, "Contractor Submittals" and the requirements of Section 01 32 16, "CPM Construction Schedule."*

1.06 WORK BY OTHERS

- A. General: The Contractor's attention is directed to the fact that other contractors may conduct work at the site during the performance of the Work under this contract. The Contractor shall conduct its

operations so as to cause a minimum of interference with the Work of such other contractors, and shall cooperate fully with such contractors to provide continued safe access to their respective portions of the site, as required to perform their respective contracts.

- B. Interference with Work on Utilities: The Contractor shall cooperate fully with all utility forces of the City or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the Work, and shall schedule the Work so as to minimize interference with said relocation, altering, or other rearranging of facilities.
- C. Concurrent Work by Other Contractors: The Contractor's attention is directed to the fact that work *will may* be conducted *at adjacent to* the site by other contractors during the performance of the Work of this Contract. The Contractor shall conduct its operations so as to cause a minimum of interference with the work of such other contractors.

1.07 WORK SEQUENCE

- A. Construct Work in stages to accommodate OWNER use of premises during construction.
 - 1. Coordinate Progress Schedule during construction.
 - 2. Provide for continuous public usage. Roads should not be closed without the consent of the Director of Public Works during any phase of construction.
 - 3. Construction Work in each stage: It is anticipated that the Contractor will stage the work as shown below.
 - a. Establishing traffic control,
 - b. Installing erosion control measures,
 - c. Over-excavate,
 - d. Install imported backfill,
 - e. Installing sanitary sewer improvements,
 - f. Installing storm drain improvements,
 - g. Installing culinary water improvements,
 - h. Installing roadway improvements,
 - i. Installing surface features such as landscaping, traffic markings, etc.
 - j. Removing traffic control and erosion control measures.

1.08 PROJECT MEETINGS

- A. Preconstruction Conference: Prior to the commencement of Work at the site, a preconstruction conference will be held at a mutually agreed time and place which shall be attended by the Contractor, its superintendent, and its subcontractors as appropriate. Other attendees will be:
 - 1. Engineer and the Resident Project Representative.
 - 2. Representatives of City.
 - 3. Governmental representatives as appropriate.
 - 4. Others as requested by Contractor, City, or Engineer.
- B. Unless previously submitted to the Engineer, the Contractor shall bring to the conference one copy each of the following:

1. Tentative Construction Schedule.
 2. Procurement schedule of major equipment and materials and items requiring long lead-time.
 3. Shop Drawing/Sample/Substitute or "Or Equal" submittal schedule.
 4. *Schedule of values (lump sum price breakdown) for progress payment purposes.*
- C. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the Contractor prior to the meeting date, which may include the following:
1. Contractor's tentative schedules.
 2. Transmittal, review, and distribution of Contractor's submittals.
 3. Processing applications for payment.
 4. Maintaining of record documents.
 5. Critical work sequencing.
 6. Field decisions and Change Orders.
 7. Use of project site, office and storage areas, security, housekeeping, and City's needs.
 8. Major equipment deliveries and priorities.
 9. Contractor's assignments for safety and first aid.
- D. The City Construction Manager will preside at the preconstruction conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.
- E. Progress Meetings: The Contractor shall schedule and hold regular on-site progress meetings at least *bi-weekly* and at other times as requested by Engineer or Architect or as required by progress of the Work. The Contractor, Engineer or Architect, and all subcontractors active on the site shall be represented at each meeting. Contractor may at its discretion request attendance by representatives of its suppliers, manufacturer's, and other subcontractors.
- F. The Contractor shall preside at the meetings and provide for keeping and distribution of the minutes. The purpose of the meetings will be to review the progress of the Work maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.

*** END OF SECTION ***

**SECTION 01 14 00
WORK RESTRICTIONS**

PART 1 GENERAL

- A. The OWNER and/or utility owners may be working within the Project area while this contract is in progress. If so, the Contractor shall schedule his work in conjunction with these other entities to minimize mutual interference.
- B. All compaction and other testing requirements specified shall be provided and paid for by CONTRACTOR.
- C. CONTRACTOR shall notify ENGINEER of the schedule for materials testing as required in Section 01 45 00 Quality Control and Materials Testing and Section 01 45 23 Testing and Inspection Services a minimum of 24 hours in advance in order to provide ENGINEER time to be present during desired testing. Contractor shall be responsible for obtaining copies of testing reports or data and insuring that the work is in full compliance with the Contract Documents.
- D. CONTRACTOR shall notify owners of Private rights-of-way 72 hours prior to work being performed across owner's right-of-way.
- E. If required to work in City Streets or Utah Department of Transportation (UDOT) right-of-way, CONTRACTOR shall notify right-of-way owner 72 hours prior to work being performed therein. Work within the City Streets or UDOT right-of-way shall be in accordance with required permits and any license agreement with OWNER. CONTRACTOR shall obtain and comply with all required permits.
- F. CONTRACTOR must work with all adjacent property owners to ensure no harm or damage is caused to homes or property during construction of the project.

1.2 MEASUREMENT AND PAYMENT

- A. Work Restrictions shall not be measured or paid as a separate item, but shall be included as part of the various items to which it relates.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 22 00
MEASUREMENT AND PAYMENT

PART 1 GENERAL

- A. All work completed under this contract shall be in accordance with the Drawings and Specifications and will be measured by ENGINEER/OWNER. The quantities appearing on the Bid Schedule are approximate only, and are prepared for the comparison of bids. Payment to CONTRACTOR on bid items with unit prices other than "Lump Sum" will be made for actual quantities of work performed and accepted, or material furnished in accordance with the Contract. The scheduled quantities of work to be done and materials to be furnished may be increased or decreased in accordance with the General Conditions.
- B. The term "Lump Sum" when used as an item of payment will mean complete payment for the work described in the contract. When a complete structure, portion of work, or unit is specified "Lump Sum" as the unit of measurement, the unit will include fittings, accessories, and all work necessary to complete the work as shown on the Drawings and as specified.
- C. When the accepted quantities of work vary from the quantities in the Bid Schedule, CONTRACTOR shall accept as payment in full, so far as contract items are concerned, payment at the original contract unit prices for the work done. OWNER reserves the right to add to or delete from quantities listed in the bid schedule in order to match the total bid with the budgeted money available.

1.2 BASE BID SCHEDULE

A. BID ITEM NO. 1 - "MOBILIZATION"

1. **GENERAL.** This bid item is provided to cover CONTRACTOR's cost for general and miscellaneous responsibilities and operations not normally attributed to any other single bid item within this schedule. This shall include, but is not limited to, work described or enumerated in Section 01 71 13 - Mobilization.
2. **METHOD OF MEASUREMENT.** Mobilization shall not be measured, but shall be paid for on a lump sum basis for the completion of the work as required in Section 01 71 13 - Mobilization.
3. **BASIS OF PAYMENT.** Payment will be made at the contract lump sum bid price. Payments will be made in accordance with the following schedule:
 - a. When 10% of the original contract amount is earned, 25% of the amount bid for mobilization will be paid.
 - b. When 25% of the original contract amount is earned, an additional 25% for a total of 50% of the amount bid for mobilization will be paid.
 - c. When 50% of the original contract amount is earned, an additional 25% for a total of 75% of the amount bid for mobilization will be paid.

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

B. BID ITEM NO. 2 - "CONSTRUCTION SURVEYING AND SWPPP"

1. **METHOD OF MEASUREMENT.** Measurement shall be based on performing construction surveying complete and submission of a completed SWPPP as one item.
2. **BASIS OF PAYMENT.** Payment shall be at the contract price bid on a lump sum basis for performing construction surveying complete and submission of a completed SWPPP. Payment shall be considered full compensation for all labor, equipment, materials and incidentals required to complete this item.

C. BID ITEM NO. 3 - "PUMP HOUSE STRUCTURE, GENERATOR SCREENING WALLS AND CONCRETE PAD"

1. **METHOD OF MEASUREMENT.** Measurement shall be based on construction of pump house structure, generator screening walls and concrete pad complete as one item.
2. **BASIS OF PAYMENT.** Payment shall be at the contract price bid on a lump sum basis for construction of pump house structure, generator screening walls and concrete pad complete. Payment shall be considered full compensation for all labor, equipment, materials and incidentals required to complete this item.

D. BID ITEM NO. 4 - "PUMP, SHAFT AND MOTOR"

1. **METHOD OF MEASUREMENT.** Measurement shall be based on installation of the pump, shaft and motor complete as one item.
2. **BASIS OF PAYMENT.** Payment shall be at the contract price bid on a lump sum basis for installation of the pump, shaft and motor complete. Payment shall be considered full compensation for all labor, equipment, materials and incidentals required to complete this item. Prior to payment, the pump must be in proper operating condition.

E. BID ITEM NO. 5 - "PUMP STATION PIPING, VALVING, AND CHLORINATION SYSTEM"

1. **METHOD OF MEASUREMENT.** Measurement shall be based on installation of pump station piping, valving, and chlorination system complete as one item.
2. **BASIS OF PAYMENT.** Payment shall be at the contract price bid on a lump sum basis for installation of pump station piping, valving, and chlorination system complete. Payment shall be considered full compensation for all labor, equipment, materials and incidentals required to complete this item.

F. BID ITEM NO. 6 - "PIPELINE (DISCHARGE, FLOOR DRAIN SEWER, PUMP-TO-WASTE) AND PUMP-TO-WASTE DISCHARGE STRUCTURE"

1. **METHOD OF MEASUREMENT.** Measurement shall be based on installation of discharge, floor drain sewer, and pump-to-waste pipelines and construction of pump-to-waste discharge structure complete as one item.

2. **BASIS OF PAYMENT.** Payment shall be at the contract price bid on a lump sum basis for installation of discharge, floor drain sewer, and pump-to-waste pipelines and construction of pump-to-waste discharge structure complete. Payment shall be considered full compensation for all labor, equipment, materials and incidentals required to complete this item.

G. BID ITEM NO. 7 - "SITE IMPROVEMENTS (LANDSCAPING, FENCING, PAVEMENT, AND CURB)"

1. **METHOD OF MEASUREMENT.** Measurement shall be based on construction of site improvements complete as one item.
2. **BASIS OF PAYMENT.** Payment shall be at the contract price bid on a lump sum basis for construction of site improvements including, but not limited to, landscaping, fencing, pavement, and curb. Payment shall be considered full compensation for all labor, equipment, materials and incidentals required to complete this item.

H. BID ITEM NO. 8 - "ELECTRIC POWER SUPPLY, ELECTRICAL SYSTEMS, INSTRUMENTATION, CONTROL PANELS, GENERATOR AND TRANSFER SWITCH"

1. **METHOD OF MEASUREMENT.** Measurement shall be based on connection to existing electric power supply, installation of electrical systems, instrumentation, control panels, generator and transfer switch complete as one item.
2. **BASIS OF PAYMENT.** Payment shall be at the contract price bid on a lump sum basis for connection to existing electric power supply, installation of electrical systems, instrumentation, control panels, generator and transfer switch complete. Payment shall be considered full compensation for all labor, equipment, materials and incidentals required to complete this item.

I. BID ITEM NO. 9 - "HVAC SYSTEM"

1. **METHOD OF MEASUREMENT.** Measurement shall be based on construction and installation of the HVAC system complete as one item.
2. **BASIS OF PAYMENT.** Payment shall be at the contract price bid on a lump sum basis for construction and installation of the HVAC system complete. Payment shall be considered full compensation for all labor, equipment, materials and incidentals required to complete this item.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.
- B. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.
- C. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.
- D. UDOT, OWNER, and/or utility owners may be working within the project area while this contract is in progress. If so, CONTRACTOR shall schedule his work in conjunction with these other organizations to minimize mutual interference.
- E. All existing West Jordan City waterlines and service connections shall remain active during the construction of this project. All connections to the existing waterlines, except those being hot-tapped, shall only be done upon successful completion of mainline installation and testing.
- F. Water service to this area can only be interrupted per specification Coordination 01 31 13.
- G. If required to work in City Streets or Utah Department of Transportation (UDOT) right-of-way, CONTRACTOR shall notify UDOT 72 hours prior to work being performed therein. Work within the City Streets or UDOT right-of-way shall be in accordance with their required permit and their license agreement with OWNER. CONTRACTOR shall obtain and comply with all required permits.
- H. Coordination with Adjacent Property Owner
 - 1. Once each week hand deliver or mail a written "**Construction Status Update Notice**" to all residents, businesses, schools and property owners adjacent to and affected by the Work. Notice shall be on CONTRACTOR's company letterhead paper and be secured to doorknob should occupants not be home. Obtain ENGINEER's review of notice prior to distribution. As a minimum the notice shall contain the following:
 - a. name and phone number of CONTRACTOR's representative for the project
 - b. work anticipated for the next 7 days including work locations and work by subcontractors and utility companies
 - c. rough estimate of construction schedule through end of project
 - d. anticipated driveway approach closures
 - e. anticipated water, sewer or power outages
 - f. anticipated vehicular traffic impacts, rerouting or lane closures
 - g. anticipated pedestrian impacts and sidewalk closures
 - h. changes to public transportation bus routes

- i. any other construction or work items which will impact or restrict the normal use of streets and amenities

Failure to comply with this contract provision is considered grounds for project suspension per Article 15.1 of the General Conditions (APWA Document 00 72 00) Article 16.02 of the General Conditions (EJCDC 00 70 00).

1.2 FIELD ENGINEERING

- A. CONTRACTOR shall provide the following construction staking at no cost to the OWNER.
 - 1. Benchmark network throughout the construction zone
 - 2. Pipeline alignment stakes at approximately 100 foot intervals and all bends and designated changes in grade.
 - 3. Stake locations for air vents and other fittings
- B. Construction staking and surveying shall be performed by a registered Land Surveyor in the State of Utah.
- C. ENGINEER shall not be responsible for stakes, etc. removed through negligence of CONTRACTOR and in that event shall be compensated by CONTRACTOR for re-staking efforts.
- D. Locate and protect survey control and reference points. Promptly notify ENGINEER of discrepancies discovered.
- E. Control datum for survey is that shown on Contract Drawings.
- F. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- G. Promptly report to ENGINEER loss or destruction of reference point or relocation required because of changes in grades or other reasons.
- H. The CONTRACTOR shall be responsible to coordinate with all property owners to determine the location of existing sewer and water service laterals. The CONTRACTOR shall be responsible to coordinate with all property owners during installation or relocation of existing service laterals.
- I. All service laterals shall be verified and indicated on the Record Drawings supplied by the CONTRACTOR to the ENGINEER.

1.3 PRECONSTRUCTION MEETING

- A. Prior to the commencement of work at the site, a preconstruction conference will be held at a mutually agreed time and place which shall be attended by CONTRACTOR's Project Manager, its superintendent, and its subcontractors as appropriate. Other attendees will be:
 - 1. ENGINEER and the Resident Project Representative (RPR)

2. Representatives of OWNER
 3. Governmental representatives as appropriate
 4. Others as requested by CONTRACTOR, OWNER, or ENGINEER.
- B. Unless previously submitted to ENGINEER, CONTRACTOR shall bring to the conference one copy of each of the following:
1. Progress schedule
 2. Procurement schedule of major equipment and materials and items requiring long lead time
 3. Shop Drawings/Sample/Substitute or "Or Equal" submittal schedule.
- C. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda may include the following:
1. CONTRACTOR's tentative schedules
 2. Transmittal, review, and distribution of CONTRACTOR's submittals
 3. Processing applications for payment
 4. Maintaining record documents
 5. Critical work sequencing
 6. Field decisions and Change Orders
 7. Use of project site, office and storage areas, security, housekeeping, and OWNER's needs
 8. Major equipment deliveries and priorities
 9. CONTRACTOR's assignments for safety and first aid
- D. ENGINEER will preside at the preconstruction conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.
- E. The CONTRACTOR should plan on the conference taking no less than 4 hours.

1.4 PROGRESS MEETINGS

- A. CONTRACTOR shall schedule and hold regular on-site progress meetings at least every other week and at other times as required by ENGINEER or as required by progress of the work. CONTRACTOR, ENGINEER, and all subcontractors active on the site shall be represented at each meeting. CONTRACTOR may at its discretion request attendance by representatives of its suppliers, manufacturers', and other subcontractors.

- B. ENGINEER shall preside at the meetings and provide for keeping and distribution of the minutes. The purpose of the meetings will be to review the progress of the work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.
- C. At each construction progress meeting a progress report shall be presented by the CONTRACTOR containing an updated Progress Schedule. Where the delayed completion date of a project phase is noted, the CONTRACTOR shall describe the anticipated delays or problems and outline the action plan being taken to resolve the issues.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 31 13

COORDINATION

1.01 GENERAL

- A. The Contractor shall coordinate all work hours, shut downs, and closures during the construction period with all utility service companies, local school district schools, postal service, solid waste companies, businesses and residents, and City staff. The Contractor shall submit a proposed work schedule to the City for approval per Section 01 32 16.
- B. The Contractor shall restore affected utility systems to full operation after each work day and will be liable to repair all damage to existing utility systems that are damaged by the new construction. The Contractor shall repair all existing infrastructure that is damaged by the new construction including replacement of existing trees, shrubs, ground cover and lawn with plant material of comparable size within 48 hours of damage (non-wintertime conditions). The Contractor shall restore all disturbed areas of the roadway surface to useable condition after each workday.
- C. The Contractor shall notify the local fire and police departments when construction activities will block traffic or create detour routes.
- D. The Contractor shall notify Ace Disposal - Dawn Beagley – account representative – at Office:801-363-9995 or Cell:801-652-8946 to coordinate waste pickup time and required contract work. Effort shall be given to allow a normal garbage disposal pickup schedule.

1.02 INTERRUPTIONS OF UTILITY SERVICE

- A. The Contractor shall restore affected utility systems to full operation after each work day and will be liable to repair all damage to existing utility systems that are damaged by the new construction.
- B. All work that requires disruption of the water supply must be completed first. All work that requires disruption of sanitary sewer service must be completed second.
- C. The Contractor is responsible for giving the City a 7-day notice to the project Engineer and the City prior to any water shut-downs or closures which will affect services to the City's residents. The Contractor is to coordinate water shutdowns with the City Water Department. Water valves shall only be operated by City personnel. Notice shall be given by email on the form approved by the City for shut down requests.
- D. A Drinking Water Shutdown request shall be accompanied by plans that outline what lines need to be shut down and a step by step plan of what the Contractor hopes to accomplish during the shutdown. At least 72 hours prior to any shutdown a pre-activity meeting will be required between the Contractor, the Project Inspector, the project Engineer, and the City water department. Following the pre-activity meeting the Contractor shall provide a 3-day notice to affected residents.
- E. The Contractor is responsible for giving the City and the residents a 3-day notice prior to any sewer

shut-downs or closures which will affect services to the City's residents. Notice shall be given by email on the form approved by the City for shut down requests. Shutdown request shall also be accompanied by plans that outline what lines need to be shut down, a sewer bypass plan and a step by step plan of what the Contractor hopes to accomplish during the shutdown.

- F. The Contractor is responsible for giving the City a 3-day notice prior to any storm drain shut-downs or closures which will affect the City's storm drainage system. Shutdown request shall also be accompanied by plans that outline what lines need to be taken out of service, a bypass plan and a step by step plan of what the Contractor hopes to accomplish during the shutdown.
- G. All utility equipment that is to be removed, relocated or adjusted will be marked in the field by a representative of the City and/or a representative of the respective utility company.
- H. The Contractor is responsible for ensuring all existing facilities that are to be removed, are returned to the City, or to the appropriate utility company.

1.03 ROADWAY AND LANE CLOSURES

- A. The Contractor's operations shall not cause unnecessary inconvenience to the public. The public right-of-way shall be maintained at all times unless the City authorizes interruption. The Contractor's desire to close and/or detour traffic is to be authorized through the preparation of the required plans, which will then be approved by the City's Traffic Engineer or authorized representative.
- B. The Contractor shall comply with the requirements of all applicable responsible units of government for closure of any street, road, or highway. The Contractor shall provide the required barriers, guards, lights, signs, temporary bridges, and flaggers together with informing the public of any detours and construction hazards by the most suitable means available such as local newspapers, local radio stations, etc. The Contractor shall also be responsible for compliance with additional public safety requirements that may arise during construction.
- C. Unless otherwise specified, not less than seven (7) days prior to closing, or partially closing, or reopening any street, road, or highway, the Contractor shall notify in writing, the Fire Chief, Police Chief, County Sheriff, State Highway Patrol, schools that operated school buses, or any other government official as may be appropriate.
- D. Unless otherwise specified, the Contractor shall furnish to the Engineer a written plan showing the proposed method of signing, barricading for traffic control, and safety for the street detours and closures. All temporary detours will be maintained to ensure use of public rights-of-way is provided in a safe manner. This may include dust control, grading, graveling, etc., as required by the City's project manager and this specification.
- E. Construction materials and equipment shall not be stored or parked on public streets, roads, or highways. During any material or equipment loading and/or unloading activities that may temporarily interfere with traffic, acceptable detour(s) will be provided for the duration of the activity. Any associated expense for this activity will be the responsibility of the Contractor.
- F. Excavated material, including suitable material that is intended for adjacent trench backfills or other earth backfill, shall not be stored in the public streets, roads, or highways that remain in service for

the public. Any waiver of this requirement must be obtained from the proper local authority and approved by the Engineer. All excess and unsuitable material shall be removed from the site as soon as possible. Any spillage shall be removed from roadways prior to use by the public.

- G. Roadway Access to Adjacent Properties: Maintain reasonable access from the project to all adjacent properties at all times during construction. Prior to restricting normal access from public streets to adjacent properties, notify each property owner or responsible person, at least three working days prior to the disruption, informing him of the nature of the access restriction, the approximate duration of the restriction, and the best alternative access route for that particular property.
- H. Night Work: All night work will require written approval from the Engineering Department. Lane closures, road detours, road closures, and traffic signal modifications associated with overnight construction activities will require warning signs be placed at least one week in advance of starting construction.
- I. All roadways and sidewalks shall be returned to unrestricted vehicle and pedestrian usage when construction is not underway in the work zone.

1.04 PERMITS

- A. The Contractor shall obtain permits required for the execution of the work in accordance with the Contract Documents. Copies of these permits shall be provided to the Owner.
- B. The intent of the Permit Section of the specifications is to furnish the Contractor with a preliminary list of required permits for the work under the Contract Documents. Contractor should note that additional permit requirements may exist or arise.
- C. The Contractor shall include in the cost of the Bid the cost of obtaining all necessary permits including application fees and other costs, and the costs of complying with the conditions of all permits. Any fees listed in this section are estimates for Contractor information only. The Contractor shall verify and pay all actual fees.
- D. The Owner does not guarantee the completeness of the preliminary list of permits. The absence of information does not relieve the Contractor of the responsibility of determining or verifying the extent of the permits required and of obtaining permits.
- I. The Contractor shall submit within 30 days of the Notice to Proceed a list of all permits the Contractor shall obtain indicating the agency required to grant the permit, the expected date of permit submittal, and the required date for receipt of the permit.

1.05 PRELIMINARY LIST OF PERMITS TO BE OBTAINED BY THE CONTRACTOR

- A. The following permits shall be obtained by the Contractor. Copies of these permits shall be submitted to the Project Representative and be held on-site. The Contractor shall comply with all conditions of the permit.
1. City of West Jordan Right of Way Encroachment Permit. This permit covers construction within City of West Jordan right of way.
 - a. The Contractor shall obtain the permit from the City of West Jordan Engineering Department, 7960 South 4000 West, West Jordan Utah.
 - b. City of West Jordan will waive any fees associated with this permit as the Contractor is working for the City.
 2. City of West Jordan Construction Water Meter. If water for construction is required and will be taken from a City fire hydrant, the Contractor shall obtain a hydrant meter from the City. A deposit and monthly user fee is required for the use of the meter.
 - a. The Contractor shall apply for the hydrant meter with the City of West Jordan Utility Billing Department, 8523 South Redwood Road, West Jordan Utah.
 - b. The Contractor shall obtain the meter from the City of West Jordan Water Department, 7960 South 4000 West, West Jordan Utah.
 - c. The Contractor shall be responsible to pay all fees associated with the hydrant meter. The meter must be returned undamaged to receive a refund of the deposit fee, or the Contractor shall pay to repair or replace the meter.

*** END OF SECTION ***

SECTION 01 32 16
CPM CONSTRUCTION SCHEDULE

1.01 GENERAL

- A. The project management scheduling tool "Critical Path Method," a network scheduling system commonly called CPM, shall be employed by the Contractor for cost reporting, planning, and scheduling, of all work required under the Contract Documents. All schedule reports shall be in the form of computer printouts. The Contractor may elect to use bar charts (Gantt Charts) as an onsite scheduling tool; provided, that all such bar charts shall be generated from the approved CPM network using the same computer program as used for the CPM network and reports submitted to the Engineer or Architect.

1.02 CONSTRUCTION SCHEDULE

- A. The project management scheduling tool "Critical Path Method," a network scheduling system commonly called CPM, shall be employed by the Contractor for cost reporting, planning, and scheduling, of all work required under the Contract Documents. Schedules must be submitted in both paper and soft copy format using Primavera Systems, Inc., scheduling software.
- B. Schedule Submittals:
1. Proposed Construction Schedule: Submit at Preconstruction Conference, per Section 01 33 00 entitled "Contractor Submittals". Provide a revised version of proposed construction schedule after Engineer or Architect approval.;
 2. Revised Construction Schedules: Updated revisions of the Initial Construction Schedules and network diagrams are required with each progress payment submittal.
- C. Acceptance: Schedules should be fully reviewed to ensure they comply with the schedule submission requirements before acceptance. Work on the project cannot begin until the City of West Jordan has approved the submitted schedule. When the *Preliminary Construction Schedule* network diagram and schedule reports have been accepted by the Engineer or Architect, the Contractor shall submit to the Engineer or Architect 4 copies of the network diagram.
- D. Schedule Standards: Schedules must be submitted in both paper and soft copy format. The following information is required as part of the schedule submittal for this project:
1. Each schedule report shall be prefaced with the following summary data: Project name, contractor, duration, scheduled completion date, and the date of commencement of the Work. If an updated schedule, cite the new project completion date and current project status.
 2. Paper copies of all submitted schedules must show a Critical Path in a Gantt (Bar) chart format. Individual pages shall not exceed 11-inch by 17-inch.
 3. The schedule must be created using predecessor/successor logic. Schedules shall indicate the relationship lines between the various activities.
 4. Notation on each activity arrow shall include a brief work description and a duration estimate. The duration estimate indicated for each activity shall be computed in working days, converted to calendar days, and shown on the construction schedule in calendar days, and shall represent the single best estimate considering the scope of the Work and resources planned for the activity. Limit the maximum duration of any activity to 15 days unless otherwise accepted by the Engineer.

5. All construction activities and procurement shall be indicated in a time scaled format and a calendar scale shall be shown on all sheets. Each activity arrow or node shall be plotted so that the beginning and completion dates and free float time of said activity could be determined graphically by comparison with the calendar scale. All activities shall be shown using the symbols that clearly distinguish between critical path activities, non-critical activities, and free float for each non-critical activity. All non-critical path activities shall show estimated performances time and free float time in scaled form.
 6. Schedule calendars should represent the workdays of the proposed workweek(s) and any approved non-workdays (e.g. Holidays and seasonal shutdown periods).
 7. If there is a contractual finish date, the critical path must reflect Total Float calculated from this date. Total project float is defined as the cumulative length of time activities can be delayed before they affect the finish date of the project. Float is a shared commodity between the Contractor and the Department and not for the exclusive use or financial benefit of either party. Either party has the full use of the project float until it is depleted.
- E. Schedule Format: Schedule Reports shall be prepared from the Preliminary Construction Schedule and from all subsequent Revised Construction Schedules, and shall include the following minimum data for each activity:
1. Activity Numbers or i-j Numbers.
 2. Estimated Activity Duration.
 3. Activity Description (including procurement items)
 4. Early Start Date (Calendar Dated).
 5. Early Finish Date (Calendar Dated).
 6. Late Start Date (Calendar Dated).
 7. Late Finish Date (Calendar Dated).
 8. Status (Whether Critical).
 9. Total Float for Each Activity.
 10. Free Float for Each Activity.
 11. Cost Value of Each Activity.
- F. Schedule Narrative: Provide a schedule narrative that describes:
1. The construction philosophy supporting the work outlined in the submitted schedule. Address the reasons for the sequencing of the work and describe any limited resources, potential conflicts, or any other items that may affect the project schedule.
 2. The justification for the constraints used.
 3. The approach used to apply relationships between activities, for example, all ties are based on physical relationships between work activities.
 4. The project critical path and any challenges that may arise associated with the critical path.
 5. How coordination will be handled.
- G. Schedule Updates: Updated schedules must show the following:
1. Cumulative progress reported up to the end of the current update cycle.
 2. The progress date (data date) advanced to represent the date to which progress has been recorded.
 3. Actual start and actual finish date for completed activities.
 4. Remaining duration estimates for activities in progress but not completed.
 5. Changes to the critical path and the project finish date.
 6. Changes in the scope of the project or activities. This may include updated durations, additional

- or voided activities, and changed schedule logic and schedule log notes documenting the change in project scope.
7. Suspension and resumption of work on delayed activities with log notes documenting the reason for delay.

1.03 CHANGE ORDERS

- A. Upon issuance of a Change Order or Work Directive Change, the approved change shall be reflected in the next submittal of the Revised Construction Schedule by the Contractor.

1.04 COST VALUE FOR ACTIVITIES

- A. The Contractor shall establish a cost value for each activity in its CPM network so that monthly partial payments to the Contractor can be calculated on the basis of CPM-reported work in place. All cost value items shall be correlated with the line items of the required Schedule of Values.
- B. Subject to the provisions of Article 14 of the General Conditions, all cost value reports for network activities shall be based upon the close of books as of the 20th day of each month, and the computer printout report of such cost value for activities shall be submitted to the Engineer or Architect for review and approval not later than the 25th day of each month.
- C. Where it is elsewhere provided in these Specifications that payments will be allowed for materials delivered to the site but not yet incorporated in the Work, separate pay items shall be established for such materials and for the furnishing and the installation of such items. Costs of such materials delivered to the site but not yet incorporated into the Work shall not be included in the cost value of the installation of such materials but shall be covered under a separate cost value report.

*** END OF SECTION ***

SECTION 01 33 00

CONTRACTOR SUBMITTALS

1.01 GENERAL

- A. General: Wherever submittals are required hereunder, all such submittals by the Contractor shall be submitted to the Engineer or Architect through the Project Representative at the construction site for recording and forwarding to the Engineer or Architect. A Submittal is defined as any drawing, calculation, specification, product data, samples, manuals, requests for substitutes, spare parts, photographs, survey data, record drawings, bonds, or similar items required to be submitted to the City or the Engineer or Architect under the terms of the contract.
- B. Submittals Required Within 14 Days After Notice of Intent to Award: Within 14 days after the date of receipt of the Notice to Award, the Contractor shall submit the following items to the Engineer or Architect:
1. You must deliver to the City set of Contract Documents in PDF form containing fully executed counterparts of the Agreement.
 2. You must deliver at least one set of Contract Documents in PDF form containing the original Payment Bond, Performance Bond, and Insurance Certificate as specified in the Instructions to Bidders, the General Conditions (Article 5), and the Supplementary General Conditions.

Failure to comply with these conditions within the time specified will entitle the City to consider your Bid abandoned and will annul the Notice of Award.

Within 10 days after you comply with the foregoing conditions, the City will return to you one fully executed counterpart of Contract Documents.

- C. Submittals Required Prior to Preconstruction Conference: Prior to scheduling a preconstruction conference with the City, the Contractor shall submit a Preliminary Construction Schedule with verifiable job logic, as specified in Section 01 32 16 CPM Scheduling.
- D. Submittals Required Within 7 Days After Notice to Proceed: Within 7 days after the date of commencement as stated in the Notice to Proceed, the Contractor shall submit the following items to the Engineer or Architect for review:
1. A preliminary schedule of Shop Drawings and proposed substitutes or "Or Equal" submittals.
 2. A list of all permits and licenses the Contractor shall obtain indicating the agency required to grant *the permit and the expected date of submittal for the permit and required date for receipt of the permit.*
- E. Submittals Required Within 35 Days After Agreement: The Contractor shall, within 35 days after execution of the Agreement, submit to the Engineer or Architect all proposed Substitutes or "Or Equal" products for the Engineer or Architect's review and approval. All such submittals shall be in

conformance with the requirements of Paragraph 1.04, herein.

- F. The Contractor hereby agrees that failure to submit alternative product requests within the stipulated time period shall act as a waiver of any future rights to offer such substitutes, and the Contractor hereby agrees to provide one of the specific products called for in the Contract Documents.
- G. Submittals Required Prior to Final Payment: Prior to submitting final payment, the Contractor shall submit the following items to the Engineer or Architect for review:
 - 1. Written guarantees or warranties, where required
 - 2. Completed final Record Drawings
 - 3. Certificates of inspection and acceptance by local governing agencies having jurisdiction
 - 4. Releases executed by property owners adjacent to the project site attesting that the Contractor has restored any damage done to their property during construction.
 - 5. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

1.02 SHOP DRAWINGS

- A. Wherever called for in the Contract Documents, or where required by the Engineer or Architect, the Contractor shall furnish to the Engineer or Architect for review, one copy of each shop drawing submittal in PDF format. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication and installation drawings, erection drawings, lists, graphs, operating instruction, catalog sheets, data sheets, and similar items. Unless otherwise required, said Shop Drawings shall be submitted to the Engineer or Architect, through the Project Representative, at a time sufficiently early to allow review of it by the Engineer or Architect, and to accommodate the rate of construction progress required under the Contract.
- B. All Shop Drawings shall be accompanied by the Engineer or Architect's standard submittal transmittal form. Any submittal not accompanied by such a form, or where all applicable items on the form are completed, will be returned for resubmittal.
- C. Normally, a separate transmittal form shall be used for each specific items or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole. A multiple-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the Engineer or Architect.
- D. Except as may otherwise be provided herein, the Engineer or Architect will return PDF format of each submittal to the Contractor through the Project Representative, with its comments noted thereon, within 21 calendar days following their receipt by the Engineer or Architect. It is considered reasonable that the Contractor shall make a complete and acceptable submittal to the

Engineer or Architect by the second submission of a submittal item. The City reserves the right to withhold monies due the Contractor to cover additional cost of the Engineer or Architect's review beyond the second submittal.

- E. If a submittal is returned to the Contractor marked "APPROVED" or "ACCEPTED" or "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required,
- F. If a submittal is returned to the Contractor marked "AMEND-RESUBMIT," the Contractor shall revise said submittal and shall resubmit one PDF copy of said revised submittal to the Engineer or Architect.
- G. If a submittal is returned to the Contractor marked "REJECTED-RESUBMIT," the Contractor shall revise said submittal and shall resubmit one PDF copy of said revised submittal to the Engineer or Architect.
- H. Fabrication of an item may be commenced only after the Engineer or Architect has reviewed the pertinent submittals and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "APPROVED" or "ACCEPTED" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.
- I. All Contractor submittals shall be carefully reviewed by an authorized representative of the Contractor, prior to submittal to the Engineer or Architect, through the Project Representative. Each submittal shall be dated, signed, and certified by the Contractor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the Engineer or Architect of any Contractor submittals will be made for any items, which have not been so certified by the Contractor. All non-certified submittals will be returned to the Contractor without action taken by the Engineer or Architect, and any delays caused thereby shall be the total responsibility of the Contractor.
- J. The Engineer or Architect's review of Contractor submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in Contractor submittals. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.

1.03 CONTRACTOR'S SCHEDULES

- A. A Contractor's construction schedules shall be prepared and submitted to the Engineer or Architect in accordance with the provisions of Section 01 32 16 "CPM Construction Schedules" and Section 01 71 13 Mobilization.

1.04 PROPOSED SUBSTITUTES OR "OR EQUAL" ITEMS

- A. For convenience in designation in the Contract Documents, any material, product, or equipment to be incorporated in the Work may be designated under a brand or trade name or the name of a manufacturer and its catalog information. The use of any substitute material, product, or equipment

which is equal in quality and utility and possesses the required characteristics for the purpose intended will be permitted, subject to the following requirements:

1. The burden of proof as to the quality and utility of any such substitute material, product, or equipment shall be upon the Contractor.
 2. The Engineer or Architect will be the sole judge as to the quality and utility of any such substitute material, product, or equipment and its decision shall be final.
- B. Wherever in the Contract Documents the name or the name and address of a manufacturer or Supplier is given for a material, product, or equipment, or if any other source of a material, product, or equipment is indicated therefore, such information is given for the convenience of the Contractor only, and no limit, restriction, or direction is indicated or intended thereby, nor is the accuracy or reliability of such information guaranteed. It shall be the responsibility of the Contractor to determine the accurate identity and location of any such manufacturer, Supplier, or other source of any material, product, or equipment called for in the Contract Documents.
- C. The Contractor may offer any material, product, or equipment which it considers equal to those specified. Unless otherwise provided by law or authorized in writing by the Engineer or Architect, the substantiation of any proposed substitute or "or-equal" material, product, or equipment must be submitted within 35 days after the execution of the Agreement. The Contractor, at its sole expense, shall furnish data concerning items it has offered as substitute or "or-equal" to those specified. The Contractor shall provide the data required by the Engineer or Architect to determine that the quality, strength, physical, chemical, or other characteristics, including durability, finish, efficiency, dimensions, service, and suitability are such that the substitute or "or-equal" item will fulfill its intended function.
- D. The Contractor's attention is further directed to the requirement that its failure to submit data substantiating a request for a substitution of an "or equal" item within said 35-day period shall be deemed to mean that the Contractor intends to furnish one of the specific brand or trade-named material, product, or equipment specified in the Contract Documents and the Contractor does hereby waive all rights to offer or use substitute materials, products, or equipment in each such case. Wherever a proposed substitute material, product, or equipment has not been submitted within said 35-day period, or wherever the submission of a proposed substitute materials, product, or equipment fails to meet the requirements of the Specifications and an acceptable resubmittal is not received by the Engineer or Architect within said 35-day period, the Contractor shall furnish only one of the materials, products, or equipment originally-named in the Contract Documents. Approval by the Engineer or Architect of a substitute item proposed by the Contractor shall not relieve Contractor of the responsibility for full compliance with the Contract Documents and for adequacy of the substituted item. The Contractor shall also be responsible for resultant changes and all additional costs which the substitution requires in its work, the work of its subcontractors and of other contractors and shall effect such changes without cost to City.

1.05 SUBMITTALS REQUIRING REVIEW OR ACTION

- A. Use the following list to identify CONTRACTOR's need dates and ENGINEER's action dates.

When Due	Section Reference	Submittal
Pre-construction conference	01 33 00	Submittal Register
Pre-construction conference	01 33 00	Preliminary Progress Schedule
Prior to Starting Work	01 57 00	Storm Water Pollution Prevention Plan
Prior to Starting Work	01 33 00	Permits for Work
Prior to Starting Work	01 55 26	Traffic Control Plan
Prior to Use	31 05 13	Top Soil Supplier and Source Data
Prior to Use	32 12 13	Equipment Calibration Test Data
Prior to Delivery On Site	31 05 13	Common Fill
Prior to Delivery On Site	32 11 23	Select Fill Mix Design
Prior to Delivery On Site	32 12 05	Asphalt Concrete Mix Design Supplier's Mix
Prior to Delivery On Site	03 30 04	Portland Cement Concrete Source Data and Supplier's Mix
Prior to Delivery On Site	33 11 00	Water System Product Data
Prior to Delivery On Site	33 31 00	Sanitary Sewer System Product Data
Prior to Delivery On Site	33 41 00	Storm Water System Product Data
Upon Delivery to Site	32 12 16	Asphalt Concrete Batch Delivery Ticket
Upon Delivery to Site	03 30 10	Portland Cement Concrete Batch Delivery Ticket
Prior to Water Line Use	33 12 19	Water System Disinfection Report
Prior to System Use	33 08 00	Pipeline Commissioning
Prior to 1st Concrete Placement	03 30 10	Name, Certification Number and renewal date for all ACI Certified Finishers
Prior to 1st Concrete Placement	03 30 10	Portland Cement Concrete Curing Compound Source, Type, and Data
Daily as applicable	03 30 04 03 30 10	Portland Cement Concrete Quality Control Test Reports
Daily as applicable	32 01 13	Daily Quantity Log Reports
With Each Monthly Pay Request	01 32 16	Progress Schedule
5 Working Days Prior to Substantial Completion	01 78 50	Certification of Compliance and Request for Final Inspection
Prior to Final Payment	01 78 50	Evidence of Payment to Suppliers and Subcontractors
Prior to Final Payment	01 78 50	Redlines – Record drawings
Prior to Final Payment	01 78 50	Operational and Maintenance Manuals

When Due	Section Reference	Submittal
Prior to Final Payment	01 78 50	Water Line Commissioning Test Reports

NOTES:

1. Section references listed in this table but not found in the Project Manual may be found in the APWA Standard Specifications.

1.06 SAMPLES

- A. Unless otherwise specified, whenever in the Specifications samples are required, the Contractor shall submit not less than 3 units of each such sample item or material to the Engineer or Architect for approval at no additional cost to the City.
- B. Samples, as required herein, shall be submitted for approval a minimum of 21 days prior to ordering such material for delivery to the job-site, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the Work.
- C. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and manufacturer's names for identification and submittal to the Engineer or Architect for approval, through the Project Representative. Upon receiving approval of the Engineer or Architect, one set of the samples will be stamped and dated by the Engineer or Architect and returned to the Contractor through the Project Representative, one set will be retained by the Engineer or Architect, and one set of samples shall remain at the job site for reference by the Engineer or Architect and the Project Representative until completion of the Work.
- D. Unless otherwise specified, all colors and textures of specified items will be selected by the Engineer or Architect from the manufacturer's standard colors and standard materials, products, or equipment lines.

1.09 RECORD DRAWINGS

- A. General: The Contractor shall keep and maintain, at the job site, one record set of Contract Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction.
- B. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully, the Work as actually constructed.
- C. These master record drawings of the Contractor's representation of "as-built" conditions, including all revisions made necessary by addenda, change orders, and the like shall be maintained up-to-date

during the progress of the Work.

- D. In the case of those drawings which depict the detail requirement for equipment to be assembled and wired in the factory, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.
- E. Record drawings prepared by the Contractor shall be accessible to the Engineer or Architect at all times during the construction period and shall be delivered to the Engineer or Architect upon completion of the work.
- F. Effect on Progress Payments: Requests for partial payments will not be approved if the record drawings are not kept current. All such Record Drawings will be inspected by the Engineer or Architect each month, showing all variations between the Work as actually constructed and as originally shown on the Contract Drawings or other Contract Documents, and the City will not process monthly payment requests until such drawings are made current each month.
- G. Final Record Drawings: Upon substantial completion of the Work and prior to final acceptance by the City, the Contractor shall complete and deliver the completed set of Record Drawings to the Engineer or Architect for transmittal to the City, conforming to the construction records of the Contractor. This set of drawings shall consist of corrected plans showing the reported location of the Work. The information submitted by the Contractor and incorporated by the Engineer or Architect into the Record Drawings will be assumed to be reliable, and the Engineer or Architect will not be responsible for the accuracy of such information, nor for any errors or omissions, which may appear on the Record Drawings as a result.
- H. Effect on Final Payment: Final payment will not be approved until the Contractor- prepared Final Record Drawings have been delivered to the Engineer or Architect. Said up-to-date, Record Drawings may be in the form of a set of prints with carefully plotted information overlaid in pencil.

1.10 SHEETING, SHORING, BRACING, OR SLOPING OF EXCAVATIONS

- A. Prior to commencement of any excavation, 5 feet or greater in depth, the Contractor shall submit to the City or its Engineer or Architect, a detailed plan showing the design of sheeting, shoring, bracing, sloping, or equivalent method and shall be in receipt of the City's acceptance of same.

*** END OF SECTION ***

**SECTION 01 42 13
ABBREVIATIONS**

1.01 GENERAL

- A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user these specifications, the following acronyms or abbreviations, which may appear in these specifications, shall have the meanings indicated herein.

INSTRUCTIONS TO SPECIFIER

Delete all abbreviations or acronyms not actually referred to in the project specifications.

1.02 ABBREVIATIONS AND ACRONYMS

AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Assn of Textile Chemists and Colorists
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Assn., Inc.
AGA	American Gas Association
AGC	Associated General Contractors
AGMA	American Gear Manufacturer's Association
AHAM	Association of Home Appliance Manufacturer's
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ASA	Acoustical Society of America
ASAE	American Society of Agriculture Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASLE	American Society of Lubricating Engineers

ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CBM	Certified Ballast Manufacturer's
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CLPCA	California Lathing & Plastering Contractors Assn
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drill Manufacturer's Association
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IME	Institute of Makers of Explosives
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association
MPTA	Mechanical Power Transmission of Association
MTI	Marine Testing Institute
NAAM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NCCLS	National Committee for Clinical Laboratory Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NGLI	National Lubricating Grease Institute
NMA	National Microfilm Association
NWMA	National Woodwork Manufacturer's Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
RIS	Redwood Inspection Service

RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Maker Association
SIS	Swedish Standards Association
SMA	Screen Manufacturer's Association
SMACCN	Sheet Metal and Air Conditioning Contractors National Association
SPR	Simplified Practice Recommendation
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
TAPPI	Technical Assn of the Pulp and Paper Industry
TFI	The Fertilizer Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

*** END OF SECTION ***

SECTION 01 42 19
REFERENCE STANDARDS

1.01 GENERAL

- A. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.
- B. Applicable Publications: Whenever in these specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the drawings shall be waived because of any provision of, or omission from, said standards or requirements.
- C. Specialists, Assignments: In certain instances, specifications test requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the Contractor.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the general provisions of other portions of the specifications, all work specified herein shall conform to or exceed the requirements of all applicable codes and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of these Specifications nor the applicable codes.
- B. References herein to codes shall mean the following listed codes, as adopted by City of West Jordan, including all addenda, modifications, amendments, or other lawful changes thereto:
 - 1. 2015 International Building Code
 - 2. 2015 International Residential Code
 - 3. 2015 International Mechanical Code
 - 4. 2015 International Plumbing Code
 - 5. 2015 International Fire Code
 - 6. National Electric Code, 2014 Edition, as Published by the National Fire Protection Association (NFPA)
- C. In case of conflict between codes, reference standards, drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the

Engineer or Architect for clarification and directions prior to ordering or providing any materials or labor. The Contractor shall bid the most stringent requirements.

- D. Applicable Standard Specifications: The contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed herein; except, that whenever references to "Standard Specifications" are made, the provisions therein for measurement and payment shall not apply.
- E. References in the Contract Documents to "Standard Specifications" shall mean the Manual of Standard Specifications for Public Works Construction (" APWA Orange Book"), 2017 Edition including all current supplements, addenda, and revisions thereof.
- F. Applicable Standard Drawings: References herein to "Standard Drawings" shall mean the Standard Drawings of the City of West Jordan which drawings are hereby incorporated in and made a part of these Contract Documents, and copies of which are included in Appendix A herein.
- G. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

*** END OF SECTION ***

SECTION 01 45 00
QUALITY CONTROL AND MATERIALS TESTING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section outlines responsibilities for controlling quality of materials, products and workmanship.

1.2 MATERIALS

- A. All materials incorporated in the project shall be new and shall fully comply with the specifications. Unless otherwise clearly provided in the specifications, all workmanship, equipment, materials, and articles incorporated in the work covered by the contract are to be of the best available grade of their respective kinds. Whenever, in the specifications, any material, article, device, product, fixture, form, type of construction, or process indicated or specified by patent or proprietary name, by name of manufacturer, or by catalog number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the material or process desired and shall be deemed to be followed by the words "or approved equal" and CONTRACTOR may in such case, upon receiving the ENGINEER's approval, purchase and use any item, type, or process which shall be substantially equal in every respect to that indicated or specified.
- B. Materials and equipment may be used in the Work based upon receipt of a Supplier's certificate of compliance. Certificate must be in possession of CONTRACTOR and reviewed by ENGINEER prior to use.
- C. Quality Assurance Testing by the OWNER and/or ENGINEER shall not relieve CONTRACTOR of responsibility to furnish materials and work in full compliance with Contract Documents.

1.3 MANUFACTURER'S INSTRUCTIONS

- A. Should instructions conflict with Contract Documents, request clarification before proceeding.
- B. When required in individual sections, submit manufacturer's instructions in the quantity required for product data, delivery, handling, storage, assembly, installation, start-up, adjusting, balancing, and finishing, as appropriate.

1.4 WORKMANSHIP

- A. Maintain performance control and supervision over Subcontractors, Suppliers, manufacturers, products, services, workmanship, and site conditions, to produce work in accordance with Contract Documents.
- B. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

- C. Provide suitable qualified personnel to produce specified quality.
- D. Ensure finishes match approved samples.

1.5 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.6 TESTING AND INSPECTION SERVICES

- A. Testing agency and testing for quality control and material testing shall be furnished by CONTRACTOR as part of the project. Results of testing shall be reported to CONTRACTOR and ENGINEER on site. Reports of the testing shall be transmitted directly to the ENGINEER.
- B. Materials to be supplied under this contract will be tested and/or inspected either at their place of origin or at the site of the work by the testing agency. CONTRACTOR shall give ENGINEER written notification well in advance of actual readiness of materials to be tested and/or inspected at point of origin so ENGINEER may witness testing by the testing agency. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the material nor shall it preclude retesting or reinspection at the site of the work.
- C. CONTRACTOR shall furnish such samples of materials as are requested by the ENGINEER, without charge. No material shall be used until reports from the testing agency have been reviewed and accepted by the ENGINEER. See Section 01 33 00, Submittal Procedures.

1.7 UNSATISFACTORY CONDITIONS

- A. Examine areas and conditions under which materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

1.8 AUTHORITY AND DUTIES OF PROJECT REPRESENTATIVE

- A. Refer to Section 00 80 00 "Supplementary Conditions" sub-section SC 9.3 "Project Representation".

1.9 QUALITY CONTROL TESTING

- A. ENGINEER's failure to detect any defective Work or materials does not prevent later rejection when such defect is discovered nor does it obligate ENGINEER to accept the Work in question.

- B. CONTRACTOR shall provide 24-hours minimum notice to ENGINEER for all testing required by these specifications so that ENGINEER may coordinate or be present during testing.

1.10 TESTING ACCEPTANCE AND FREQUENCY

- A. Minimum Quality Control Testing Frequency: As defined in Table 01 45 00-1, the CONTRACTOR shall be responsible to ensure that all testing is performed at the frequencies shown. CONTRACTOR shall uncover any work at no cost to OWNER to allow the testing agency to perform required testing at the frequency shown.
- B. Acceptance of Defective Work: As defined in Article 13.08 of the General Conditions.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

TABLE 01 45 00-1: QUALITY CONTROL TESTING FREQUENCY

SYSTEM or MATERIAL	TESTS	MINIMUM REQUIRED FREQUENCY
SUBGRADE AND BACKFILL MATERIALS		
Section 31 23 15 Excavation and Backfill for Buried Pipelines	Field Density	1 test per 200 linear feet per 1.5 feet of backfill thickness placed.
	Laboratory	1 test for each material type which includes proctor, classification and gradation.
Section 31 23 23 Excavation and Backfill for Structures	Field Density	1 test per 200 linear feet per 1.5 feet of backfill thickness placed.
	Laboratory	1 test for each material type which includes proctor, classification and gradation.
Section 32 11 23 Road Base - Untreated Base Course	Field Density	Base course subgrade: 1 test per 2,000 square feet of area. Base course: 1 test per 2,000 square feet of area.
	Laboratory	Base course: 1 test for each material type which includes proctor, classification and gradation.
ASPHALT		
Section 32 12 16 Hot-Mix Asphalt Concrete Paving	Mix Design	Marshall Test Method: 1 test initially per each type of material and each change in target, and for each day of production thereafter. Specific Gravity: 1 per each Marshall Test Extraction: 1 test per each Marshall Test
	Field Density	Bituminous surfaces: 1 test per 2,000 square feet placed or part thereof.
	Asphalt Thickness and Core Density	Bituminous surfaces: 1 test sample every 300 linear feet of completed roadway.
PORTLAND CEMENT CONCRETE		
Section 03 30 00 Cast-in-Place Concrete	Slump	1 test every day of placement (if less than 100 cubic yards in a day), 1 test for every 100 cubic yards, or 1 test for each 3,000 square feet of surface area for slabs and more frequently if batching appears inconsistent.
	Entrained air	1 test with slump test.
	Ambient and concrete temperatures	1 test with slump test.
	Water cement ratio.	to be verified and provided with batch tickets.
	Compressive strength	1 set of 5 cylinders. 1 test every day of placement (if less than 100 cubic yards in a day), 1 test for every 100 cubic yards, or 1 test for each 3,000 square feet of surface area for slabs, and more frequently if batching appears inconsistent.

NOTES:	
1	Additional tests shall be conducted when variations occur due to the contractor's operations, weather conditions, site conditions, etc.
2	Classification, moisture content, Atterberg limits and specific gravity tests shall be conducted for each compaction test if applicable.
3	Tests can substitute for same tests required under "Aggregates" (from bins or source), although gradations will be required when blending aggregates.
4	Aggregate moisture tests are to be conducted in conjunction with concrete strength tests for water/cement calculations.

- END OF SECTION -

SECTION 01 45 23
TESTING AGENCY SERVICES

PART 1 GENERAL

1.1 SUMMARY

- A. CONTRACTOR shall be responsible for providing Construction Quality Control Testing of all soils, concrete, etc. as required by the various sections of these Specifications. This section includes the following:
1. Use of independent testing agency
 2. Control testing report submittal requirements
 3. Responsibilities of testing agency

1.2 RELATED WORK

- A. Related work specified in other sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 01 22 00 Measurement and Payment

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM D 3740 Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 2. ASTM D 4561 Standard Practice for Quality Control Systems for Organizations Producing and Applying Bituminous Paving Materials
 3. ASTM E 329 Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.4 DEFINITIONS

- A. Independent Testing Agency: A testing agency NOT owned by CONTRACTOR, and an agency that does not have any preferential affiliation or association with CONTRACTOR, or any of CONTRACTOR's Subcontractors and Suppliers other than entering into a contract with CONTRACTOR to perform the duties defined in these Specifications.
- B. Professional Engineer: An engineer who complies with Utah licensing law and is acceptable to the authority having jurisdiction.

1.5 **QUALITY ASSURANCE**

- A. CONTRACTOR shall employ and pay for services of an independent testing agency which complies with ASTM D 3740, ASTM D 4561, and ASTM E 329 to test materials for contract compliance.
- B. Concrete Technician: Approved by ENGINEER or ACI certified.
- C. Person charged with engineering managerial responsibility
- D. Professional engineer on staff to review services
- E. Level of certification of technicians

1.6 **CONTRACTOR SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures
- B. If the CONTRACTOR is employing and paying for an independent testing agency, prior to start of Work, submit testing agency's name, address, telephone number and the following:
 - 1. Person charged with engineering managerial responsibility
 - 2. Professional engineer on staff to review services
 - 3. Level of certification of technicians

1.7 **TESTING AGENCY SUBMITTALS**

- A. Field Test Report: Submit report no later than the end of the current day.
- B. Laboratory Test Report: Submit original report within 48 hours after test results are determined.
- C. Final Summary Report: Submit prior to final payment
- D. On all reports include:
 - 1. Project title, number and date of the report
 - 2. Date, time and location of test
 - 3. Name and address of material Supplier
 - 4. Identification of product being tested and type of test performed
 - 5. Identify whether test is initial test or retest
 - 6. Results of testing and interpretation of results
 - 7. Name of technician who performed the testing

1.8 **RESPONSIBILITIES OF TESTING AGENCY**

- A. Calibrate testing equipment at least annually with devices with an accuracy traceable to either National Bureau of Standards or acceptable values of natural physical constraints.
- B. Provide sufficient personnel at site and cooperate with CONTRACTOR, ENGINEER and OWNER's Representative in performance of testing service.

- C. Secure samples using procedures specified in the applicable testing code.
- D. Perform testing of products in accordance with applicable sections of the Contract Documents.
- E. Immediately report any compliance or noncompliance of materials and mixes to CONTRACTOR, ENGINEER, and OWNER's Representative.
- F. When an out-of-tolerance condition exists, perform additional inspections and testing until the specified tolerance is attained, and identify retesting on test reports.

1.9 LIMITS ON TESTING AGENCY AUTHORITY

- A. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Agency may not suspend Work.
- C. Agency has no authority to accept Work for OWNER.

1.10 MEASUREMENT AND PAYMENT

- A. Testing agency services shall be measured or paid in one lump sum, as provided in the Bid Schedule.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 50 30
PROTECTION OF EXISTING FACILITIES

PART 1 GENERAL

1.1 DESCRIPTION

- A. Any existing facilities, disturbed which are located in or adjacent to the line of work such as curbs, gutters, drive approaches, sidewalks, driveways, fences, underground pipes, conduits, or utilities, shall be cleaned up and restored in kind by CONTRACTOR and in accordance with the Specifications contained herein governing the various types of services involved.
- B. CONTRACTOR shall not perform work that would affect any oil, gas, sewer, or water pipeline; any telephone, fiber optic, television cable, or electric transmission line; any fence; or any structure, until authorization has been obtained from OWNER of the improvement. Provide OWNER of the improvement due notice of the beginning of the work, and remove, shore, support, or otherwise protect such improvement or replace the same.

1.2 RELATED WORK

- A. Related work specified in other sections includes, but is not limited to:

Section 01 78 50 Project Closeout

1.3 RESTORATION OF FENCES

- A. Where it is necessary to remove any fence to facilitate CONTRACTOR's operation, CONTRACTOR shall obtain prior agreement with OWNER for removal of the fence, and shall be responsible for any damage due to negligence of CONTRACTOR. As soon as practical, the fence shall be restored substantially to the same or improved condition as it was prior to the commencement of the work. Where livestock is present CONTRACTOR shall provide temporary fencing to keep livestock away from the construction area.

1.4 UNDERGROUND SERVICE ALERT

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, CONTRACTOR shall notify the regional notification center (Blue Stakes of Utah) at 1-800-662-4111 or 811 or submit an on-line request at www.bluestakes.org at least 2 days, but no more than 7 days, prior to such excavation.

1.5 INTERFERING STRUCTURES AND UTILITIES

- A. CONTRACTOR shall exercise all possible caution to prevent damage to existing structures and utilities, whether above ground or underground. Prior to submittal of Shop Drawings, and prior to commencing any excavations for new pipelines or structures, conduct investigations, including exploratory excavations and borings, to determine the location and type of underground utilities and services connections that could result in

damage to such utilities. It shall be the responsibility of CONTRACTOR to locate and expose all existing underground and overhead structures and utilities in such a manner as to prevent damage to same. CONTRACTOR shall notify all utility offices concerned at least 48 hours in advance of construction operations in which a utility agency's facilities may be involved. This shall include, but not be limited to, irrigation water, culinary water, telephone, television cables, fiber optic communication, gas, and electric. CONTRACTOR shall be responsible for any and all changes to, reconnections to public utility facilities encountered or interrupted during prosecution of the work, and all costs relating hereto shall be at CONTRACTOR's expense. CONTRACTOR shall contract with and pay Public Utility Agencies for work required in connection with all utility interferences and handle all necessary notifications, scheduling, coordination, and details. The cost of public utility interferences shall be included in CONTRACTOR's lump sum or unit price bid covering the major contract facility to which interference or changes are attributable.

- B. All exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of the construction to avoid possible delays to CONTRACTOR's progress. Prepare a report identifying each utility by its size, elevation, station and material of construction. Immediately notify ENGINEER and the utility in writing as to any utility discovered in a different position than as marked in the field or shown on the Drawings, or any utility which is not marked in the field or not shown on the Drawings.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility. Conform to local agency requirements for backfill and pavement repair subsequent to performing exploratory excavations.
- D. Any damages to private property, either inside or outside the limits of the easements provided by OWNER, shall be the responsibility of CONTRACTOR. Any roads, structures, or utilities damaged by the work shall be repaired or replaced in a condition equal to or better than the condition prior to the damage. Such repair or replacement shall be accomplished at CONTRACTOR's expense without additional compensation from OWNER.
- E. CONTRACTOR shall remove and replace small miscellaneous structures such as fences and culverts which are damaged by the construction activity at his own expense without additional compensation from OWNER. CONTRACTOR shall replace these structures in a condition as good as or better than their original condition.
- F. At points where CONTRACTOR's operations are adjacent to or across properties of railway, telegraph, telephone, irrigation canal, power, gas, water, or adjacent to other property (damage to which might result in considerable expense, loss, and inconvenience), no work shall be started until all arrangements necessary for the protection thereof have been made.
- G. The locations of the major existing culinary water lines, gas pipes, underground electric, cable television, and telephone lines that are shown on the plans were taken from city maps, and maps supplied by the utility owner. No excavations were made to verify the locations shown for underground utilities, unless specifically stated on the Drawings. It should be expected that some location discrepancies will occur. Neither OWNER nor its officers or agents shall be responsible for damages to CONTRACTOR as a result of the locations of the utilities being other than those shown on the plans or for the existence of utilities not shown on the plans.

- H. CONTRACTOR shall be solely and directly responsible to OWNERS and operators of such properties for any damage, injury, expense, loss or inconvenience, delay, suits, actions, or claims of any character brought because of an injury or damage which may result from the carrying out of the work to be done under the contract.
- I. All utilities including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities encountered along the line of the work shall remain continuously in service during all operations under the Contract, unless other arrangements satisfactory to ENGINEER are made with OWNER of said utility.
- J. In the event of interruption to either domestic or irrigation water, or to other utility services as a result of accidental breakage, or as a result of being exposed or unsupported, CONTRACTOR shall promptly notify the proper authority. CONTRACTOR shall cooperate with the authority in restoration of service as soon as possible, and shall not allow interruption of any water or utility service outside working hours unless prior approval is received.
- K. In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of CONTRACTOR, be notified by OWNER to move such property within a specified reasonable time. When utility lines that are to be moved are encountered within the area of operations, CONTRACTOR shall notify ENGINEER a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.
- L. Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such Utility or improvement in a manner satisfactory to ENGINEER and OWNER of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by CONTRACTOR in a manner that will restore or replace the Utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

1.6 RIGHTS-OF-WAY

- A. CONTRACTOR shall be required to confine construction operations within the dedicated rights-of-way for public thorough fares, or within areas for which construction easements have been obtained, unless they have made special arrangements with the affected property owners in advance. CONTRACTOR shall be required to protect stored materials, cultivated trees and crops, and other items adjacent to the proposed construction site.
- B. CONTRACTOR shall submit for approval by ENGINEER the type and size of equipment used, and the methods for work performed on the rights-of-way across private properties, to avoid or minimize injury to trees, shrubs, gardens, lawns, fences, driveways, retaining walls, or other improvements within the rights-of-way.
- C. The construction easement widths and access to private properties are as shown on the Drawings and as described in the easement documents; however CONTRACTOR is to minimize impacts to surface improvements within the right-of-way. CONTRACTOR shall obtain a signed release from the property owner, approving restoration of work in the

construction easements across or bordering private properties. See Project Closeout Section 01 78 50, 1.4.D.

- D. Property owners affected by the construction shall be notified by CONTRACTOR at least 48 hours in advance of the time the construction begins. During all construction operations, CONTRACTOR shall construct and maintain such facilities as may be required to provide access by all property owners to their property. No person shall be cut off from access to his property for a period exceeding 8 hours unless CONTRACTOR has made special arrangements with the affected persons. CONTRACTOR shall, daily or more frequently if necessary, grade all disturbed areas to be smooth for motor vehicle traffic.

1.7 PROTECTION OF SURVEY, STREET OR ROADWAY MARKERS

- A. CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed by CONTRACTOR shall be accurately restored after street or roadway resurfacing has been completed.

1.8 TREES OR SHRUBS WITHIN PROJECT LIMITS

- A. Except where trees or shrubs are indicated to be removed, CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or OWNER. Existing trees and shrubs which are damaged during construction shall be trimmed or replaced by CONTRACTOR or a certified tree company under permit from the jurisdictional agency and/or OWNER. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.
 - 1. Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosenes, coal tar, creosote, or other material injurious to the life of the tree.
 - 2. CONTRACTOR shall immediately notify the jurisdictional agency and/or OWNER if any tree or shrub is damaged by CONTRACTOR's operations. If, in the opinion of said agency or OWNER, the damage is such that replacement is necessary, CONTRACTOR shall replace the tree or shrub at its own expense. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a smaller size, CONTRACTOR shall pay to OWNER of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or OWNER. The size of the tree or shrub shall be not less than 1-inch diameter nor less than 6 feet in height.

1.9 RESTORATION OF PAVEMENT

- A. Pavement work shall meet the specifications for installation as noted in APWA Section 33 12 16.

- B. All paved areas damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract or in the requirements of the agency issuing the permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement. Pavements which are subject to partial removal shall be neatly sawcut in straight lines.
- C. Wherever required by the local agency having jurisdiction, CONTRACTOR shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

1.10 CONCRETE WORK

- A. Concrete work shall meet the specifications for installation as noted in APWA Section 32 16 13 Driveway, Sidewalk, Curb and Gutter.
- B. All flat work in streets tying into existing flatwork shall be doweled into the existing concrete. Dowels to be spaced at 12" O.C. and be No. 5 rebar x 14" for slabs up to 8 inches in thickness and No. 8 rebar x 18" for slabs over 8 inches.

1.11 LAWNS

- A. Lawns that are damaged or destroyed during performance of the work shall be repaired or replaced with turf sod according to APWA Section 32 92 00 - Turf and Grass.

1.12 FENCES

- A. Fences that are damaged or destroyed during performance of the work shall be repaired or replaced back to the original condition or better to the satisfaction of the land owner and OWNER.

1.13 LANDSCAPING

- A. All landscaping on private property that is damaged or destroyed during performance of the work shall be repaired or replaced back to the original condition or better to the satisfaction of the land owner and OWNER.

1.14 OTHER SURFACE IMPROVEMENTS

- A. All other surface improvements not explicitly mentioned herein that are damaged or destroyed during performance of the work shall be repaired or replaced back to original condition or better.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 55 26

TRAFFIC CONTROL

PART 1 -- GENERAL

1.01 SCOPE OF WORK

- A. General. The work shall consist of establishing traffic control and maintaining safe, convenient use of public roads and rights-of-way.
- B. This section covers Traffic Control Plan requirements and materials and labor necessary for its implementation.
- C. It includes issues related to Traffic Control Maintainer and flagging, work zone traffic control devices, advance warning arrow panels and pilot cars.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 32 01 05 – Informational, Regulatory, and Warning Signs.
- B. Section 32 17 23 – Pavement Markings.

1.03 REFERENCES

- A. AASHTO Roadside Design Guide, current edition.
- B. Utah Manual of Uniform Traffic Control Devices (Utah MUTCD), current edition.
- C. ATSSA: American Traffic Safety Services Association. Quality Standards for Work Zone Traffic Control Devices.
- D. Americans with Disabilities Act (ADA)
- E. NCHRR – Report 350: Recommended Procedures for the Safety Performance Evaluation of Highway Features.
- F. OSHA Construction Industry Standards (29 CFR Part 1926), Subpart G, Signs, Signals, and Barricades.

1.04 SUBMITTALS

- A. Submit traffic control plan in accordance with the Special Conditions and UDOT State Specifications. The Contractor shall be responsible for the preparation and adequacy of any traffic control plan utilized, including this suggested plan, and shall submit the final traffic control plan (prepared, signed and sealed by a certified traffic control technician) in drawing form to the Engineering inspector.
- B. Submit to the Engineering inspector a detailed signing and traffic detouring plan in drawing form for each phase for approval. Post detour routes to provide clear guidance to traffic as approved by the Engineering inspector.
- D. Traffic Control Inspection forms.
- E. Submit plans to the Engineer 10 working days before the Traffic Control Plan is to be implemented. Do not begin work until the Traffic Control Plan is authorized for use and has been fully implemented.

1.05 GENERAL

- A. Control traffic at those locations indicated and in conformance with the plans approved by the Engineering inspector.
- B. Furnish, install, construct, maintain, and remove detours, road closures, lights, temporary signals, signs, barricades, K-rail, fences, flares, miscellaneous traffic devices, flagmen, drainage facilities, paving, and such other items and services as are necessary to adequately safeguard the public from hazard and inconvenience. All such work shall comply with the ordinances, directives, and regulations of authorities with jurisdiction over the public roads in which the construction takes place and over which detoured traffic is routed by the Contractor.
- C. After devices have been installed, maintain and keep them in good repair and working order until no longer required. Replace such devices that are lost or damaged, to such an extent as to require replacement, regardless of the cause of such loss or damage.
- D. Prior to the start of construction operations, notify the Engineering inspector, City of West Jordan, UDOT, police and fire departments in whose jurisdiction the project lies, giving the expected starting date, completion date, and the name and telephone number of a responsible person who may be contacted at any hour in the event of a condition requiring immediate correction.

1.06 TRAFFIC CONTROL DEVICES AND SIGNS

- A. Construction signing, striping, barricades, and other traffic control devices used for handling traffic and public convenience shall conform to the latest edition of the Federal Highway Administration "Manual on Uniform Traffic Control Devices for Streets and Highways" (MUTCD).
- B. Signs shall be reflectorized when they are used during hours of darkness. Provide cones, pylons, barricades, or posts used in the diversion of traffic with flashers or other illumination if in place during hours of darkness.
- C. Maintain a 24-hour emergency service to remove, install, relocate, and maintain warning devices and furnish to the authority having jurisdiction names and telephone numbers of three persons responsible for this emergency service. In the event these persons do not promptly respond or the authority having jurisdiction deems it necessary to call out other forces to accomplish emergency service, the Contractor will be held responsible for the cost of such emergency service.
- D. During the duration of a detour, cover all signs not in accordance with the traffic control plan. Relocate existing signs to provide visibility from all relocated traffic lanes.
- E. Temporary traffic striping, where used, shall be removable pavement marking tape. Pavement markings shall be white or yellow, weather and traffic resistant reflective film on conformable backing and pre-coated with a pressure-sensitive adhesive that does not require an activation process.

Temporary pavement markings shall conform to the following minimum reflective values as specified. Express reflective values as candlepower per foot-candle per square foot measured on a 1 foot by 2 foot panel at 86 degrees incidence.

Divergence Angle	White	Yellow
0.20	0.20	0.18

0.50	0.18	0.16
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Supply striping tape in rolls ready for application. Use pavement message tape 20 to 30 mils thick, that does not shrink or release prematurely, and that has an easily removable liner.

- F. At the end of each workday, place temporary pavement markers on any roadway surfaces open to traffic. Apply pavement markers to a clean and dry surface during daylight hours. During winter shutdown, place permanent paint striping and pavement messages.
- G. Press the tape into the surface until it adheres to the pavement surface.

1.07 VEHICULAR TRAFFIC CONTROL

- A. Reduce speed limit through the construction zone to 25 mph and post accordingly.
- B. Traffic lane transitions from permanent lanes to construction zone patterns shall be transitioned in accordance with the requirements for the normal posted speed limit and as shown on the plans.
- C. Where traffic is directed around or adjacent to the construction area, the contractor shall provide, lights, signs, and other devices required for the control of traffic as required by the UDOT traffic regulations and said "Manual of Uniform Traffic Control Devices." The engineering inspector shall have the right to relocate or direct the Contractor to relocate traffic control devices.
- D. In the event the Engineering inspector finds the worksite to be improperly barricaded or delineated and the Contractor is either unavailable or unresponsive to requests for improvement, the Engineering inspector will furnish and set up barricades and delineators as required. Two hundred dollars (\$200) will be charged the Contractor for each set-up event plus five dollars (\$5) "rental" for each barricade or delineator for each day's or partial day's use until such barricades or delineators are returned in good condition by Contractor or the Owner's yard.
- E. All roadways and sidewalks shall be returned to unrestricted vehicle and pedestrian usage when construction is not underway.
- F. Truck operations in and out of construction and staging areas shall be controlled by flagmen at all times.
- G. The maximum delay to the public due to Contractor construction activities is four hours.
- H. Construction in Intersections: Maintain at least one through lane in each direction on the following intersecting streets during working hours while constructing within the intersection
- I. Detour Routing: Notify the Engineering inspector at least 2 calendar days in advance and complete coordination prior to the detouring of traffic along the affected streets.

1.08 ACCESS TO ADJACENT PROPERTIES

- A. General: Maintain reasonable access from the project to all adjacent properties at all times during construction. Prior to restricting normal access from public streets to adjacent properties, notify each property owner or responsible person, at least three working days prior to the disruption,

informing him of the nature of the access restriction, the approximate duration of the restriction, and the best alternative access route for that particular property.

1.09 TRAFFIC CONTROL PLAN REVIEW REQUIREMENTS

A. The Contractor will:

1. Submit one PDF copy of the Traffic Control Plan to the Engineer. Submit plans in 11x17 format prepared using AutoCAD software. All plans must be signed and sealed by a certified traffic control technician. When available, the City will provide basemap CAD files to the Contractor on a CD-ROM at no cost.
2. Attend a mandatory meeting at the time and location as directed by the Engineer with City staff and the following:
 - a. Contractor's traffic control designer
 - b. Contractor's traffic control maintainer
 - c. Resident engineer
 - d. City's Traffic Engineer or designated representative
3. Do not begin work. Do not implement traffic control until written authorization is received from the Engineer.

1.10 CERTIFICATIONS

- A. Use devices and systems which meet NCHRP-350 Report crash test requirements as defined in the four categories by the Federal Highway Administration.
- a. Category 1 (cones, barrels and delineators), Category 2 (barricades and sign stands) and Category 3 (Barriers, crash cushions and truck mounted attenuators) – Must meet NCHRP-350 Report test requirements.
 - b. Category 4 – Arrow board and portable variable message signs do not have to meet NCHRP-350 Report test requirements.
- B. Devices may meet MASH 2016 criteria instead of NCHRP-350 Report requirements.

1.11 TRAFFIC CONTROL PLAN REQUIREMENTS

A. Traffic Control Plan (TCP) Checklist and Guidelines – In preparing the Traffic Control Plan, the design professional will need to address the following items:

1. The Traffic Control Plan (TCP) shall be drawn on 24" x 36" or 11" x 17" sheets, unless otherwise approved by the City's Project Manager. TCPs prepared for work occurring on all streets shown on the Circulation Element of the General Plan shall be prepared by a certified traffic control technician.
2. Draw the TCP with ink using legible lettering and symbols.
3. Indicate contractor's name, address and telephone number. Include name and telephone number of the 24-hour contact person presenting the Contractor.
4. Indicate a north arrow and scale on the drawings. If the drawing is NOT-TO-SCALE (N.T.S.), indicate so on the drawing.
5. Show all nearby streets with street names to assure proper orientation.
6. Show existing traffic signals and regulatory signs, as appropriate.
7. Show existing striping, pavement markings, painted crosswalks and bike lanes.
8. Show existing curbs, gutters, sidewalks, driveways and intersections in the construction work zone including areas affected by taper transition.

9. Indicate total roadway widths. Dimension existing striping from edges of pavement.
 10. Indicate posted speed limits.
 11. Show location and dimensions of the construction work zone.
 12. Show staging areas and materials storage area, as appropriate.
 13. Indicate locations of construction signs, barricades, and delineators.
 14. Label all taper lengths and widths, delineator spacing and sign spacing.
 15. Use a legend to define all symbols and designate them with UDOT nomenclature.
 16. Show all parking restriction zones and signs, as appropriate.
 17. Road closures will require approval from the City Engineer.
 18. Signs and barricades will be required to direct pedestrians through or around the construction work zone and shall be shown on the TCP.
 19. Indicate the encroachment permit number or improvement plans number on the traffic control plan.
 20. Indicate on the plan the duration of the construction work and subsequent traffic control
- B. Traffic Control Plan General Notes – The following notes need to be attached to and adhered to in preparing and implementing the Traffic Control Plan.
1. All traffic control devices shall conform to the latest edition of the UDOT’s Traffic Manual of Traffic Control Devices for Construction and Maintenance Work Zones and the Standard Specifications for Public Works Construction.
 2. The City Engineer or his representative has the authority to initiate field changes to assure public safety.
 3. All traffic control devices shall be removed from view when not in use.
 4. Work hours shall be restricted to between 7:00 a.m. and 10:00 p.m. unless otherwise approved.
 5. Trenches must be back filled or plated during non-working hours.
 6. Pedestrian controls shall be provided as shown on the plans.
 7. Temporary “NO PARKING” signs will be posted 24-hours prior to commencing work.
 8. Access to driveways will be maintained at all times unless other arrangements are made.
 9. The Contractor shall replace all traffic signal loop detectors damaged during construction within 72-hours of them being damaged.
 10. All striping removed or damaged, will be replaced by the Contractor within 24-hours (or replaced with temporary tape).
 11. All Workers shall be equipped with an orange vest (or a reflective vest at night). All flaggers shall also be equipped with a hard hat, C28 “Stop/Slow” paddle, shall be trained in the property fundamentals of flagging traffic, and be certified as indicated in this section
 12. Any work that disturbs normal traffic signal operations shall be coordinated with the City of West Jordan’s Traffic Engineer, 48-hours prior to beginning construction.
 13. The Contractor shall maintain all traffic control devices 24-hours per day and 7-days per week.
 14. A minimum of twelve (12) foot travel lanes must be maintained unless otherwise approved by the Engineering Department.
 15. All night work will require written approval from the Engineering Department. Lane closures, road detours, road closures, and traffic signal modifications associated with overnight construction activities will require warning signs be placed at least one week in advance of starting construction
 16. A solar powered flashing arrow board shall be required on all arterial street land closures.
- C. Design the traffic control plan resolving discrepancies between the various standards for traffic control in accordance with Section 00727 – Control of Work paragraph 1.5.B and the following:
1. UDOT Standard Traffic Control Drawings 745-2 Series. UDOT Standards Drawing 745-60, 745-60A, 745-60B, and 745-60D for post mounted signs.
 2. Manual of Uniform Traffic Control Devices (MUTCD), latest edition.

- D. Follow the requirements and limitations identified in the Traffic Control Special Provision (if included), Section 00555, Prosecution and Progress, paragraph 1.11. Limitation of Operations, Section 00725, Scope of Work, paragraphs associated with the maintaining of traffic and Section 00820 – Legal Relations and Responsibility to Public, paragraph 1.10 “Public Convenience and Safety – Traffic and Pedestrians”.
- E. Consider the safe and efficient movement of traffic when land closures are proposed.
 - 1. Open lanes to traffic wherever and whenever practical.
 - 2. Minimize and restrict land closures to the locations and times essential for prosecution of work.
- F. Provide for concrete barriers and attenuation to satisfy hazard mitigation according to UDOT Standard Drawing 745-2 Detail AA, and 745-2E Detail E-1.
- G. Provide for delineation and temporary pavement markings and/or removal as needed for traffic control or as required in accordance with this section, paragraph 1.6, lines H and I.
- H. Provide protection for all hazards (i.e.: bridge parapets, barrier blunt ends, poles, large equipment to include but not limited to cranes, pile drivers, etc.) when hazard is within AASHTO clear zone requirements for approach traffic.
- I. Use the following format and provide the following documentation:
 - 1. Section I: Description of each phase
 - a. List phases, and corresponding bid items and elements of work to be accomplished in each phase.
 - b. Accounting for each contract bid item and element of work, reference the traffic control detail designed to provide for the safe and efficient movement of traffic and safety of workers.
 - c. All contract bid items and elements of work must be identified and included in the phasing.
 - 2. Section II: CAD generated drawings showing detailed Traffic Control Plan for each phase:
 - a. Adapt Standard Drawings and work zone traffic control examples contained in the MUTCD to reflect actual project conditions such as curves, grades, presence of ramps, intersections and accesses.
 - b. Use basemap CAD files when supplied by the City as a basis for the Traffic Control Plan drawings.
 - c. Use the same level of detail as in the MUTCD and UDOT Standard Traffic Control Drawings.
 - d. Include the anticipated duration of the traffic control setup used in each phase.
 - e. Provide for the safe passage of pedestrians and bicyclists through the work zone in accordance with the Americans with Disabilities Act and the MUTCD.
 - f. Indicate clearly, the following:
 - i. Proposed regulatory speed reductions in accordance with this Section, paragraph 3.6.
 - ii. For all tapers; length of taper, device spacing, land or shoulder closures, amount of land shift in accordance with this Section, paragraph 3.3.A.
 - iii. Length of buffer zone, in accordance with this Section, paragraph 3.3.A.
 - iv. Device spacing used in tangents in accordance with this Section, paragraph 3.3.B.
 - v. Lengths of work zones, land and shoulder widths and area available for vehicle recovery.
 - vi. Proposed changes to be made to existing traffic signals including: timing changes, phase changes, etc.
 - vii. Sign locations for required and existing signs.
 - viii. Existing signs that are to be removed, covered, relocated or otherwise changed from the original configuration.

- ix. Worker parking, work vehicle and equipment access to and from work area, staging and material sites.
- 3. Section III: Emergency and Special Situations
 - a. Identify procedures for dealing with emergencies and special situations.
- J. Provide temporary pavement markings on newly constructed asphalt pavement and refresh as needed until the final surfacing is placed in accordance with Section 01558: Temporary Pavement Markings, as directed by the Engineer.
- K. Completely remove all existing traffic marking that conflict with the Traffic Control Plan, in accordance with Section 02765. Do not use paint or other material to cover markings.

1.12 TRAFFIC CONTROL MAINTAINER

- A. Certified by the City or by the American Traffic Safety Services Association (ATSSA) as a Traffic Control Technician. Certifications are available through:
 - 1. Associated General Contractors
1135 South West Temple
Salt Lake City, Utah
Telephone: (801) 363-2753
 - 2. American Traffic Safety Services Association (ATSSA)
15 Riverside Parkway, Suite 100
Fredericksburg, Virginia 22406-1022
Telephone: (800) 272-8772
Internet: www.atssa.com
- B. Authority:
 - 1. Obtains and uses all labor, equipment, and materials necessary to maintain traffic control.
 - 2. Changes traffic control operations per the traffic control plan.
- C. Responsibility and Duties:
 - 1. Oversees all traffic control operations.
 - 2. Implement the Traffic Control Plan.
 - 3. Remains available 24-hours a day, 7-days a week and can be on-site within 30-minutes of notification.
 - 4. Corrects deficiencies immediately upon verbal or written notification from the Engineer or representative.
 - 5. Inspect and document inspections of traffic control on a form acceptable to the Engineer at least four times each day as follows:
 - a. Before beginning of shift.
 - b. At mid-shift.
 - c. Half-hour after evening shift ends.
 - d. At the midpoint of the off-shift period.
 - 6. Coordinates project traffic control with emergency services and local law enforcement agencies.
 - 7. Inspect and document inspections of traffic control twice each day when no construction work is being done.
 - a. One during light hours and one during nighttime hours.
 - b. Conduct inspections a minimum of 8-hours apart.
 - 8. Completes a daily record of traffic control activities using a form acceptable to the Engineer.
 - 9. Submit to the Engineer, inspection and activities forms each week on a day and time acceptable

to the Engineer.

10. Provide a daily report of all planned traffic control activities to the Engineer by 7:00 AM each day. Provide the report each day during the contract.

1.13 TRAFFIC AND ACCESS

- A. The Contractor's operations shall not cause unnecessary inconvenience to the public. The public right-of-way shall be maintained at all times unless the City authorizes interruption. The Contractor's desire to close and/or detour traffic is to be authorized through the preparation of the required plans, which will then be approved by the City's Traffic Engineer or authorized representative.
- B. Safe and adequate access shall be provided and maintained to all public protection devices and to all critical utility locations. Facility access shall be continuous and unobstructed unless otherwise approved by the City's Traffic Engineer.

1.14 STORAGE OF EQUIPMENT AND MATERIALS IN PUBLIC STREETS AND RIGHTS-OF-WAY

- A. Construction materials and equipment shall not be stored or parked on public streets, roads, or highways. During any material or equipment loading and/or unloading activities that may temporarily interfere with traffic, acceptable detour(s) will be provided for the duration of the activity. Any associated expense for this activity will be the responsibility of the Contractor.
- B. Excavated material, including suitable material that is intended for adjacent trench backfills or other earth backfill as specified in Section 5 of this specification, shall not be stored in the public streets, roads, or highways that remain in service for the public. Any waiver of this requirement must be obtained from the proper local authority and approved by the Engineer. All excess and unsuitable material shall be removed from the site as soon as possible. Any spillage shall be removed from roadways prior to use by the public.

1.15 STREET CLOSURES, DETOURS, AND BARRICADES

- A. The Contractor shall comply with the requirements of all applicable responsible units of government for closure of any street, road, or highway. The Contractor shall provide the required barriers, guards, lights, signs, temporary bridges, and flaggers together with informing the public of any detours and construction hazards by the most suitable means available such as local newspapers, local radio stations, etc. The Contractor shall also be responsible for compliance with additional public safety requirements that may arise during construction. The Contractor shall furnish and install, and upon completion of the work, promptly remove all signs, warning devices, and other materials used in the performance of this work.
- B. Unless otherwise specified, not less than seven (7) days prior to closing, or partially closing, or reopening any street, road, or highway, the Contractor shall notify in writing, the Fire Chief, Police Chief, County Sheriff, State Highway Patrol, schools that operated school buses, or any other government official as may be appropriate.
- C. Unless otherwise specified, the Contractor shall furnish to the Engineer a written plan showing the proposed method of signing, barricading for traffic control, and safety for the street detours and closures.

- D. All temporary detours will be maintained to ensure use of public rights-of-way is provided in a safe manner. This may include dust control, grading, graveling, etc., as required by the City's project manager and this specification.

1.16 MAINTENANCE OF WORK ZONE TRAFFIC CONTROL

- A. Implement and maintain traffic control per the Traffic Control Plan. Implement changes to traffic control required in order to meet UDOT Standard Specifications. Drawings and MUTCD at no additional cost to the City. Coordinate changes to traffic control and the Traffic Control Plan with the Engineer prior to implementation.
- B. Meet all requirements of this Section, paragraph 1.7 when traffic control devices are required to be in place overnight or on weekends.
- C. Meet the acceptable classification as identified by *Quality Standards for Work Zone Traffic Control Devices* published by American Traffic Safety Services Association (ATSSA) for traffic control devices.
 - 1. Wash devices weekly unless conditions warrant more frequent cleaning.
- D. Maintain traffic control devices during and after all snow plowing operations at no additional cost to the City. Clear snow away from all traffic control devices so that the devices function as intended.

1.17 WAGE RATES FOR TRAFFIC CONTROL PERSONNEL (Federal Aid Jobs Only)

- A. Payment of wages must be as stated below during the time the certified Traffic Control Maintainer, or others involved in setting up or maintaining traffic control devices working under the direction of the certified Traffic Control Maintainer, is on the project site and does any of the following work:
 - 1. Laborer I – for moving traffic control devices by hand: loading or unloading devices on to or off of the truck: and for all hours required to be at the project site except those hours spent in the truck driver classification.
 - 2. Truck Driver – for all hours spent driving on the project site in the performance of the duties required to maintain the traffic control. The rate of pay is determined by the size of vehicle being driven. Pickup Truck being the smallest.

1.18 MEASUREMENT AND PAYMENT

- A. For items of work for which specific lump sum prices are established in the contract, payment for the work will be made at the contract lump sum price. Progress payments will be made based upon the percentage of estimated total time that traffic control will be required unless otherwise specified in Section 7 of this specification. Payment will constitute full compensation for all flaggers, labor, materials, equipment and all other items necessary and incidental to completion of the work.
- B. Compensation for any item of work described in the contract but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and items to which they are made subsidiary are identified in Section 7 of this specification.
- C. Partial Payments – Based on the percentage of the project completed, excluding the cost of traffic control.
- D. Price Adjustments:

1. The City reduces payment when traffic control is not in compliance with the Traffic Control Plan, or when the contractor fails to meet all requirements cited or referenced in this specification.
 - a. The amount per day by which the Contractor's compensation will be reduced is calculated using the daily charge for Calendar Day in the Schedule of Liquidated Damages in Table 1 of Section 00555 or the Contract lump sum bid price for Traffic Control divided by the number of contract days, whichever is greater.
 2. A Stop Work Order issued due to non-compliance with this specification is not considered to be an authorized suspension of contract time. Contract time will continue to accrue as defined in Section 00555, paragraph 1.14 – "Determining Contract Time".
- E. Include in the bid item "Traffic Control" all materials, equipment, labor, flagging, pilot car, temporary pavement markings and/or removal and workmanship required for the design, implementation and maintenance of the Traffic Control Plan.
- F. Provide the Engineer in writing with a detailed analysis showing impacts to traffic control caused by extra work that necessitates modifications to the Traffic Control Plan. Negotiate and agree to either a lump sum price for additional Traffic Control or agree to unit prices to be used for additional traffic control measures or devices required, prior to performing the extra work.

PART 2 -- PRODUCTS

2.01 PILOT CAR

- A. Equip with a reflectorized sign:
1. Comply with Section 02891: Traffic Signs.
 2. MUTCD sign G20-4
- B. Equip with a minimum two rotating lights or strobe lights.
1. Minimum 100-mm diameter and minimum 1830 mm mounting height
 2. Yellow color

2.02 FLAGGER EQUIPMENT AND CLOTHING

- A. Comply with UDOT's "Flagger Training Handbook".
- B. Comply with Standard Drawings 745-1.
- C. Clothing:
1. Flagger vest and hard hat: Orange, red-orange, or fluorescent version of these colors with:
 - a. Minimum 83870 mm² each on the front and back of strong yellow-green reflective tape, or
 - b. Minimum of 41935 mm² each on the front and back of strong yellow-green non-reflective tape, with 41935 mm² white reflective tape placed on both sides of the non-reflective tape on the front and back.
 - c. Orange or fluorescent orange hardhat with 6450 mm² of white or strong yellow-green reflective tape placed around the base of the hard hat and visible to traffic.

2.03 TRAFFIC CONTROL SIGNING AND DEVICES

- A. Signs:
 - 1. Comply with paragraph 1.5.
- C. Comply with Section Section 32 01 05 – Informational, Regulatory, and Warning Signs.
 - 2. Comply with UDOT Standard Drawing 745-1.
 - 3. Comply with UDOT Standard Drawings 745-60, 745-60A, 745-60B, and 745-60D when using post mounted signs.
- B. Channelizing Devices:
 - 1. Comply with paragraph 1.5.
 - 2. Comply with UDOT Standard Drawing 745-1.
 - a. Use construction orange tubular markers and cone during daylight hours only.
- C. Precast Concrete Barrier:
 - 1. Comply with paragraph 1.5.
 - 2. Comply with UDOT Standard Drawings 745-2, Detail AA, and 745-2E, Detail E-1.
 - 3. Use an approved construction zone attenuator or permanent style end sections, as listed in UDOT Guidelines for Attenuators and End Section.
 - a. Use a construction zone attenuator when approach ends of temporary precast barrier are within AASHTO clear zone.
 - i. Use AASHTO Roadside Design Guide to determine proper clear zone distance requirements.
 - ii. Install attenuators or end sections as per UDOT Standard Drawings 735-1 series and manufacturers recommendations.
 - 4. Do not use a truck-mounted attenuator (TMA) to protect temporary precast barrier end for more than 24-hours. Use properly rated TMA as directed in this Section, paragraph 2.3.D.
- D. Use properly rated truck-mounted attenuator for the posted speed limit prior to construction.
 - 1. NCHRP-350 Test Level 2 for speeds 45 mph or less.
 - 2. NCHRP-350 Test Level 3 for speeds greater than 45 mph.

2.04 ADVANCE WARNING ARROW PANEL

- A. Advance Warning Device:
 - 1. Meet all standards as specified in the MUTCD, Section 6F.53 – Arrow Panels.
 - 2. Perform all functions as specified in UDOT Standard Drawing 745-1 and the MUTCD.

PART 3 -- EXECUTION

3.01 MODIFICATION OF TRAFFIC CONTROL PLANS

- A. Each phase of construction must use an authorized Traffic Control Plan. If a construction phase is proposed that is not covered by the Traffic Control Plan, submit a proposed plan to the Engineer for review.
 - 1. Submit proposed plans to the Engineer 10 working days before the Traffic Control Plan is to be implemented.
 - 2. Do not begin work until the new Traffic Control Plan is authorized for use and has been fully implemented.
 - 3. Implement changes required to meet UDOT Standard Specifications, Standard Drawings and MUTCD at no additional cost to the City.
 - a. Comply with this Section, paragraph 1.4.A.1.

3.02 FLAGGING

- A. Flaggers must have a current flagging certificate and must present proof of certification upon request by the City.
 - 1. Acceptable certifications
 - a. UDOT Contractor Certification (Utah Valley State College).
 - b. American Traffic Safety Service Association (ATSSA).

3.03 TRAFFIC CONTROL SIGNING AND DEVICES

- A. Use posted speed limit prior to construction to compute sign spacing, taper lengths, buffer zones and construction clear zone.
 - 1. Use plastic drums for land closure taper devices for speeds 50 mph and greater.
 - 2. Do not use cone or tubular markers at night.
- B. Use posted speed during construction to compute the tangent spacing for channelizing devices.
- C. Remove all traffic control from site of work when not required within 24-hours.
 - 1. Remove traffic control devices from the roadway a distance twice that of the Construction Clear Zone (Table 1 – Standard Drawing TC 2A) if they will be used within 24-hours of the daily work stoppage and are not required for immediate traffic control.
 - a. Obtain written permission from property owner prior to storing traffic control devices on private property.
 - 2. Cover post mounted signs when directed by Engineer.
 - a. Cover signs completely with an opaque and durable covering.

3.04 ADVANCE WARNING ARROW PANEL

- A. May substitute Type C units for Type B units.
 - 1. Comply with UDOT Standard Drawing 745-1.
- B. Do not substitute Type B units for Type C units.
- C. Remove Advance Warning Arrow Panel from the site of work when not needed for the control of traffic within a 4-hour period.

3.05 TRAFFIC SIGNALS

- A. Use uniformed police officers when construction activities are impacting an operating signalized intersection.
- B. Use of flaggers at traffic signals is permitted when the signals have been turned to red flash mode.
 - 1. Each approach is to be controlled by a separate flagger(s).
 - a. Flaggers can control only two lanes of approach traffic.
 - i. Third land control permitted when left or right turn bays are present.
- C. Changes to traffic signal operations will be done by the City.

3.06 CONSTRUCTION ZONE SPEED LIMIT REQUIREMENTS

- A. Obtain approval from the Engineer for regulatory speed reductions.
 - 1. Use speed reduction only when construction activities impact traffic.
 - 2. Restore regulatory speed limit at locations where construction activities are not impacting traffic.

*** END OF SECTION ***

SECTION 01 56 00
DUST CONTROL

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials and equipment as required to provide dust control for the project.
- B. All materials and services shall comply with the requirements of the State of Utah, Department of Environmental Quality, Division of Air Quality and the City's Municipal Code.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Water. CONTRACTOR shall be responsible to arrange and pay for water for dust control.
- B. Calcium chloride shall be added to the water used to provide dust control, if required by the City.

PART 3 EXECUTION

3.1 DUST CONTROL

- A. CONTRACTOR shall comply with the requirements of the State of Utah Department of Environmental Quality, Air Quality Regulations (including R301-205 Emission Standards: Fugitive Emissions and Fugitive Dust, and R307-309 Fugitive Emissions and Fugitive Dust, of the Utah Air Conservation Rules (UACR). CONTRACTOR shall submit a Fugitive Dust Control Plan to the Utah Division of Air Quality, which meets the requirements of R307-309-4. CONTRACTOR shall obtain a permit from the Division of Air Quality.
- B. CONTRACTOR shall execute Work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into the atmosphere. Give all unpaved streets, roads, detours, or haul roads used in the construction area an approved dust-preventive treatment or periodically water to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.

3.2 WATER PLACEMENT FOR DUST CONTROL

- A. CONTRACTOR is responsible for placement of sufficient water to control dust on the project. Dust control is defined by the permit requirements of the State of Utah, Division of Environmental Quality, Division of Air Quality. Permit shall be obtained by CONTRACTOR.

3.3 WATER AND CALCIUM CHLORIDE MIXTURE FOR DUST CONTROL

- A. CONTRACTOR may also use a water and calcium chloride solution to abate the dust for the project. The mixture of calcium chloride per 10,000-gallon truck shall be 10 pounds.

The calcium chloride shall be added to the water truck container as the water is being put into the water truck in order to provide sufficient mixing.

- B. In the absence of providing the water and calcium chloride mixture, CONTRACTOR shall meet the requirements of Subsection 3.2 of this document, or shall use other approved methods by OWNER that will allow CONTRACTOR to meet permit requirements.

- END OF SECTION -

**SECTION 01 57 00
TEMPORARY CONSTRUCTION AIDS
AND ENVIRONMENTAL CONTROLS**

PART 1 -- GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish temporary utilities, including electricity, lighting, telephone service, water and sanitary facilities; temporary controls, including barriers, protection of work and water control; and construction facilities, including parking, progress cleaning and temporary building as required.

1.02 TEMPORARY UTILITIES

- A. Temporary Electricity: Contractor shall provide, maintain and pay for all power required by the Contractor, including electrical service to the field office.
- B. Temporary Lighting: Contractor shall provide all temporary lighting required for prosecution of his work and for employee and public safety. As a minimum, lighting levels during working hours shall meet the requirements of UOSHA, subsection 1926.56 illumination.
- C. Telephone Service: Contractor shall provide, maintain and pay for telephone service to the field office.
- D. Temporary Water Service
1. The Contractor shall provide for all workers on the project, an adequate and reasonably convenient, uncontaminated drinking water supply. All facilities shall comply with the regulations of the local and State Department of Health.
 2. Contractor shall be responsible to arrange for water, both potable and non-potable water.
 3. When water is taken from a City water system or any other potable water supply source for construction purposes, suitable precautions shall be taken to prevent cross connection and contamination of the water supply.
- E. Temporary Sanitary Facilities
1. Contractor shall provide and maintain sanitary facilities for his employees and his subcontractors' employees that will comply with the regulations of the local and State Department of Health.

1.03 TEMPORARY CONTROLS

- A. Barriers: Provide barriers as necessary to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.
- B. Dust Control: The Contractor shall furnish all labor, equipment, and means required and shall

carry out effective measures wherever and as often as necessary to prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity. The Contractor shall be responsible for any damage resulting from any dust originating from its operations. The dust abatement measures shall be continued until the Contractor is relieved of further responsibility by the Engineer.

- C. Protection of Work: Contractor shall protect installed work and provide special protection where specified in individual specification sections. Contractor shall provide temporary and removable protection for installed products, and shall control activity in immediate work area to minimize damage.
- D. Open Burning: No open burning or waste materials is allowed.
- E. Explosives and Blasting: The use of explosives on the work is not allowed.
- F. Noise Abatement: In inhabited areas, particularly residential, operations shall be performed in a manner to minimize unnecessary noise generation and shall comply with City ordinances and standards.
- G. Storm and Ground Water:
 - 1. The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water entering the excavation or other parts of the work, whether the water be surface or underground water.
 - 2. In excavation, fill and grading operations, care shall be taken to disturb the pre-existing drainage pattern as little as possible. Particular care shall be taken not to direct drainage water into private property or into streets or drainage ways inadequate for the increased flow.
 - 3. The Contractor shall maintain effective means to minimize the quantity of sediments leaving the work area either by storm water or the Contractor's own dewatering operations.
 - 4. All work shall have a Storm Water Pollution Prevention Plan (SWPP) provided by the Engineer or Architect or Contractor as defined in the plans or in the Instructions to Bidders.

1.4 CONSTRUCTION UTILITIES

- A. Parking: Contractor shall provide temporary parking areas to accommodate use of construction personnel. Parking shall be located in an area approved by the City.
- B. Progress Cleaning:
 - 1. Contractor shall maintain areas free of waste materials, debris and rubbish. He shall also maintain the site in a clean and orderly condition. Upon completion of work, repair all damage caused by equipment and leave the project free from rubbish or excess materials of any kind.
 - 2. Thoroughly clean all spilled dirt, gravel or other foreign materials caused by the construction operations from all streets, roads, and storm water facilities at the conclusion of each day's operation.
 - 3. It shall be the responsibility of the Contractor to promptly clean up and remove any oil and or fuel spills caused by the Contractor or his subcontractors during the course of the project. The Contractor shall properly dispose of contaminated soil according to local, State and federal

laws. The Contractor shall be responsible for any damages to the Owner resulting from the Contractor's actions in promptly cleaning up said spills.

1.5 REMOVAL OF UTILITIES, FACILITIES AND CONTROLS

- A. Contractor shall remove temporary above grade or buried utilities, equipment, facilities and materials prior to application for final progress payment. Clean and repair damage caused by installation or use of temporary work. Restore existing facilities used during construction to their original condition.

*** END OF SECTION ***

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- C. Furnish interchangeable components from same manufacturer for components being replaced.

1.2 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.3 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- D. For exterior storage of fabricated products, place on sloped supports above ground.
- E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- F. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- H. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.4 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.5 PRODUCT SUBSTITUTION PROCEDURES

- A. ENGINEER will consider requests for Substitutions only after Notice of Award.
- B. Substitutions may be considered when a product becomes unavailable through no fault of CONTRACTOR.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that CONTRACTOR:
 - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
 - 2. Will provide same warranty for Substitution as for specified product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to OWNER.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse OWNER for review or redesign services associated with re-approval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure:
 - 1. Submit one PDF copy of request for Substitution for consideration to ENGINEER.
 - 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
 - 3. ENGINEER may require CONTRACTOR to provide additional data about the proposed substitution.
 - 4. ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and ENGINEER's decision shall be final.
 - 5. ENGINEER will notify CONTRACTOR in writing of decision to accept or reject request.
 - 6. Acceptance by ENGINEER of a substitution proposed by CONTRACTOR shall not relieve CONTRACTOR of the responsibility for full compliance with the Contract Documents and for the adequacy of the substitution.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

- END OF SECTION -

SECTION 01 71 13

MOBILIZATION AND DEMOBILIZATION

1.01 GENERAL

- A. Mobilization shall include the obtaining of all bonds, insurance, and permits; moving onto the site of all plant and equipment; and the furnishing and erecting of plants, temporary buildings, and other construction facilities; all as required for the proper performance and completion of the Work. Mobilization shall include but not be limited to the following principal items:
1. Field Office: Moving on to the site of all Contractor's plant and equipment required for first month's operations. When required by contract documents provide field office trailers for the Contractor and the Engineer or Architect, complete with all specified furnishings and utility services including telephones, telephone appurtenances, computer and printer, and copying machine.
 2. Utilities: Providing temporary construction power, telephone, water, storm and sanitary facilities, and all other temporary facilities required.
 3. Security and Protection: Install and maintain temporary fencing for the protection of the public and private property as well as all materials, tools, and equipment. Obtain approval from the City or private property owner prior to temporary fence placement. Locate all storage areas to avoid interference from drainage, traffic or private property.
 4. Construction and Support: Construct and maintain any temporary roads, paving, dewatering facilities, enclosures, identification signs, waste disposal and temporary heat required by the Work. Provide and maintain temporary all weather pedestrian walk ways and road detours if required to safely complete the Work.
 5. Permits, Regulations, and Job Safety: Obtaining and paying for all required permits prior to construction. Posting all OSHA required notices, and the establishment of safety programs. Have the Contractor's superintendent at the job site full time.
 6. Construction Schedules: Submittal of a Preliminary Construction Schedule on or before Preconstruction Conference, acceptable to the Engineer or Architect, per Section 01 32 16. Submittal of a Progress Schedule with each pay request that updates the preliminary schedule per Section 01 32 16.
- B. Demobilization shall include removing all construction materials, equipment, facilities and debris so that the site is restored to its original condition. Demobilization shall include but not be limited to the following principal items:
1. Removal of any temporary materials, equipment, facilities and debris at the completion of the Work.
 2. Clean or repair damage caused by installation or use of temporary facilities.
 3. Restoration work area to its original or to specified conditions at the completion of Work.

*** END OF SECTION ***

SECTION 01 78 20
OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes: Preparation and submittal of Operation and Maintenance Manuals.

1.2 SUBMITTALS

- A. Submit Operation and Maintenance Manuals before field quality control testing and before training of each piece of equipment or system.
- B. Submit 1 electronic copy manual for each piece of equipment or system.
- C. Make manuals available at project site for use by construction personnel and ENGINEER.
- D. Make additions and revisions to the manuals in accordance with ENGINEER's review comments.

1.3 OPERATION AND MAINTENANCE MANUALS

- A. Preparation:
 - 1. Provide electronic copy of the Operations and Maintenance Manual in PDF Format.
 - a. Organize the PDF file by creating a bookmark for each piece of equipment or system.
 - 2.
 - 3. Provide all dimensions in English units.
- B. Contents of Operation and Maintenance Manuals:
 - 1. Cover page:
 - a. Equipment name, equipment tag number, project name, OWNER's name, appropriate date.
 - 2. Table of Contents:
 - a. General description of information provided within each tab section.
 - 3. Equipment Summary Form:
 - a. Completed form in the format shown in Appendix A.
 - b. The manufacturer's standard form will not be acceptable.
 - 4. Lubrication information:
 - a. Required lubricants and lubrication schedules.
 - 5. Control diagrams:
 - a. Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.
 - b. Complete set of 11-inch by 17-inch drawings of the control system.
 - c. Complete set of control schematics.
 - 6. Programming:

- a. Copies of all CONTRACTOR furnished programming.
- 7. Start-up procedures:
 - a. Recommendations for installation, adjustment, calibration, and troubleshooting.
- 8. 8. Operating procedures:
 - a. Step-by-step procedures for starting, operating, and stopping equipment under specified modes of operation.
 - b. Include safety precautions and emergency operating shutdown instructions.
- 9. Preventative maintenance procedures:
 - a. Recommended steps and schedules for maintaining equipment.
- 10. Overhaul instructions:
 - a. Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.
- 11. Parts list:
 - a. Complete parts list for all equipment being provided.
 - b. Catalog data for all products or equipment furnished including generic title and identification number of each component part of equipment.
 - 1) Include bearing manufacturer, model and ball or roller pass frequencies for every bearing.
- 12. Spare parts list:
 - a. Recommended number of parts to be stored at the site and special storage precautions.
- 13. Drawings:
 - a. Exploded view or plan and section views with detailed callouts.
 - b. Complete set of 11-inch by 17-inch drawings of equipment.
 - c. Provide electrical and instrumentation schematic record drawings.
- 14. Source (factory) quality control test results:
 - a. Provide copies of factory test reports as specified in Sections 15958 or the equipment section.
- 15. Field quality control test results:
 - a. After field-testing is completed, insert field test reports as specified in Sections 15958 or the equipment section.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

- END OF SECTION -

**SECTION 01 78 50
PROJECT CLOSEOUT**

1.01 FINAL CLEANUP

- A. The Contractor shall promptly remove from the vicinity of the completed Work, all rubbish, debris, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Work by the City will be withheld until the Contractor has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

1.02 CLOSEOUT TIMETABLE

- A. The Contractor shall establish dates for equipment testing, acceptance periods, (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow the City, the Engineer or Architect, and their authorized representatives and consultants sufficient time to schedule attendance at such activities.
- B. All temporary buildings, including field offices, storage buildings, and sheds shall be removed from the project site 7 days after completion of the Work as defined in the Contract Documents. All temporary services such as water, power, utilities, service contracts, pager contracts, telephones, and other temporary services shall remain in service for 7 days following completion of the Work, and shall be discontinued within 7 days after said completion of the Work.

1.03 FINAL SUBMITTALS

- A. The Contractor, prior to requesting its final progress payment, shall submit the following items to the Engineer or Architect for transmittal to the City:
1. Written guarantees or warranties, where required
 2. Completed final Record Drawings
 3. Certificates of inspection and acceptance by local governing agencies having jurisdiction
 4. Releases executed by property owners adjacent to the project site attesting that the Contractor has restored any damage done to their property during construction.
 5. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

1.04 COMPLETION OF THE WORK

- A. Completion of the Work, as the term is used in this Contract shall mean substantial completion of the Work and acceptance by the City. Substantial completion shall mean substantial performance of the Contract, which shall exist where there has been no willful departure from the terms of the Contract, and no omission in essential points, and the Contract has been honestly and faithfully performed in its material and substantial particulars, and the only variance consists of technical or relatively unimportant omissions or defects, and the Work can be used or occupied for the purpose for which it was intended.

- B. The date of substantial completion of the Project shall be the date when the construction is sufficiently completed, in accordance with the Contract Documents, as modified by any change orders agreed to by the parties, so that the City can occupy or utilize the project for the use for which it was intended, and the legislative body of the City has accepted the Project as evidenced by execution and recording of a Notice of Completion.

1.06 REMAINING PUNCH LIST ITEMS5

- A. Upon attaining completion/substantial completion as defined in Article 14.8 of the General Conditions and upon acceptance of the Work by the City, by agreement between the parties some small remaining punch list items may remain to be completed by the Contractor, as provided under the provisions for "Completion of the Work" in Paragraph 1.05A, herein.
- B. As provided in Articles 14.11 and 14.12 of the General Conditions, the City shall have the right to retain an additional amount of money from the final progress payment due the Contractor, equal to 2 times the Engineer or Architect's estimate of the value of such uncompleted punch list items. The Contractor hereby agrees to complete all such outstanding punch list items within 30 calendar days following the date of the Notice of Completion and acceptance of the Work by the City.
- C. As provided in Article 14.12 of the General Conditions, failure of the Contractor to complete or correct all such outstanding punch list work to the satisfaction of the Engineer or Architect within 30 calendar days following acceptance and Notice of Completion, shall constitute a waiver by the Contractor of all rights to any and all claims it may have to all monies withheld by the City under the Contract to cover the value of such uncompleted or uncorrected items.

1.06 MAINTENANCE AND REPAIR PERIOD

- A. The Contractor shall comply with the maintenance and repair requirements contained in Article 13 of the General Conditions.
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the Contractor which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the Contractor shall have obtained a statement in writing from the affected private owner or public agency releasing the City from further responsibility and liability in connection with such repair or resurfacing.
- C. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the City. If the Contractor fails to make such repairs or replacements promptly, the City reserves the right to do the work or to have the work done by others and the Contractor and its Surety shall be liable to the City for the cost thereof.

1.07 EXTENSION OF PERFORMANCE BOND

- A. The Contractor shall provide a bond to guarantee performance of the provisions contained in Paragraph entitled "Maintenance and Repair Period," above, and Article 13 of the General Conditions.

*** END OF SECTION ***

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section covers the work necessary to furnish, install, and complete, the concrete formwork.

1.2 RELATED WORK

- A. Related work in other sections includes but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 03 30 00 Cast-in-Place Concrete

1.3 MEASUREMENT AND PAYMENT

- A. Concrete formwork shall not be measured or paid as a separate item, but shall be included as part of the various items to which it relates.

1.4 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
 - 1. American Concrete Institute (ACI) -ACI 347R- Guide to Formwork for Concrete
 - 2. American Hardboard Association (AHA) -AHA A135.4- Basic Hardboard
 - 3. Department of Commerce (DOC) -DOC PS 1- Structural Plywood
 - 4. ACI 350R-01 – Code Requirements for Environmental Engineering Concrete Structures and Commentary
 - 5. NSF International (NSF) 61 - Drinking Water System Components - Health Effects

1.5 DESIGN

- A. Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the finish specified in Section 03 30 00 Cast-in-Place Concrete. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

1.6 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. The following shall be submitted:
 - 1. Drawings showing details of forming, shoring and bracing for footings, walls, and floors shall be submitted to the Engineer at least 3 weeks prior to their use. Drawings showing details of formwork shall include joints, supports, studding and shoring, and sequence of form and shoring removal.

2. If requested by ENGINEER, design analysis and calculations shall be submitted for form design and methodology used in the design. The analysis and calculations shall verify the selection of form ties, horizontal and vertical stiff-backs or braces for wall panels, forming and form openings, or any other part of forming, shoring or bracing which may be considered critical by ENGINEER.
 3. Manufacturer's data including literature describing form materials, accessories, and form releasing agents.
 4. Manufacturer's recommendation on method and rate of application of form releasing agent.
- C. ENGINEER's review will not relieve CONTRACTOR from any responsibility as to the adequacy of the forming, shoring and bracing design. Any formwork installed by CONTRACTOR shall be solely at CONTRACTOR's risk. ENGINEER's review will not lessen or diminish CONTRACTOR's liability.

PART 2 PRODUCTS

2.1 FORM MATERIALS

- A. Form surfaces shall be in "new and undamaged" condition and may be plywood, hard plastic finished plywood, overlaid waterproof particle board, and steel of sufficient strength and surface smoothness to produce the specified finish. CONTRACTOR shall verify that his types of form surfaces and panel sizes satisfy all requirements of these specifications.
- B. The wall form design shall be such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.

2.2 FORM TIES

- A. Form ties on exposed surfaces shall be located in a uniform pattern. Snap ties shall not be broken until the concrete has reached the design concrete strength. The use of tie wires as form ties will not be permitted. Snap ties, designed so that the ends must be broken off before the forms can be removed, shall not be used. Form ties shall be **Plastic Cone Snap Tie by Dayton-Superior, Wrench Head Snap Tie by MASCO Mason Supply**, or approved equal.
- B. Taper ties with plastic or rubber plugs of an approved and proven design may also be used. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Taper ties shall be **Taper Tie by Dayton-Superior, Taper-Tie by MASCO Mason Supply**, or approved equal.

2.3 FORM RELEASING AGENTS

- A. Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03 30 00 Concrete. Forms shall be used, whenever necessary, to confine the concrete, to shape the concrete to the required lines and grades, and to obtain a thoroughly compacted dense concrete through proper vibrating. The forms shall have sufficient strength and rigidity to hold the concrete and to withstand the necessary pressure, tamping and vibration, without deflection from the prescribed lines. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar.
- B. The surfaces of all forms in contact with the concrete shall be clean, rigid, tight and smooth. All dirt, chips, sawdust, mud, water and other foreign matter shall be removed from within the forms or within the excavated areas, before any concrete is deposited therein.
- C. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be thoroughly cleaned of mortar from previous concreting and of all other dirt and foreign matter before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.
- D. Bulkheads to form vertical wall joints shall be strong enough to withstand concrete pressures during pouring and vibrating, and shall be properly placed between the forms to avoid mortar seepage. Holes shall be provided in the bulkheads to permit passage of horizontal mild steel reinforcing where required by the Drawings. Unless these are specifically called for on the Drawings, no chamfer strips shall be placed in the corners of vertical construction joints.

3.2 COATING

- A. Form inside surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.3 ALIGNMENT AND TOLERANCES

Forms shall be properly aligned and adequately supported to produce concrete surfaces conforming to construction tolerance given in Table 03 10 00-1, Tolerances for Formed Surfaces.

**TABLE 03 10 00-1
TOLERANCES FOR FORMED SURFACES**

Condition	Measurement	Tolerance
1. Variations from the plumb:	In any 10 feet of length	1/4 inch
a. In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length	1 inch
b. For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 20 feet of length Maximum for entire length	1/4 inch 1/2 inch
2. Variation from the level or from the grades indicated on the drawings	In any 10 feet of length In any bay or in any 20 feet of length	1/4 inch 3/8 inch
3. Variation of the linear building lines from established position in plan	In any 20 feet Maximum	1/2 inch 1 inch
4. Variation of distance between walls, columns, partitions	1/4 inch per 10 feet of distance, but not more than 1/2 inch in any one bay, and not more than 1 inch total variation	
5. Variation in the thickness of slabs and walls	Minus Plus	1/4 inch 1/2 inch

3.4 FORM REMOVAL

- A. Forms shall be removed in a manner that will prevent injury to the concrete and ensure the complete safety of the structure. Forms shall not be removed until approval is given by ENGINEER. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement.
- B. CONTRACTOR shall remove all wood splinters on concrete surfaces after stripping of wood forms.

- END OF SECTION -

**SECTION 03 20 00
CONCRETE REINFORCEMENT**

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers the reinforcing steel bars, wire fabric or rod mats for cast-in-place concrete.

1.2 RELATED WORK

- A. Related work in other sections includes but is not limited to:

1. Section 01 33 00 Submittal Procedures

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. AMERICAN CONCRETE INSTITUTE (ACI)

- | | |
|-------------|--|
| 1. ACI 301 | Specifications for Structural Concrete |
| 2. ACI 315 | Details and Detailing of Concrete Reinforcement |
| 3. ACI 318 | Building Code Requirements for Structural Concrete and Commentary |
| 4. ACI 350R | Code Requirements for Environmental Engineering Concrete Structures and Commentary |

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|----------------|--|
| 1. ASTM A 184 | Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement |
| 2. ASTM A 615 | Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement. |
| 3. ASTM A 767 | Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement |
| 4. ASTM A 775 | Standard Specification for Epoxy-Coated Steel Reinforcing Bars |
| 5. ASTM A 1064 | Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |

D. CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

1. CRSI (DA4) Manual of Standard Practice (MSP-1)

1.4 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

1. Drawings of Concrete Reinforcement System with details showing reinforcing steel schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.
2. Reinforcing Steel with certified copies of mill reports attesting that the reinforcing steel furnished meets the requirements specified, prior to the installation of reinforcing steel.

1.5 DELIVERY AND STORAGE

- A. Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

1.6 MEASUREMENT AND PAYMENT

- A. Concrete reinforcement shall not be measured or paid as a separate item, but shall be included as part of the various items to which it relates.

PART 2 PRODUCTS

2.1 DOWELS

- A. Dowels shall conform to ASTM A 615, Grade 60.

2.2 FABRICATED BAR MATS

- A. Fabricated bar mats shall conform to ASTM A 184.

2.3 REINFORCING STEEL

- A. Reinforcing steel shall be deformed bars conforming to ASTM A 615 grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 1064. When no grade is indicated use 60 ksi grade steel. Special coated bars (epoxy and zinc) may be specified for use in a highly corrosive atmosphere where concrete cover is not considered sufficient. In which case reference to ASTM A 767 and A 775 will be included.

2.4 WELDED WIRE FABRIC

- A. Welded wire fabric shall conform to ASTM A 1064.

2.5 WIRE TIES

- A. Wire ties shall be 16-gauge or heavier black annealed steel wire.

2.6 SUPPORTS

- A. Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI (DA4) MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete.

- B. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within ½ inch of concrete surface shall be plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

PART 3 EXECUTION

3.1 REINFORCEMENT

- A. Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete.
- B. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety.
- C. Placement:
 - 1. Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete.
 - 2. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.
- D. Splicing:
 - 1. Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6-inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.2 WELDED-WIRE FABRIC

- A. Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in

either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

3.3 DOWELS

- A. Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately aligned parallel to the finished concrete surface and rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

- END OF SECTION -

SECTION 03 25 00
EXPANSION JOINTS, CONSTRUCTION JOINTS AND WATERSTOPS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section covers the work necessary to furnish, install and complete expansion and construction joints, including waterstops.
- B. All waterstops and sealants in contact with potable water including waterstops embedded in concrete floors and walls of potable water tanks shall be NSF 61 certified.

1.2 RELATED WORK

- A. Related work in other Sections includes but is not limited to:

- 1. Section 01 33 00 Submittal Procedures
- 2. Section 03 33 00 Cast-in-Place Concrete

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

- B. AMERICAN CONCRETE INSTITUTE (ACI)

- 1. ACI 318 Building Code Requirements for Reinforced Concrete

- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- 1. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
- 2. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
- 3. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- 4. ASTM D 570 Standard Test Method for Water Absorption of Plastics
- 5. ASTM D 624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
- 6. ASTM D 638 Standard Test Method for Tensile Properties of Plastics
- 7. ASTM D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
- 8. ASTM D 747 Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
- 9. ASTM D 792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- 10. ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- 11. ASTM D 1752 Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

12. ASTM D 2240 Standard Test Method for Rubber Property-Durometer Hardness

D. FEDERAL SPECIFICATIONS (FS)

1. FS-TT-S-00227E Sealing Compound: Elastomeric Type, Multi-Component (For Calking, Sealing, and Glazing in Buildings and Other Structures)

E. NSF International (NSF)

1. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.4 SUBMITTALS

A. The following shall be submitted in accordance with Section 01 33 00 – Submittal Procedures:

1. Submit certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified. ENGINEER, at his option, may take samples of any materials and have them tested by an independent testing laboratory to verify their compliance with these Specifications. All such costs shall be borne by OWNER. If any materials should fail to meet these Specifications, all costs for further testing of the replacement material shall be borne by CONTRACTOR.
2. Samples of factory fabricated waterstop joints representing in all respects the material and workmanship of the material that will be furnished under this contract. Samples will be submitted and approved by ENGINEER prior to use of the factory joints in the field.
3. Manufacturer's catalog data and manufacturer's recommended instructions for splicing of waterstops.

1.5 OBSTRUCTIONS

A. CONTRACTOR shall pay particular attention to removing all obstructions such as concrete, nails, etc., from joints when movements of floor or wall sections can be expected under temperature and other conditions.

1.6 QUALITY ASSURANCE

A. Waterstop manufacturer shall demonstrate five years (minimum) continuous, successful experience in production of waterstops.

1.7 DELIVERY AND STORAGE

A. Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

1.8 MEASUREMENT AND PAYMENT

A. There shall be no separate measurement and payment for expansion joints, construction joints, and waterstops. Full compensation for expansion joints, construction joints, and waterstops shall be considered as included in the contract unit or lump sum prices for the various items of the Contract to which it relates.

PART 2 PRODUCTS

2.1 HORIZONTAL JOINT SEALANT

- A. Horizontal joints not requiring waterstops or when so indicated on the drawings, shall be sealed using **Sikaflex-2c NS**, or approved equal, and shall meet the requirements of ASTM C-920, Type M, Grade NS, Class 25 and FS-TT-S-00227E, Type II, Class A, and shall be NSF 61 certified (Sikaflex 2c NS EZ) if in contact with potable water. Color shall match color of concrete.

2.2 VERTICAL JOINT SEALANT

- A. Vertical joints not requiring waterstops or when so indicated on the drawings, shall be sealed using **Sikaflex-2c NS**, or approved equal, and shall meet the requirements of ASTM C-920, Type M, Grade NS, Class 25 and FS-TT-S-00227E, Type II, Class A, and shall be NSF 61 (Sikaflex 2c NS EZ) certified if in contact with potable water. Color shall match color of concrete.

2.3 JOINT PRIMER

- A. All joints receiving a joint sealant shall be primed using **Sikaflex Primers 429/202**, or approved equal.

2.4 EXPANSION JOINTS

- A. Expansion joints shall be composed of cellular fibers securely bonded together and uniformly saturated with asphalt. Joint shall be resilient, flexible, and non-extruding. Expansion joints shall meet the requirements of ASTM D 1751. Manufacturer shall be **Fibre Expansion Joint by W.R. Meadows, Fiberflex by JD Russel Company**, or approved equal.

2.5 PVC WATERSTOPS

- A. Waterstops shall be of an approved type, supplied by an approved manufacturer and shall be plastic made of virgin polyvinylchloride (PVC) compound, shall be ribbed, uniform in dimensions, dense, homogeneous, free from porosity, and as detailed on the Drawings. No reclaimed PVC shall be used in the compound. Waterstop in contact with potable water shall be NSF 61 certified.

- B. The finished waterstop material shall meet the following minimum requirements:

Tensile strength	2,000 psi min.	(ASTM D-638)
Ultimate elongation	350% min.	(ASTM D-638)
Shore hardness	75 ± 5	(ASTM D-2240)
Specific gravity	1.38 max	(ASTM D-792)
Stiffness in flexure	700 psi min.	(ASTM D-747)
Cold brittleness	No Failure at -35°F	(ASTM D-746)
Water absorption: 48 hours	0.15% max	(ASTM D-570)
Tear Resistance	290 lb./in. min.	(ASTM D-624)

C. Manufacturer, or approved equal:

1. Vinylex Waterstop & Accessories
2. Greenstreak, Inc. (Sika Corporation)
3. Durajoint Concrete Accessories

D. Factory made waterstop joints shall have a tensile strength across the joint equal to at least 600 psi. Field splices and joints shall be made in accordance with the waterstop manufacturer's instructions using a thermostatically-controlled heating iron.

2.6 HYDROPHILIC WATERSTOP

A. Non-bentonite rubber hydrophilic waterstop shall only be used where shown on the Contract Drawings or when approved by ENGINEER. Hydrophilic waterstop in contact with potable water including in potable water tank floor slabs and walls shall be NSF 61 certified. Size shall be as indicated on the Contract Drawings.

B. The hydrophilic waterstop shall meet the following physical properties:

Physical Property	Test Method	Result
Tensile Strength (Minimum)	ASTM D412	350 psi
Elongation (minimum)	ASTM D412	600 %
Hardness	ASTM D2240	52 +/-5 Shore A
Tear Resistance	ASTM D624	50 lb/in
Specific Gravity	ASTM D792	1.35 +/-5

C. Manufacturer, or approved equal:

1. Conseal CS-231
2. Sika Hydrotite CJ-1020-2K

PART 3 EXECUTION

3.1 WATERSTOPS

A. Waterstops shall be of the type indicated and shall be installed at the locations shown to form a continuous water-tight diaphragm. The waterstop shall be correctly positioned in the forms so that the center of the waterstop is centered on the joint. Waterstop shall be held in place in the forms by use of a split form or other approved method that will positively hold the waterstop in the correct position and to the correct alignment. Vibrate concrete to obtain impervious concrete in the vicinity of all joints. In horizontal joints, ensure that the areas below the water stop are completely filled with concrete.

B. Horizontal plastic waterstops shall be bent up during placing of concrete until the concrete has been brought to the level of the waterstop; additional concrete shall then be placed over the waterstop, after which the concrete shall be thoroughly vibrated. All horizontal and vertical waterstops, which are not accessible during pouring, shall be tied off in two directions every 12 inches in such a manner that bending over one way or another is prevented. A hog-ring or nail may be driven through both ends of the waterstop to facilitate placing and tying of waterstops to reinforcing steel forms or form-ties.

- C. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. All waterstops shall be properly spliced and joints shall be checked for strength and pinholes after splicing. Splices shall be strong enough to develop a pulling force of 75 percent of the strength of the waterstop, and shall be watertight. Splices in waterstop shall be made in conformance with the recommendations of the waterstop manufacturer. Continuity of cross sectional features shall be maintained across the splice. Splices showing evidence of separation after bending shall be remade.
- D. Install hydrophilic waterstop in accordance with the manufacturer's written instructions. Adhesives used on hydrophilic waterstop shall be NSF 61 certified. Adhesives shall meet the requirements of ASTM C 920 and shall be **Manus Bond 75-AM Lot NSF61, DAP Premium Polyurethane Construction Adhesive**, or approved equal.

3.2 JOINTS

- A. Joints shall be installed at locations indicated and as authorized. Joints shall be constructed so as to produce straight joints, and shall be vertical or horizontal, except where walls intersect sloping floors.
- B. Construction Joints
 1. Prior to placing the abutting concrete for all construction joints, the contact surface shall be cleaned by approved means to remove all laitance and expose the aggregate. The exposed portion of the reinforcing steel shall be cleaned of all concrete. The cleaning method shall be conducted so as to not damage waterstop, if waterstop is present. Where the joint is to receive a sealant, a recess 3/4-inch deep shall be formed along the joint using a dressed-and-oiled wood strip or other method approved by the ENGINEER. The wood strip shall be removed after the concrete has set.
- C. Expansion Joints
 1. Expansion joint filler shall be used where required on the drawings. The edges of the joint shall be neatly finished with an edging tool of 1/8-inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a recess 3/4-inch deep to be filled with sealant. The wood strip shall be removed after the concrete has set. In lieu of the wood strip a removable expansion filler cap designed and fabricated for this purpose may be used.
- D. Joint Sealant
 1. The joint cavity shall be cleaned by sandblasting or power wire brushing and shall be blown clean of dust and sand with compressed air before the joint sealant may be applied. Joints must be frost-free, free of oils, grease, curing compound residues, and any other foreign matter that might prevent bond. A bond breaker tape shall be installed over the joint per manufacturer's instructions. After the joints have been prepared as described above, the joints shall be primed and the sealant shall be applied in accordance with the manufacturer's recommendations.

- END OF SECTION -

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. This Section covers cast-in-place concrete.

1.2 RELATED WORK

- A. Related work specified in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 01 45 00 Quality Control and Material Testing
3. Section 03 10 00 Concrete Forming and Accessories
4. Section 03 20 00 Concrete Reinforcement
5. Section 31 23 23 Excavation and Backfill for Structures

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.

B. AMERICAN CONCRETE INSTITUTE (ACI)

1. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary
2. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
3. ACI 301 Structural Concrete for Buildings
4. ACI 305R Hot Weather Concreting
5. ACI 306R Cold Weather Concreting
6. ACI 318 Building Code Requirements for Structural Concrete and Commentary
7. ACI 350R Code Requirements for Environmental Engineering Concrete Structures and Commentary

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
2. ASTM C 33 Standard Specification for Concrete Aggregates
3. ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
4. ASTM C 42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
5. ASTM C 78 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
6. ASTM C 94 Standard Specification for Ready-Mixed Concrete

- 7. ASTM C 109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
- 8. ASTM C 143 Standard Test Method for Slump of Hydraulic-Cement Concrete
- 9. ASTM C 150 Standard Specification for Portland Cement
- 10. ASTM C 171 Standard Specification for Sheet Materials for Curing Concrete
- 11. ASTM C 172 Standard Specification for Sampling Freshly Mixed Concrete
- 12. ASTM C 173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- 13. ASTM C 192 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
- 14. ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- 15. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete
- 16. ASTM C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- 17. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
- 18. ASTM C 618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- 19. ASTM C 1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

D. NSF INTERNATIONAL (NSF)

- 1. NSF/ANSI 61 Drinking Water System Components - Health Effects.

1.4 DEFINITIONS

- A. Average Strength (f_{cr}): The required average strength for 30 consecutive strength tests which statistically assures not more than the permissible proportions of tests will fall below Specified Strength.
- B. Specified Strength (f_c'): The indicated strength.

1.5 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.
- B. The results of trial mix designs along with a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of each strength of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an independent commercial testing laboratory, attesting that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the work without additional tests to show that the quality of the concrete is satisfactory. Indicate whether mixes have been designed for pumping. Include in the report the following information:
 - 1. Water-cement ratio.
 - 2. Proportion of materials in the mix.
 - 3. Source and type of cement.

4. Analysis of water to be used unless potable.
 5. Type and name of admixtures applied. Indicate when accelerating or retarding admixtures are to be used and the resulting change in placement times.
 6. Slump, air content and temperature of samples.
 7. Unit weight of fresh and dry light weight concrete.
- C. Preapproved Mix Design Data: If supplier has on record, an OWNER approved mix design, submit name and address of supplier for each mix design 1 day prior to using concrete mix.
- D. Certified copies of laboratory test reports, including all test data, for aggregate, admixtures, and curing compound. These tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturers of the materials.
- E. Cementitious Materials showing Manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished, for cement and pozzolan.

1.6 QUALITY ASSURANCE

- A. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures, or aggregate without ENGINEER'S approval.
- B. In proportioning materials for mixing, use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.
- C. Do not change the quantity of cement per cubic yard for approved mix design without written approval of ENGINEER.
- D. Use of admixtures will not relax hot or cold weather placement requirements.
- E. Ready-mixed concrete to be in accordance with Alternate No. 3 of ASTM C-94 and the requirements in this Section.
- F. Tolerances for concrete construction and materials shall be in accordance with ACI 117.

1.7 PRODUCT STORAGE AND HANDLING

- A. Store bagged and bulk cement in weatherproof enclosures to exclude moisture and contaminants.
- B. Stockpile aggregate to avoid segregation and prevent contamination.
- C. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.

1.8 MEASUREMENT AND PAYMENT

- A. Cast-in-place concrete shall not be measured or paid as a separate item, but shall be included as part of the various items to which it relates.

PART 2 PRODUCTS

2.1 ADMIXTURES

- A. Air Entrainment: ASTM C 260.
- B. Later Reducing and Set Retarding Agents: ASTM C494.
 - 1. Type A: Set water reducing.
 - 2. Type B: Set retarding.
 - 3. Type C: Set accelerating.
 - 4. Type D: Water reducing and set retarding.
 - 5. Type E: Water reducing and set accelerating.
 - 6. Type F: High range water reducing (super plasticizer).*
 - 7. Type G: High range water reducing and set retarding.*
- * The relative durability factor of water reducing admixtures shall not be less than 80 and the chlorides content (as Cl⁻) expressed as a percent of the cement shall not exceed 0.1 percent by weight.
- C. Calcium Chloride: None allowed.
- D. Pozzolan: Pozzolan conforming to the requirements of ASTM C 618, Class F, is allowed as a Portland cement replacing agent under the following conditions:
 - 1. The maximum percentage of Portland cement replacement is:
 - a. 15 percent, for concrete exposed to weather.
 - b. 20 percent, for interior concrete.
 - 2. Pozzolan should not exceed 25% by weight of the cement plus pozzolans.
 - 3. The minimum cement content shall be used in the design formulas before replacement is made.
 - 4. Loss of ignition of pozzolan is less than 3 percent and the water requirement does not exceed 100 percent.
 - 5. All other requirements of this section still apply.
 - 6. Mix designs including trial batches are required for each aggregate source and for each concrete class.
- E. Cementitious Materials showing Manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished, for cement and pozzolan.

2.2 CEMENTITIOUS MATERIALS

- A. Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall conform to one of the following:
 - 1. Cement: Use Portland cement, ASTM C 150, Type II, Type IIA, or Type V, low alkali, unless noted otherwise.

2. Portland - Pozzolan Cement: ASTM C-595, Type IP-A(MS). Do not use Pozzolan cement unless approved by ENGINEER

B. Only one brand of cement from one manufacturing plant may be used.

2.3 AGGREGATES

A. Aggregates shall be natural aggregates, free from deleterious coatings, and shall conform to the requirements of ASTM C 33, except as modified herein. Aggregates shall not be potentially reactive as defined in Appendix XI of ASTM C 33. CONTRACTOR shall import nonreactive aggregates if local aggregates are reactive.

B. Fine Aggregates

1. Fine aggregate shall consist of clean, sharp, natural sand and shall conform to the requirements of ASTM C 33. Fine aggregate shall be graded as follows:

FINE AGGREGATES	
Sieve Size	Percent Passing by Weight
3/8 inch	100
#4	95-100
#8	80-100
#16	50-85
#30	25-60
#50	10-30
#100	2-10

2. Fine aggregates shall have no more than two percent by weight passing #200 sieve.

C. Coarse Aggregate

1. Coarse aggregate shall be washed gravel or crushed stone, or a combination of these materials, consisting of hard, tough, durable particles free from adherent coatings. It shall contain no more than 15 percent flat or elongated particles. A thin, flat or elongated particle is defined as a particle having a maximum dimension in excess of five times its minimum dimension. Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered in the work under consideration shall be not be used. Coarse aggregate shall be graded as follows (ASTM C 33):

COARSE AGGREGATES	
Sieve Size	Percent Passing by Weight
1-1/2 inch	100
1 inch	95-100
1/2 inch	25-60
#4	0-10
#8	0-5

2. Coarse aggregates shall have no more than 1.75 percent by weight passing #200 sieve. Proof of gradation will be provided to ENGINEER by CONTRACTOR.

2.4 ACI MIX DESIGN

- A. The amount by which the average strength (f_{cr}) of a concrete mix exceeds the specified compressive strength (f'_c) shall be based upon no more than 1 in 100 random individual strength tests falling more than 500 psi below the specific strength.
- B. Proportion the materials in accordance with ACI 211.1, 211.2 or 211.3 as applicable to produce concrete having the properties or limitations of Table No. 03 30 00-A.

2.5 HAND MIXING

- A. Do not hand mix batches exceeding 0.5 cubic yards.
- B. Hand mix only on watertight platform. Mix cement and aggregate prior to adding water.
- C. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency.

2.6 HEATING, WATER AND AGGREGATE

- A. Do not allow products of fuel combustion to contact the aggregate.
- B. Heat mixing water to maximum temperature of 150 degrees F. Heat aggregates uniformly.
- C. Do not mix cement with water and aggregate at a mix temperature greater than 100 degrees F.

2.7 WATER

- A. Water shall be potable, except that non-potable water may be used if it produces mortar cubes having 7- and 28-day strengths at least 90 percent of the strength of similar specimens made with water from a municipal supply. The strength comparison shall be made on mortars, identical except for mixing water, prepared and tested in accordance with ASTM C 109. Water for curing shall not contain any substance injurious to concrete, or which causes staining.

2.8 PROPORTIONS OF MIX

- A. Mixture Proportioning, Normal Weight Concrete: All concrete that must be watertight and resistant to freeze-thaw cycles and to naturally occurring or commonly used chemicals should be air entrained. All materials should be proportioned to produce a well-graded mixture of high density and maximum workability with a minimum specified 28 day compressive strength of concrete classification. Trial batches shall contain materials proposed to be used in the project. Trial mixtures having proportions, consistencies and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios. Trial mixes shall be proportioned to produce concrete strengths specified. In the case where ground iron blast-furnace slag is used, the weight of the slag will be substituted in the equations for the term P which is used to denote the weight of pozzolan. Trial mixtures shall be designed for maximum permitted slump and air content. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results a curve shall be plotted

showing the relationship between water-cement ratio and strength. Maximum water-cement or water-cement plus pozzolan Ratio: 0.45.

- B. Average Strength: In meeting the strength requirements specified, the selected mixture proportion shall produce an average compressive strength exceeding the specified strength by the amount indicated below. Where a concrete production facility has test records, a standard deviation shall be established. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths within 1000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at other test age designated for determination of the specified strength.

TABLE NO. 03 30 00-A

CONCRETE MIX PROPERTIES (e)			
CONCRETE PROPERTIES	CONCRETE CLASSIFICATION(S)		
	Class 4000	Class 3500	Class 3000
Specified Compressive Strength f_c at 28 days, min., psi	4000	3500 (d)	3000 (d)
Compressive Strength at 7 days, min., psi (a)	2680	2345	2010
Cement content (94 lb. sacks of cement per cubic yard of concrete), min. (b)	6.0	5.75	5.5
Entrained air content, (% by volume).	6±1	6±1	6±1
Slump Range, in. (c)	1 - 4 (f)	2 - 4	2 - 4

(a) Used for monitoring purposes only.

(b) May include pozzolan replacements if approved by ENGINEER.

(c) Not more than 8 inches after adding high range water reducing admixture (super-plasticizer) at site.

(d) Not allowed if concrete is exposed to freezing and thawing temperatures. Use Class 4000 or higher compressive strength and 6±1.0 percent air entrainment.

(e) All mix designs must be approved by ENGINEER.

(f) 1-3" for footings, sub-structural walls and 1-4" for slabs, beams, reinforced walls and columns.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACES

- A. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Conduit and other similar items shall be in place and clean of any deleterious substance.

- B. Foundations: Earthwork shall be as specified. Flowing water shall be diverted without washing over freshly deposited concrete. Rock foundations shall be cleaned by high velocity air-water jets, sandblasting, or other approved methods. Debris and loose, semi-detached or unsound fragments shall be removed. Rock surfaces shall be moist but without free water when concrete is placed. Semi porous subgrades for foundations and footings shall be damp when concrete is placed. Pervious subgrades shall be sealed by blending impervious material with the top 6 inches of the in-place pervious material or by covering with an impervious membrane.
- C. Preparation of Previously Placed Concrete: Concrete surfaces to which other concrete is to be bonded shall be roughened in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be moist but without free water when concrete is placed.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Embedded items shall be free from oil, loose scale or rust, and paint. Embedded items shall be installed at the locations indicated and required to serve the intended purpose. Voids in sleeves, slots and inserts shall be filled with readily removable material to prevent the entry of concrete.

3.3 BATCHING, MIXING AND TRANSPORTING CONCRETE

- A. Ready-mixed concrete shall be batched, mixed and transported in accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and non-agitating units shall comply with NRMCA TMMB-1. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA-QC 3.
- B. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quantity and quality of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by ENGINEER.
- C. Truck mixers and their operation must be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than 1 inch when the specified slump is 3 inches or less, or more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- D. Admixtures: Admixtures shall be batched within an accuracy of 3 percent. Where two or more admixtures are used in the same batch, they shall be batched separately and must be compatible. Retarding admixture shall be added within one minute after addition of water is complete or in the first quarter of the required mixing time, whichever is first. Superplasticizing admixtures shall be added at the project site, and the concrete with the admixture shall be mixed 4 to 5 minutes before placing as recommended by manufacturer. Concrete that shows evidence of total collapse or segregation caused by the use of

admixture shall be removed from the site.

- E. Control of Mixing Water: No water from the truck system or elsewhere shall be added after the initial introduction of mixing water for the batch. No water shall be added at the jobsite without the approval of ENGINEER.

3.4 SAMPLING AND TESTING

- A. Sampling and Testing of the concrete will be as defined in Section 01 45 00 – Quality Control and Material Testing.
 - 1. Aggregates: Aggregates for normal weight concrete shall be sampled and tested in accordance with ASTM C 33.
 - 2. Sampling of Concrete: Samples of concrete for air, slump, unit weight, and strength tests shall be taken in accordance with ASTM C 172.
 - a. Air Content: Test for air content shall be performed in accordance with ASTM C 173 or ASTM C 231. A minimum of 1 test shall be conducted each time a slump test is made.
 - b. Slump: At least 1 slump test shall be made on randomly selected batches of each mixture of concrete for every 100 cubic yards of ready-mixed concrete delivered to the job site. Also note the time batched at the plant and the starting time when unloading began at the site. Tests shall be performed in accordance with ASTM C 143.
 - c. Temperature: Concrete and air temperatures shall be measured and recorded with each set of cylinders and the air temperature shall also be recorded when the air temperature at the site is 40 degrees F or below and/or 90 degrees F or above.
 - 3. Evaluation and Acceptance of Concrete
 - a. Frequency of Testing: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 3000 square feet of surface area for slabs or walls. If this sampling frequency results in less than 5 strength tests for a given class of concrete, tests shall be made from at least 5 randomly selected trucks or from each truck if fewer than 5 truck loads are used. Field cured specimens for determining form removal time or when a structure may be put in service shall be made in numbers directed to check the adequacy of curing and protection of concrete in the structure. The specimens shall be removed from the molds at the age of 24 hours and shall be cured and protected, insofar as practicable, in the same manner as that given to the portion of the structure the samples represent.
 - b. Testing Procedures: Cylinders for acceptance tests shall be molded and cured in accordance with ASTM C 31. Cylinders shall be tested in accordance with ASTM C 39. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at another specified test age.
 - c. Evaluation of Results: Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength and no individual strength test result falls below the required strength by more than 500 pounds per square inch.

- d. Unless noted otherwise, make a minimum of five (5) concrete cylinders each time a test is required. When concrete is being placed in suspended slabs, beams and retaining walls make two (2) extra cylinders which must be cured on site. The extra cylinders will be used to determine when to remove forms and/or when to backfill.
- B. Investigation of Low-Strength Test Results: When any strength test of standard-cured test cylinder falls below the specified strength requirement by more than 500 pounds per square inch, or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803 or ASTM C 805 may be permitted by ENGINEER to determine the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection. When strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores shall be determined by ENGINEER to least impair the strength of the structure. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for seven days before testing and shall be tested dry. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C 42. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to or at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. If the core tests are inconclusive or impractical to obtain, or if structural analysis does not confirm the safety of the structure, load tests may be directed by ENGINEER in accordance with the requirements of ACI 318. Concrete work evaluated by structural analysis or by results of a load test and found deficient shall be corrected in a manner satisfactory to ENGINEER. All investigations, testing, load tests, and correction of deficiencies shall be performed, and approved by ENGINEER, at the expense of CONTRACTOR.

3.5 CONVEYING CONCRETE

- A. Concrete shall be conveyed from mixer to forms as rapidly as possible and within the time interval specified in paragraph 3.6 CONCRETE PLACEMENT by methods which will prevent segregation or loss of ingredients.
- 1. Chutes: When concrete can be placed directly from a truck mixer or other transporting equipment, chutes attached to this equipment may be used. Separate chutes will not be permitted except when specifically approved.
 - 2. Buckets: Bucket design shall be such that concrete of the required slump can be readily discharged. Bucket gates shall be essentially grout tight when closed. The bucket shall provide means for positive regulations of the amount and rate of deposit of concrete in each dumping position.
 - 3. Belt Conveyors: Belt conveyors may be used when approved. Belt conveyors shall be designed for conveying concrete and shall be operated to assure a uniform flow of concrete to the final place of deposit without segregation or loss of mortar. Conveyors shall be provided with positive means for preventing segregation of the concrete at transfer points and point of placement.

4. Pumps: Concrete may be conveyed by positive displacement pumps when approved. Pump shall be the piston or squeeze pressure type. Pipeline shall be steel pipe or heavy duty flexible hose. Inside diameter of the pipe shall be at least three times the maximum size of the coarse aggregate. Distance to be pumped shall not exceed the limits recommended by the pump manufacturer. Concrete shall be supplied to the pump continuously. When pumping is completed, the concrete remaining in the pipeline shall be ejected without contaminating the concrete in place. After each use, the equipment shall be thoroughly cleaned. Flushing water shall be wasted outside the forms.

3.6 CONCRETE PLACEMENT

- A. Mixed concrete which is transported in truck mixers or agitators or concrete which is truck mixed, shall be discharged within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. These limitations may be waived by ENGINEER if the concrete is of such slump after the 1-1/2 hour time or 300 revolution limit has been reached that it can be placed, without the addition of water to the batch. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the truck.
 1. Placing Operation: Concrete shall be handled from mixer to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by CONTRACTOR prevent proper consolidation, finishing and curing. Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 4 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Concrete should not be allowed to drop through a cage of reinforcing steel. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screened to the proper level to avoid excessive shimming or grouting.
 2. Consolidation: Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 8000 vibrations per minute, and the head diameter and amplitude shall be appropriate for the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then withdrawn slowly. The use of form vibrators must be specifically approved. Vibrators shall not be used to transport concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique.

- B. Cold Weather Requirements: Special protection measures, approved by ENGINEER, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. Provisions should be made to keep the concrete at a minimum temperature of 50 degrees F for 7 days. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. No concrete shall be placed on frozen ground. The temperature of the concrete when placed shall be not less than 55 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Calcium chloride shall not be used.
- C. Hot Weather Requirements: The temperature of the concrete placed during hot weather shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 95 degrees F.

3.7 CONSTRUCTION JOINTS

- A. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of ENGINEER. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete is no longer plastic, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints are required, a strip of 1-inch square-edge lumber, beveled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph 3.1, PREPARATION OF SURFACES.

3.8 FINISHING CONCRETE

- A. Formed Surfaces
 - 1. Repair of Surface Defects: Surface defects shall be repaired within 24 hours after the removal of forms. Honeycombed and other defective areas shall be cut back to solid concrete or to a depth of not less than 1 inch, whichever is greater. Edges shall be cut perpendicular to the surface of the concrete. The prepared areas shall be dampened and brush-coated with neat cement grout. The repair shall be made using mortar consisting of not more than 1 part cement to 2-1/2 parts sand. The mixed mortar shall be allowed to stand to stiffen (approximately 45 minutes), during which time the mortar shall be intermittently remixed without the addition of water. After the mortar has attained the stiffest consistency that will permit placing, the patching mix shall be thoroughly tamped into place by means approved by ENGINEER and finished slightly higher than the surrounding surface. For Class A and Class B finished surfaces the cement used in the patching mortar shall be a blend of job cement and

- white cement proportioned to produce a finished repair surface matching, after curing, the color of adjacent surfaces. Holes left after the removal of form ties shall be cleaned and filled with patching mortar. Holes left by the removal of tie rods shall be reamed and filled by dry-packing. Repaired surfaces shall be cured as required for adjacent surfaces. The temperature of concrete, mortar patching material, and ambient air shall be above 50 degrees F while making repairs and during the curing period. Concrete with defects which affect the strength of the member or with excessive honeycombs will be rejected, or the defects shall be corrected as directed.
2. Class A Finish: Where a Class A finish is indicated, fins shall be removed. A mortar mix consisting of one-part Portland cement and two parts well-graded sand passing a No. 30 sieve, with water added to give the consistency of thick paint, shall be prepared. White cement shall be used to replace part of the job cement. After the surface has been thoroughly wetted and allowed to approach surface dryness, the mortar shall be vigorously applied to the area by clean burlap pads or by cork or wood-floating, to completely fill all surface voids. Excess grout shall be scraped off with a trowel. As soon as it can be accomplished without pulling the mortar from the voids, the area shall be rubbed with burlap pads until all visible grout film is removed. The rubbing pads shall have on their surfaces the same sand-cement mix specified above but without any mixing water. The finish of any area shall be completed in the same day, and the limits of a finished area shall be made at natural breaks in the surface. The surface shall be continuously moist cured for 48 hours. The temperature of the air adjacent to the surface shall be not less than 50 degrees F for 24 hours prior to, and 48 hours after, the application. In hot, dry weather the smooth finish shall be applied in shaded areas.
 3. Class B Finish: Where a Class B finish is indicated, fins shall be removed. Concrete surface shall be smooth with a texture at least equal to that obtained through the use of Grade B-B plywood forms.
 4. Class C Finish: Where a Class C finish is indicated, fins shall be removed. Concrete surfaces shall be relatively smooth with a texture imparted by the forms used.
 5. Class D Finish: Where a Class D finish is indicated, fins exceeding 1/4 inch in height shall be chipped or rubbed off. Concrete surfaces shall be left with the texture imparted by the forms used.
- B. Unformed Surfaces: In cold weather, the air temperature in areas where concrete is being finished shall not be less than 50 degrees F in accordance with ACI 306R. In hot windy weather when the rate of evaporation of surface moisture, as determined by methodology presented in ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour; coverings, windbreaks, or fog sprays shall be provided as necessary to prevent premature setting and drying of the surface. The dusting of surfaces with dry materials or the addition of water during finishing will not be permitted. Finished surfaces shall be plane, with no deviation greater than 5/16-inch when tested with a 10-foot straightedge. Surfaces shall be pitched to drains.
1. Rough-Slab Finish: Slabs to receive fill or mortar setting beds shall be screened with straightedges immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible.
 2. Float Finish: Slabs to receive a steel trowel finish and slabs where indicated shall be given a float finish. Screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. After the concrete has stiffened to permit the operation and the water sheen has disappeared, it shall be wood floated. Concrete that portrays stickiness shall be finished with a

magnesium float in lieu of a wood float, and left free of ridges and other projections. Float finish is normally specified for surfaces that will receive other treatment such as built-up roofing, nonslip surfacing material. Float Finish shall not be used on wearing surfaces.

3. Trowel Finish: Slabs where indicated, shall be given a trowel finish immediately following floating. Surfaces shall be trowelled to produce smooth, dense slabs free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. A final hard steel troweling shall be done by hand. Trowel finish shall be used on wearing surfaces and where a smooth finish is required.
4. Broom Finish: After floating, slabs where indicated, shall be lightly troweled, and then broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.

3.9 CURING AND PROTECTION

- A. General: All concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
Concrete with Type II or IIA, or V, low alkali cement	7 days
Concrete with Type IP-A(MS) cement blended with pozzolan	10 days

- B. Immediately after placement, concrete shall be protected from premature drying extremes in temperatures, rapid temperature change, mechanical injury and injury from rain and flowing water. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. All materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat shall be permitted near or in direct contact with the concrete at any time. Curing shall be accomplished by any of the following methods, or combination thereof, as approved.
- C. Moist Curing: Concrete to be moist-cured shall be maintained continuously wet for the entire curing period. If water or curing materials used stains or discolors concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned. When wooden forms are left in place during curing, they shall be kept wet at all times. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Horizontal surfaces shall be cured by ponding, by covering with a 2-inch minimum thickness of continuously saturated sand, or by covering with waterproof paper, polyethylene sheet, polyethylene-coated burlap or saturated burlap. Once the moist curing has started the concrete surface must not be allowed to become surface dry for the entire curing period.
- D. Membrane Curing: Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete; except a styrene acrylate or chlorinated rubber compound meeting ASTM C 309, Class B requirements may be used for surfaces which are to be painted or are to receive

bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. Surfaces shall be thoroughly moistened with water and the curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. Compound shall be applied in a one-coat continuous operation by mechanical spraying equipment, at a uniform coverage in accordance with the manufacturer's printed instructions. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. On surfaces permanently exposed to view, the surface shall be shaded from direct rays of the sun for the duration of the curing period. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

- END OF SECTION -

**SECTION 03 30 05
SAMPLING AND TESTING**

This specification changes a portion of APWA Standard Specification Section 03305. All other provisions of the Section remain in full force and effect.

Add the following:

1.6 ACCEPTANCE

A. At the Site:

1. Sampling: ASTM C 172. Reject non-complying batches until 2 consecutive batches are compliant then proceed in random batch testing for acceptance.

Table 1 – Concrete Mix				
Rate of Placement (Cubic Yard / Day)	Temperature	Air	Slump	Strength
0 - 8	1	1	1	Determined by ENGINEER
0 - 50	1	1	1	1
Each additional 50 cu. yd. or fraction thereof	1	1	1	1
NOTES (a) Sampled at discharge chute prior to placement, or at pumper hose after priming grout has been wasted.				

2. Temperature, ASTM C 1064.
3. Air content, ASTM C 231 or ASTM C 173 if lightweight aggregate is used.
4. Slump, ASTM C 143.

B. At the Laboratory:

1. Compressive strength, ASTM C 31.
2. Flexure strength, ASTM C 78.

END OF SECTION

SECTION 03 60 00
GROUT

PART 1 GENERAL

1.1 REQUIREMENTS

- A. CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents.
- B. Unless indicated otherwise, grouts shall be provided as listed in this Section whether indicated on the Drawings or not.
- C. The following types of grout are covered in this Section:
 - 1. Cement Grout
 - 2. Non-Shrink Grout – Class I (cement based)
 - 3. Non-Shrink Grout – Class II (cement based)
 - 4. Non-Shrink Epoxy Grout
 - 5. Epoxy Anchor Grout for Adhesive Anchors
 - 6. Topping Grout and Concrete/Grout Fill

1.2 RELATED WORK

- A. Related work specified in other Sections includes:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 01 60 00 Product Requirements
 - 3. Section 03 30 00 Cast-in-Place Concrete

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. American Society for Testing Materials (ASTM)
 - 1. ASTM C 33 Standard Specification for Concrete Aggregates
 - 2. ASTM C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - 3. ASTM C 150 Standard Specification for Portland Cement
 - 4. ASTM C 307 Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
 - 5. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
 - 6. ASTM C 496 Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
 - 7. ASTM C 531 Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 - 8. ASTM C 579 Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes

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|-----|-------------|---|
| 9. | ASTM C 580 | Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes |
| 10. | ASTM C 827 | Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures |
| 11. | ASTM C 881 | Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete |
| 12. | ASTM C 882 | Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear |
| 13. | ASTM C 939 | Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method) |
| 14. | ASTM C 942 | Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory |
| 15. | ASTM C 1090 | Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout |
| 16. | ASTM C 1107 | Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) |
| 17. | ASTM C 1339 | Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts |
| 18. | ASTM D 648 | Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position |
| 19. | ASTM D 695 | Standard Test Method for Compressive Properties of Rigid Plastics |

1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures.
- B. Provide the following submittals for each type of grout used on the project:
 1. Test reports accompanied by a manufacturer’s statement that previously tested material is of similar type, quality, and manufacture as that which is proposed for use on this project shall be submitted for:
 - a. Cement
 - b. Aggregates
 - c. Retardants
 - d. Bonding compounds
 - e. Epoxy Resin
 2. Certifications that grouts used on the project contain no chlorides or other chemicals that cause corrosion.
 3. Manufacturer’s literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the WORK, and location of use. ICBO/ES report shall be submitted for epoxy anchor grout for adhesive anchors.
 4. Manufacturer’s certification that non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.
 5. Submit manufacturer's written warranty as indicated herein.

6. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grouts.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Grout and grout materials shall be stored in a dry shelter, protected from moisture, and for prepackaged grout, maintained in accordance with the manufacturer's recommendations.

1.6 QUALITY ASSURANCE

- A. The work shall be subject to inspection at all times by the OWNER and ENGINEER for the purpose of determining that the work is properly executed in accordance with this specification. Failure to detect defective workmanship or material during any interim inspection shall not constitute acceptance of workmanship and materials.
- B. All testing will be done by a testing laboratory at CONTRACTOR'S expense, except as otherwise indicated.
- C. Field Tests
 1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by the ENGINEER.
 2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C 1107, at intervals during construction selected by the ENGINEER. A set of 3 specimens will be made for testing at 7 Days, 28 Days, and each additional time period as appropriate.
 3. Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 31 00 - Cast-in-Place Concrete, at intervals during construction selected by the ENGINEER.
 4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C 579, Method B, at intervals during construction selected by the ENGINEER. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.
- D. Construction tolerances shall be as indicated in Section 03 31 00 Cast-in-Place Concrete unless noted otherwise.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cement: Portland cement shall be ASTM C 150 Type II of Type V.
- B. Aggregate:
 1. General: Aggregate shall be non-reactive and shall be washed before use. When sources of aggregate are changed, test reports shall be provided for the material from the new source prior to commencing grout work.

2. Fine Aggregate: Fine aggregate shall be sand or crush stone conforming to ASTM C 33 as modified herein. When tested in accordance with ASTM C 136, gradation shall be such that 100 percent by weight passes a No. 8 sieve and not less than 45 percent by weight passes a standard No. 40 sieve. Variation from the specified gradation in individual tests will be accepted if the average of three consecutive tests is within the following variation:

Standard Sieve	Permissible Variation in Individual Test
No. 30 or coarser	2% by weight
No. 50 or finer	0.5% by weight

C. Admixtures

1. General: Admixtures shall be compatible with the grout and shall comply with the manufacturer's recommendations. Admixtures shall be added to the grout mix separately.
2. Water Reducing Retarder: Water reducing retarder shall comply with ASTM C 494, Type D and shall be **Master Builders (BASF) MasterSet R 300, Sika Corporation Plastiment**, or approved equal.
3. Lubricant: Lubricant additive for cement pressure grouting shall be **Sika Intraplast**, or approved equal.

D. Water:

1. Water for washing aggregate, for mixing and for curing shall be potable, shall not contain more than 1,000 mg/L of chlorides as Cl, nor more than 1,300 mg/L of sulfates as SO₄, and shall not contain impurities which may change the setting time by more than 25 percent or a reduction of more than 5 percent of the compressive strength of the grout at 14 days when compared to the results for grout made with distilled water.

2.2 CEMENT GROUT

- A. Application: Surface repairs of concrete.
- B. Cement grout shall be composed of one part cement, 3 parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 Days shall be 4000 psi.
- C. Cement grout materials shall be as indicated in Section 03 31 00 Cast-in-Place Concrete.

2.3 NON-SHRINK GROUT

A. General

1. Non-shrink cementitious grout shall be a flowable, prepackaged, inorganic, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used. The manufacturer shall have at least 10 years' experience in the manufacture of cement based grouts. The

- manufacturer shall provide technical services and provide a representative at the jobsite for product training prior to product installation.
2. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the particular application.
 3. Grout shall not contain chlorides or additives that may contribute to corrosion.
 4. Grout shall be formulated to be used at any consistency from fluid to plastic.
 5. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:
 - a. Minimum tensile splitting strength of 500 psi per ASTM C 496.
 - b. Minimum flexural strength of 1,000 psi per ASTM C 580.
 - c. Minimum bond strength (concrete to grout) of 1,900 psi per modified ASTM C 882.
 - d. Grout shall be certified for use in freeze/thaw environments.

B. Class I Non-Shrink Grout

1. Application: Anchor bolts and reinforcing steel required to be set in grout in which the average working or operating temperature will be over 100 degrees F or in high fire risk areas; Beam and column (1 or 2 story) base plates less than 16-inches in the least dimension; Storage tanks and other non-motorized equipment and machinery under 30 horsepower; Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.; Repair of holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material; and any other location not specifically listed in this Section or on the Drawings.
2. Class I non-shrink grout shall have a minimum 28 Day compressive strength of 5,000 psi when mixed at a fluid consistency.
3. Class I non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.
4. Grout shall have a maximum early age height change of 4.0% expansion, and shall have no shrinkage (0.0%) in accordance with ASTM C 827. The grout when tested shall not bleed or segregate at maximum allowed water.
5. Grout shall have no shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with ASTM C 1090.
6. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.
7. Class I Non-Shrink Grout shall be **Five Star Grout by Five Star Products, Sikagrout 212 by Sika Corporation, CB-G PG by Hilti**, or equal.

C. Class II Non-Shrink Grout

1. Application: Column base plates (greater than 2 story or larger than 16-inches in the least dimension); under precast concrete elements; and repair of holes and defects in concrete members which are water bearing or in contact with soil or other fill materials.
2. Class II non-shrink grout shall be a high precision, fluid, extended working time, grout. The minimum 28-Day compressive strength shall be 7,500 psi, when mixed at a fluid consistency.
3. Grout shall have a maximum early age height change of 4.0% expansion, and shall have no shrinkage (0.0%) in accordance with ASTM C 827.
4. Grout shall have no shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with ASTM C 1090.

5. Class II non-shrink grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C 827 at temperature extremes of 45 to 90 degrees F in accordance with ASTM C 1107.
6. Class II non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C 939.
7. The grout when tested shall not bleed or segregate at maximum allowed water content.
8. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.
9. Class II non-shrink grout shall be **Five Star Fluid Grout 100 by Five Star Products, Crystex by L&M Construction Chemicals**, or equal.

2.4 NON-SHRINK EPOXY GROUT

- A. Application: Pumps over 1,000 horsepower, unless indicated otherwise.
- B. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.
- C. Epoxy grout shall have a maximum early age height change of 4.0% expansion, and shall have no shrinkage (0.0%) in accordance with ASTM C 827, (modified for epoxy grouts by using an indicator ball with a specific gravity between 0.9 and 1.1).
- D. Epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 18×10^{-6} in/in F when tested according to ASTM C 531.
- E. The epoxy grout shall develop a minimum compressive strength of 9,000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C 579, method B.
- F. The mixed epoxy grout shall have a minimum working life of 90 to 120 minutes at 70 degrees F.
- G. The effective bearing area shall be a minimum of 95 percent EBA in accordance with ASTM C 1339.
- H. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.
- I. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:
 1. Minimum bond strength to concrete of 3,000 psi per ASTM C 882 modified.
 2. Minimum bond strength to steel of 1,700 psi per ASTM C 882 modified.
 3. Minimum flexural strength of 2,500 psi per ASTM C 580.
 4. Minimum tensile strength of 2,000 psi per ASTM C 307.

- J. Non-shrink epoxy grout shall be **Five Star DP Epoxy Grout by Five Star Products, Inc., Sikadur 42 Grout-Pak by Sika Corporation**, or equal.

2.5 EPOXY ANCHOR GROUT

- A. Application: Anchor bolts and reinforcing steel required to be set in grout that is not in high temperature or high fire risk areas.
- B. Epoxy anchor grout shall conform to ASTM C 881, Type IV, Class A, B, and C, Grade 3 with the exception of gel time.
- C. Heat deflection temperature shall be a minimum of 139 °F per ASTM D 648.
- D. Manufacturer shall certify that the epoxy anchor grout will maintain 90 percent of its strength up to a temperature of 125 °F.
- E. Grout shall come in a 2 chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.
- F. Epoxy anchor grout shall be capable of being used in submersed applications once cured.
- G. Minimum compressive strength shall be 12,000 psi per ASTM D 695.
- H. Overhead anchors and anchors in fire-resistive construction shall be cast-in anchors.
- I. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar. Embedment shall not exceed 67 percent of the member depth.
- J. Epoxy anchor grout shall be **Epcon C6+ by ITW Ramset/Red Head, Power-Fast Epoxy Injection Gel by Powers Fasteners, RE 500 by Hilti**, or equal.

2.6 TOPPING GROUT AND CONCRETE/GROUT FILL

- A. Where fill is thicker than 3-inches, structural concrete as indicated in Section 03 31 00 - Cast-in-Place Concrete, may be used when accepted by the ENGINEER.
- B. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and be mixed as indicated. Materials and procedures indicated for normal concrete in Section 03 31 00 - Cast-in-Place Concrete, shall apply unless indicated otherwise.
- C. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Topping grout in clarifiers shall contain between 750 and 800 pounds of cement per cubic yard with a maximum water cement ratio of 0.42.

D. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
1/2 in	100
3/8 in	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

- E. Final mix design shall be as determined by trial mix design as indicated in Section 03 30 00 - Cast-in-Place Concrete.
- F. Topping grout and concrete grout/fill shall contain air-entraining agent per Section 03 30 00 – Cast-in-Place Concrete.
- G. **Strength:** Minimum compressive strength of topping grout and concrete/grout fill at 28 Days shall be 4,000 psi.

2.7 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.
- B. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.
- B. Rough concrete lightly, but not enough to interfere with placement of grout.
- C. Remove foreign materials from metal surfaces in contact with grout.
- D. Align, level, and maintain final positioning of components to be grouted.

3.2 GENERAL

- A. CONTRACTOR shall arrange for the manufacturer of prepackaged grouts to provide on-Site technical assistance within 72 hours of request, as part of the WORK.
- B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the ENGINEER.
- C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed. Concrete substrate shall not be wet prior to placement of epoxy grouts.
- D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 31 00 – Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.
- E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.
- F. Shade the WORK from sunlight for at least 24 hours before and 48 hours after grouting.
- G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.3 GROUTING PROCEDURES

- A. **General:** Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.
 - 1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.
 - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the ENGINEER, alternate grouting methods shall be submitted for acceptance by the ENGINEER.
 - 3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.
- C. Drilled Anchors and Reinforcing Bars
 - 1. General

- a. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, and cleaned. Drilled anchors shall not be installed until the concrete has reached the required 28 Day compressive strength. Anchors shall not be loaded until the grout has reached its indicated strength in accordance with the manufacturer's instructions.
 - b. The CONTRACTOR shall identify position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in coring and drilling to avoid damaging existing reinforcing or embedded items. Notify the ENGINEER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.
2. Epoxy Adhesive Anchors
- a. Grout shall be proportioned and mixed with automatic equipment.
 - b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICBO/ES report, but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.
 - c. Holes required for grouting shall be blown or vacuumed clean and are to be free of dust and standing water. Horizontal holes for grouting are to be drilled at a slight downward angle and with the inserted dowel or bolt bent to match.
3. Cement Based Non-Shrink Grout
- a. In places of high temperature or fire hazard, anchor bolts shall be grouted in using cement based non-shrink grout, Class I.
 - b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICBO/ES report, but shall not be less than 16 diameters for threaded rod or 24 diameters for reinforcing or smooth bars.
 - c. When the bolt diameter is one-inch or less, the hole diameter should be a minimum of 2-inches. When the bolt diameter is greater than one-inch, the hole diameter should be at least twice the bolt diameter.
 - d. Drilled holes shall be saturated with water for not less than 24 hours before installation of anchor/rod/rebar.
 - e. The non-shrink grout should be placed in the holes in a non-sag (trowelable) consistency. The grout should be placed in the holes before the anchor and then the anchor inserted and vibrated to ensure proper coverage.

D. Topping Grout and Concrete/Grout Fill

1. Mechanical, electrical, and finish WORK shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively where accepted by the ENGINEER, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.

2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.
3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) -- Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots that shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.
6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the ENGINEER, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.4 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

3.5 CURING

- A. Cement based grouts shall be cured per 03 30 00 – Cast-in-Place Concrete and per the manufacturer's recommendations.

- END OF SECTION -

SECTION 04 21 13
BRICK MASONRY

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers structural brick masonry and appurtenant work.

1.2 RELATED WORK

- A. Related work in other sections includes but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 03 20 00 Concrete Reinforcement
3. Section 03 30 00 Cast-in-place Concrete
4. Section 07 21 00 Insulation
5. Section 09 90 00 Painting and Finishes

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. AMERICA CONCRETE INSTITUTE (ACI)

1. ACI SP-66 ACI Detailing Manual
2. ACI 530 Building Code Requirements for Masonry Structures
3. ACI 530.1 Specifications for Masonry Structures

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
2. ASTM A 951 Standard Specification for Steel Wire for Masonry Joint Reinforcement
3. ASTM A 1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
4. ASTM C 67 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
5. ASTM C 144 Standard Specification for Aggregate for Masonry Mortar
6. ASTM C 150 Standard Specification for Portland Cement
7. ASTM C 207 Standard Specification for Hydrated Lime for Masonry Purposes
8. ASTM C 270 Standard Specification for Mortar for Unit Masonry
9. ASTM C 404 Standard Specification for Aggregates for Masonry Grout
10. ASTM C 476 Standard Specification for Grout for Masonry
11. ASTM C 578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
12. ASTM C 652 Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
13. ASTM C 1019 Standard Test Method for Sampling and Testing Grout

14. ASTM C 1314	Standard Test Method for Compressive Strength of Masonry Prisms
15. ASTM C 1384	Standard Specification for Admixtures for Masonry Mortars
16. ASTM D 226	Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
17. ASTM D 2000	Standard Classification System for Rubber Products in Automotive Applications
18. ASTM D 2287	Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
19. ASTM E 514	Standard Test Method for Water Penetration and Leakage Through Masonry
20. ASTM E 518	Standard Test Methods for Flexural Bond Strength of Masonry

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit manufacturer's product data for each type of structural brick unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements and color samples. Submit certificates showing compliance to the specifications for reinforcing steel, manufacturer's literature for anchor ties and any other accessories used, grout and mortar mix design, samples for mortar color selection, and manufacturer's literature for mortar and grout admixtures used along with Contractor's proposed usage details.
- C. Submit the following test reports:
 - 1. Compressive strength
 - 2. 24 hours cold water absorption
 - 3. Initial Rate of Absorption (I.R.A.)
 - 4. Efflorescence
 - 5. Weather classification
- D. Three sample specimens of the masonry units proposed for incorporation into the project shall be submitted to the ENGINEER.
- E. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcement bars, complying with ACI SP-66. Show bar schedules, diagrams of bent bars, stirrup, spacing, lateral ties, and other components required for fabrication and placement of masonry reinforcement.
- F. A minimum 4-ft square free-standing sample panel shall be prepared for approval before starting masonry work. The panel shall remain at the site for reference until masonry work is completed. As an alternative to the sample panel full size brick samples may be submitted to the ENGINEER.

1.5 QUALITY ASSURANCE

- A. Structural brick units shall be sampled and tested in accordance with ASTM C 67.

- B. The CONTRACTOR shall have mortar and grout tested to assure compliance with the Specifications and the governing codes by a testing laboratory approved by the ENGINEER. The test reports shall be submitted to the ENGINEER.
1. Tests shall be taken at the following times:
 - a. At commencement of masonry work, at least 2 samples each of mortar and grout shall be taken.
 - b. At any change in materials or job conditions, at least 2 samples of each modified material, grout and mortar shall be tested.
 - c. The costs of tests shall be paid by the CONTRACTOR as part of the work. The costs of additional tests, when required to verify compliance when requested by the OWNER or ENGINEER, will be paid by the OWNER. When tests do not verify compliance, the cost of additional tests shall be paid by the CONTRACTOR.
 2. Samples shall be stored in a moist environment until tested, unless directed otherwise by the ENGINEER or the testing laboratory. Testing for mortar shall be in accordance with ASTM C 270. Testing for grout shall be in accordance with ASTM C 1019.
- C. The CONTRACTOR shall test the masonry units to assure compliance with the specifications and governing codes. Testing will be by a laboratory approved by the ENGINEER.
1. Testing will be made of the following items:
 - a. At the time of the construction of the sample panel, at least 2 masonry units shall be tested for each type of block, except separate tests are not required for block which only varies by texture.
 - b. At any change in materials during construction, at least 2 masonry units shall be tested.
 - c. The CONTRACTOR shall submit a letter of certification from the masonry unit supplier at the time of, or prior to, delivery of the materials to the site that the materials used in construction are representative of the materials used to construct the prisms.
- D. Whenever required under the provisions of the Building Code, the work shall be subject to inspection by a Special Inspector selected by the OWNER and approved by the local building code representative having jurisdiction. Costs of such inspections will be paid by the OWNER. The Special Inspector will work under the supervision of the ENGINEER.
- E. Cold weather construction shall be per ACI 530.1, IBC Section 2104.3, and the local code requirements, whichever is more stringent.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. CONTRACTOR shall be responsible to deliver, handle, and store masonry units by means which will prevent mechanical damage and deterioration due to moisture, temperature changes, and corrosion. CONTRACTOR shall provide protection which will limit moisture absorption of structural brick masonry units to the maximum percentage specified for Type I units for the average relative humidity at the project site, as reported by the nearest National Weather Service station.

- B. Cementitious materials shall be stored off the ground and protected from moisture.
- C. Aggregates shall be stored in a manner which will preserve grading characteristics.
- D. Masonry accessories shall be stored to prevent corrosion, dirt accumulation, and other deterioration.

1.7 PROJECT CONDITIONS

- A. Cold Weather Protection: Do no lay masonry units when outside air temperature is below 40 degrees F.
 - 1. Grouted construction: On any day when the minimum anticipated nighttime temperature is 32 degrees F or less, in addition to complying with general procedures above, grout materials shall be heated to 90 degrees F to produce an in-place grout temperature of not less than 70 degrees F at end of work day. Protective blankets or enclosures shall remain in place for not less than 48 hours after placement of masonry units.
 - 2. Water: Water for mortar or grout shall not be heated to more than 160 degrees F.
- B. Hot-Weather Protection: Cover or shade masonry units and mortar materials and use cool water for mortar whenever ambient air temperature is 90 degrees F or greater. At air temperatures of 85 degrees F or above, if relative humidity is less than 30 percent or wind is in excess of 15 miles per hour, provide protection by immediately covering newly constructed walls by providing windbreaks, or by using fog spray to reduce rate of evaporation.

1.8 MEASUREMENT AND PAYMENT

- A. There shall be no separate measurement and payment for reinforced unit masonry. Full compensation for all reinforced unit masonry shall be considered as included in the contract unit or lump sum bid prices for the various items of the contract to which reinforced unit masonry relates.

PART 2 PRODUCTS

2.1 STRUCTURAL BRICK MASONRY UNITS

- A. Structural Brick: Comply with referenced standards for types required, and as follows:
 - 1. Unit, Grade and Type: Masonry units shall conform to the requirements of the following table:

Unit	ASTM	Grade	Type	Minimum Compressive Strength (psi)
Hollow Clay Unit	C 652	SW	HBS	9,000

2. Size: The size of masonry units shall be as indicated on the drawings. Special shapes and sizes shall be provided as required, whether or not specifically indicated on the drawings as special.
3. Surfaces: Special surface texture or architectural faces shall be provided where indicated on the drawings.
4. Color: Where the finished surface will be visible, masonry units shall have colors as indicated on the drawings. Where colors are not specified, the OWNER shall determine colors to be provided.

2.2 MATERIALS

- A. Portland Cement: ASTM C 150, Type II or IIA.
 1. Type III may be substituted during cold-weather construction.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Aggregate for Mortar: Sand conforming to ASTM C 144.
- D. Aggregate for Grout: ASTM C 404.
- E. Admixture for grout, if used, shall be **Sika Grout Aid by Sika Corp.**, or approved equal.
- F. Water: Clean and potable.
- G. Masonry cleaner shall be a non-acidic cleaner, **EaCO Chem, Sure Klean**, or approved equal.
- H. Accelerating Admixture: Non-chloride admixture for use in mortar mixes during cold weather, proportioned and mixed to comply with directions of manufacturer.
 1. Products: The following products, provided they comply with requirements of ASTM C 1384 and the contract documents, will be among those considered acceptable.
 - a. MORSET by Grace Construction Products
 - b. or approved equal
- I. Water-repellant and efflorescence control admixture.
 1. All exterior masonry units shall utilize a water-repellant and efflorescence control admixture as recommended by the manufacturer to obtain ASTM E 514 test extended to 72 hours, class E rating.
 2. Admixtures shall be **MasterPel 240 (Rheopel Plus) by BASF, Eucon Blocktite by Euclid Chemical Company**, or approved equal.
- J. Integral water repellent admixture is required for mortar for exterior masonry units and shall be **MasterPel 240MA (Rheopel Plus Mortar Admixture) by BASF, Blocktite Mortar Admixture by Euclid Chemical Company**, or approved equal.

2.3 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Bars shall be in accordance with Section 03 20 00 – Concrete Reinforcement.
- B. Joint Reinforcement and Anchorage Materials: shall comply with ASTM A 951 and the following general requirements for materials required in joint reinforcement and anchorage devices.
 - 1. Steel wire: ASTM A 1064.
 - a. Zinc coating: ASTM A 641 Class 1.
 - b. Application: Use at interior locations.
- C. Joint Reinforcement: Provide welded-wire units prefabricated into straight lengths of not less than 10 feet, with deformed continuous side rods and plain cross rods, and as follows:
 - 1. Width: Approximately 1-1/2 inches less than nominal wall width, providing not less than 1/2 inch mortar coverage on each exposure.
 - 2. Wire sizes:
 - a. Side rod diameter: 0.1483 inch.
 - b. Cross rod diameter: 0.1483 inch.
 - 3. Configuration:
 - a. Applications of single unit width: Ladder design, cross rods at not more than 16 inches on center.
 - b. Corners: Provide prefabricated L- and T-shaped units.

2.4 MISCELLANEOUS MASONRY ACCESSORIES

- A. Premolded Control Joints Strips: Joints designed to fit standard sash block and to maintain lateral stability in masonry wall, of size and configuration indicated or as required for conditions, and as follows:
 - 1. Either styrene-butadiene rubber compound complying with ASTM D 2000, 2AA-805;
or
 - 2. Polyvinyl chloride complying with ASTM D 2287, Type PVC 654-4
- B. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type 1 (No. 15 asphalt).

2.5 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures unless indicated and approved by the ENGINEER. Do not use calcium chloride in mortar or grout mixture.
- B. Mixing: Combine and thoroughly mix ingredients in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.

- C. Mortar for Unit Masonry: Comply with ASTM C 270 and IBC Section 2103.7, Proportion Specification, for types of mortar required, unless otherwise indicated.
 - 1. Limit cementitious materials in mortar to Portland cement and lime.
 - 2. Use Type S mortar for reinforced masonry. Compressive strength: 1800 psi @ 28 days.
 - 3. Mortar for use with colored masonry units shall have the integral color as approved by the OWNER.
- D. Grout: Comply with ASTM C 476 and IBC 2103.10 for grout used in construction of unit masonry elements. Use grout of consistency indicated or as required at time of placement to fill completely all spaces intended to receive grout. Compressive strength: 2000 psi @ 28 days.
 - 1. Use fine grout in spaces less than 2 inches in least horizontal dimension, unless otherwise indicated.
 - 2. Use coarse grout in spaces 2 inches or more in least horizontal dimension, unless otherwise indicated.

2.6 MASONRY SEALERS (WATER RETARDENT)

- A. Sealers shall be as noted in Section 09 90 00 - Painting and Finishes.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION PROCEDURES

- A. Structural Brick Masonry Units: Do not wet brick masonry units prior to laying.
- B. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.
- C. Reinforcing: Before placing masonry reinforcing, remove loose rust, dirt, and other coatings.
- D. Masonry Thickness: Build masonry elements to full thickness shown.
 - 1. Build single-wythe walls to actual thickness of masonry units, using units of size indicated.
- E. Chases and Recesses: Build masonry to accommodate the work of other trades, including chases and recesses as shown or required. Provide not less than 8 inches of masonry between jambs of openings and chases and recesses.
- F. Leave openings for equipment to be installed in masonry. After installation of equipment, complete masonry work to match work immediately adjacent to opening.
- G. Cutting Masonry Units: Use motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use dry cutting saws to cut brick masonry units.
- H. Add insulation to open cells if required on drawings. See Section 07 21 00 - Insulation.

- I. Work shall be performed in accordance with ACI 530 and ACI 530.1, the latest edition of the IBC, and local governing codes for reinforced structural brick masonry.
- J. The CONTRACTOR shall set or embed anchors, bolts, reglets, sleeves, conduits, and other items as required.

3.2 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: Do not exceed the following construction tolerances in vertical elements, including surfaces of walls, columns, and arises:
 - 1. 1/4 inch to 10 feet
 - 2. 3/8 inch to one story height, or 20 feet, whichever is less, except 1/4 inch for external corners, expansion joints, and other highly conspicuous vertical elements.
 - 3. 1/2 inch for 40 feet or more
 - 4. Plus or minus 1/4 inch in 10 feet, 1/2 inch maximum, for vertical alignment of head joints.
- B. Variation from Level: Do not exceed the following construction tolerances for bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous horizontal elements:
 - 1. 1/4 inch in one bay or in 20 feet maximum
 - 2. 1/2 inch in 40 feet or more
- C. Variation from Plan Lines: Do not exceed the following horizontal construction tolerances for related portions of columns, walls, and partitions:
 - 1. 3/8 inch in any bay of 16 feet maximum
 - 2. 1/2 inch in 32 feet or more
- D. Variation in Cross Section: Do not exceed the following masonry elements:
 - 1. Minus 1/4 inch
 - 2. Plus 1/2 inch
- E. Variation in Mortar Joint Thickness: Do not exceed the following construction tolerances for thickness of mortar joints:
 - 1. Bed joints: Plus or minus 1/8 inch.
 - 2. Head joints: Plus or minus 1/8 inch.

3.3 MASONRY CONSTRUCTION - GENERAL

- A. Layout: Lay out masonry for accurate pattern bond, for uniform joint widths, and for accurate location of specific features before beginning actual construction. Avoid use of masonry units of less than 1/2 size. Do not use units with less than nominal 4 inch horizontal face dimensions at corners and jambs.
- B. Pattern Bond: Lay exposed masonry in 1/2 running bond with vertical joints in each course centered on units in course above and below except where other bonds are indicated at special features.
 - 1. Lay concealed masonry with all units in a wythe in running bond.
 - 2. Bond and interlock each course of each wythe at corners.
- C. Structural Brick Unit Masonry: Maintain vertical continuity of core or cell cavities. Keep cavities clear of mortar, including bed area of first course, to provide minimum clear dimension indicated, to provide minimum clearance and grout coverage for vertical reinforcement bars, and to provide direct grout contact with supporting surfaces.
- D. Stopping and Resuming Work: Lay masonry in proper sequence to avoid toothing. Rack walls back in each course at end of each day. Before resuming, clean exposed surfaces and remove loose masonry units and mortar.
- E. Built-in Work: As work progresses, build in items indicated for installation in masonry, filling around built-in items solidly with masonry.
 - 1. Fill spaces between metal frames and masonry elements solidly with mortar, unless otherwise indicated.
- F. Install lintels of types indicated at all openings.
 - 1. Bearing: Provide not less than 8 inches of bearing at each jamb unless otherwise indicated.
 - 2. Reinforcement: At masonry openings greater than one foot in width, install horizontal joint reinforcement in 2 horizontal joints approximately 8 inches apart immediately above lintel and immediately below sill. Extend reinforcement which is in addition to required continuous joint reinforcement not less than 24 inches beyond jambs of the opening, except at control joints.
- G. Formwork: Provide temporary formwork and shores as required for temporary support of reinforced masonry elements. Construct formwork to shape line, and dimensions shown. Make sufficiently tight to avoid leakage of mortar and grout.
 - 1. Brace, tie, and support as required to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other reasonable temporary loads that may be placed on them during construction.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay brick masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be grouted or filled with concrete.
- B. Maintain joint widths indicated, except for minor variations required to maintain bond alignment. Except as otherwise indicated, maintain joint widths of 3/8 inch.
- C. Cut joints flush for masonry walls which are concealed or covered by other materials, unless otherwise indicated.
- D. Tool exposed joints slightly concave, using a jointer larger than joint thickness unless otherwise indicated.
- E. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners of jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.

3.5 HORIZONTAL JOINT REINFORCEMENT OF SINGLE-WYTHE WALLS

- A. General: Provide continuous horizontal joint reinforcement for all single-wythe masonry walls, unless otherwise indicated. Lap reinforcing a minimum of 6 inches.
- B. Install joint reinforcing in mortar joints at not more than 16 inches on center vertically.
- C. Cut or interrupt joint reinforcement at control and expansion joints.
- D. Provide continuity at corners and wall intersections by means of prefabricated L- and T-shaped sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.6 INSTALLATION OF REINFORCEMENT

- A. Preparation: Do not use reinforcement bars with kinks or bends not shown on drawings or final shop drawings. Do not use bars with cross section reduced due to excessive rusting and other causes.
- B. Placement: Position reinforcement bars accurately at spacings indicated. Support and secure vertical bars against displacement. Horizontal bars may be placed as the work progresses. Provide not less than the greater of either the bar diameter or 1 inch clear between bars. For columns, piers, and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2 inches, whichever is greater.
- C. Splicing: Provide lapped splices at locations shown; do not splice at other points or by other methods, unless approved by the ENGINEER. Provide not less than minimum lap indicated, or as required by governing code.

3.7 GROUTING

- A. Grouting Technique:

1. Provide minimum clear dimension of 2 inches and minimum clear area of 8 square inches in vertical cores to be grouted. Place vertical reinforcement prior to laying brick masonry units, extending above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters or 10 feet, whichever is less.
2. Grout shall be placed in all open areas of the masonry block as specified herein.
3. Lay masonry units to maximum pour height, not to exceed 4 feet.
4. Pour grout using chute or container with spout. Vibrate grout during placement. Place grout continuously; do not interrupt pouring operation for more than 1 hour. Terminate pour 1-1/2 inches below top of highest course in pour, except at tops of walls.
5. Stop grout in vertical cells 1-1/2 inches below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beams.

3.8 REPAIR AND POINTING

- A. Repair: Remove and replace masonry units which are loose, chipped, broken, stained, or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units, and install in fresh mortar or grout pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of mortar joints, enlarge any holes or voids except weep holes and completely fill with mortar. Point up all joints, including corners, openings, and adjacent work, to provide a neat and uniform appearance.

3.9 CLEANING AND PROTECTION

- A. Clean masonry as follows after mortar is thoroughly set and cured:
 1. Remove large mortar particles by hand, using wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample wall panel, leaving half of panel uncleaned for comparison.
 3. Clean brick unit masonry to comply with directions of masonry manufacturer and as recommended by NCMA in Tek Bulletin No. 45.
- B. Protection: CONTRACTOR shall protect all masonry until such time as the Work is completed and accepted by the ENGINEER.

3.10 FINISH

- A. Brick shall be finished as per Section 09 90 00 - Painting and Finishes.

- END OF SECTION -

SECTION 05 45 00
MECHANICAL METAL SUPPORTS (PIPE SUPPORTS)

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section covers materials and installation of mechanical metal supports, pipe supports, hangers, guides, anchors and appurtenances as specified and indicated.
- B. CONTRACTOR shall provide mechanical metal supports in accordance with this Section whether shown on the Contract Drawings or not.

1.2 RELATED WORK

- A. Related work specified in other sections:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 05 50 00 Miscellaneous Metals
 - 3. Section 09 90 00 Painting and Finishes
 - 4. Section 33 05 03 Copper Pipe
 - 5. Section 33 05 05 Ductile Iron Pipe
 - 6. Section 33 05 07.1 PVC Pressure Pipe (ASMT 1785)
 - 7. Section 33 12 00 Mechanical Appurtenances
 - 8. Section 40 05 13.13 Steel Process Piping

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTING INDUSTRY (MSS)
 - 1. MSS SP-58 Pipe Hangers and Supports – Materials Design and Manufacture
 - 2. MSS SP-69 Pipe Hangers and Supports – Selection and Application
 - 3. MSS SP-89 Pipe Hangers and Supports – Fabrication and Installation Practices
 - 4. MSS SP-127 Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application
- C. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - 1. ASME B 31.1 Power Piping
- D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 36 Standard Specification for Carbon Structural Steel
 - 2. ASTM A 47 Standard Specification for Ferritic Malleable Iron Castings
 - 3. ASTM A 48 Standard Specification for Gray Iron Castings
 - 4. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 5. ASTM A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and

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|----|------------|--|
| 6. | ASTM A 575 | Steel Hardware
Standard Specification for Steel Bars, Carbon, Merchant Quality,
M-Grades |
| 7. | ASTM A 576 | Standard Specification for Steel Bars, Carbon, Hot-Wrought,
Special Quality |

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. CONTRACTOR shall submit complete shop drawings of mechanical supports, pipe supports, hangers and guides. Provide scaled shop drawings showing locations of the supports and detailed drawings for each support. Identify each type of hanger or support by the manufacturer's part number of figure on the drawing.
- C. Provide installation drawings and manufacturer's catalog information on each type of hanger and support.
- D. Provide structural calculations for special supports and anchors, stamped and signed by a professional engineer registered in the State of Utah.

PART 2 MATERIALS

2.1 GENERAL

- A. All pipe hanger and supports shall be manufactured to comply with MSS-SP-58, MSS-SP-569, MSS-SP-89 except as modified herein. Where applicable, design and manufacture must also conform to ANSI/ASME B31.1. Supports for plumbing or fire piping shall be in accordance with the latest edition of the applicable plumbing or fire code and the requirements of the local jurisdiction.
- B. Hangers, supports, anchors and restraints must be designed in accordance with MSS-SP-127 to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment. Piping supports and equipment must be considered as a total system and appropriate balance calculations made to determine load forces at critical stress points. Loading conditions to be considered may include, but are not limited to:
 - 1. The total load of pipe, fittings, valves, insulation and any expected contents of the pipe.
 - 2. Thermal expansion and contraction
 - 3. Stress from cycling of equipment or process.
 - 4. Vibration transmitted to or from equipment or terminal connection.
 - 5. Wind, snow or ice loading on outdoor piping
 - 6. Loading due to seismic forces
- C. Static and dynamic forces at points of attachments must be considered to help ensure structural integrity of buildings or equipment. Hanger and supports must be selected so as to minimize the effect of piping system loading on the structure.
- D. In general, piping shall be supported from structural members, such as walls, beams, columns and slabs, using approved structural attachments. In situations where approved attachments cannot be used, alternative attachments or substructure assemblies must

receive approval by ENGINEER prior to installation. Prior approval by ENGINEER must be given before any cutting or drilling of building structural steel. Damage to the structure through welding, cutting or drilling will not be permitted if it reduces the structures strength below the established safety factor for the structure. Any additional structural steel required to properly support piping or equipment shall be furnished and installed by CONTRACTOR at no additional cost to OWNER.

2.2 SUPPORT MATERIALS

- A. Pipe supports, hangers, guides, etc. shall be hot-dip galvanized carbon steel, unless noted otherwise on the Drawings. Steel shall be in accordance with ASTM A 36, ASTM A 575, or ASTM A 576. Hot-dip galvanizing shall be in accordance with ASTM A 123 or ASTM A 153. Bases, rollers, and anchors shall be steel as described above or may be cast iron conforming to ASTM A 48. Pipe clamps shall be steel as described above or may be malleable iron conforming to ASTM A 47.
- B. Submerged supports, as well as piping in hydraulic structures within 24 inches of the high water level, shall have supports, including hardware and anchors constructed of Type 316 stainless steel, unless noted otherwise on the Drawings.
- C. Piping in chemical or corrosive areas shall have supports, including hardware and anchors constructed of Type 316 stainless steel or fiberglass reinforced plastic (FRP), unless noted otherwise on the Drawings.
- D. Supports fabricated from other materials specified on the Drawings shall have a protective coating in accordance with the requirements of Section 09 90 00 – Painting and Coatings.

2.3 FLOOR MOUNTED SUPPORTS

- A. Floor mounted pipe supports shall include the manufacturer's recommended pipe stanchion and base plate. Base plates shall be anchored to the floor with bolts and provided with a 1-inch thick grout pad.

2.4 SPRING-TYPE HANGERS

- A. Spring-type hangers shall be provided for piping subject to vibration or vertical expansion/contraction such as engine exhaust piping. Design the spring-type hangers per the manufacturer's recommendations.

2.5 CONCENTRATED LOADS

- A. Concentrated loads, such as meters, valves, and equipment, on PVC piping systems shall have supports on each side of the concentrated load.

2.6 CONCRETE ANCHORS

- A. Anchors shall be in accordance with Section 05 50 00 – Miscellaneous Metals.

2.7 MANUFACTURERS

- A. Mechanical Metal Support (pipe support) manufacturers shall be **Anvil International Inc., B-Line by Eaton (Cooper Industries), Utility Coatings & Fabrication**, or approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Mechanical metal supports, pipe supports, hangers, guides, etc. shall be installed per the manufacturer's instructions and ASME B31.1 – Power Piping.
- B. Pipe supports shall be positioned in order to produce an orderly, neat piping system. Hanger rods shall be vertical without offsets.
- C. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting as close to ceilings or roods as possible and without interference with other work.
- D. Hangers shall be installed in a manner to prevent obstructing ladders, manhole covers, and access hatches.
- E. Set embedded inserts accurately in position and support them rigidly before concrete is placed and prevent displacement during and after placement of concrete.
- F. Provide separate hangers or supports at valves, meters, elbows, tees, and other equipment. Provide separate hangers on each both sides of each non-rigid joint or flexible coupling.
- G. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, or other pipe to which the pipe is connected.
- H. Hangers and supports for rigid plastic pipe shall be provided with a support shield to spread the load bearing surface.
- I. Use of wire hangers, perforated strap, hanging from unreinforced metal deck and cellular roof deck are not permitted.
- J. Repair or replace metal items damaged during installation. Follow the manufacturer's procedures for repairing damaged surfaces.
- K. Galvanizing Field Repairs
 1. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.
 2. The coating shall be applied to at least 3 mils dry film thickness and shall be **Zinc-Clad XI by Sherwin-Williams, Galvax by Alvin Products, Galvite by ZRC Worldwide**, or approved equal.

3.2 SUPPORT LOCATION AND SPACING

- A. Supports for horizontal piping shall be spaced to prevent excessive sag, bending and stresses in the piping. Spacing shall not exceed the maximum indicated spans.
- B. Maximum spans indicated in the tables below are for ambient temperatures or the temperatures listed for the materials and pipe wall thicknesses shown. Adjust the span spacing for different temperatures and/or pipe wall thicknesses per the manufacturer's recommendations.

C. Install pipe supports on horizontal and vertical runs at the spacing shown or detailed on the Drawings. If no spacing or rod sizes are given on the Drawings or in the specifications for a particular piping system, use the following tables or the recommendations of the support or pipe manufacturer.

1. Support Spacing for Steel Pipe (Section 40 05 13.13 – Steel Process Piping) Schedule 40 and Schedule 80:

Pipe Size (inches)	Maximum Span Water Service (feet)	Maximum Span Vapor Service (feet)	Minimum Hanger Rod Size (inches)
3/8 and smaller	4	5	3/8
1/2 through 1	6	8	3/8
1-1/4 through 2	8	10	3/8
2-1/2 through 3	10	14	1/2
3-1/2 through 4	10	15	5/8
6	12	20	3/4
8	12	24	3/4

Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.

2. Support Spacing for Copper Pipe (Section 33 05 03 – Copper Pipe) per MSS-SP-69, Table 3:

Pipe Size (inches)	Maximum Span Water Service (feet)	Maximum Span Vapor Service (feet)	Minimum Rod Size (inches)
1/2	5	6	3/8
3/4	5	7	3/8
1	6	8	3/8
1-1/4	7	9	3/8
1-1/2	8	10	3/8
2	8	11	3/8
2-1/2	9	12	1/2
3	10	14	1/2
3-1/2	11	15	1/2
4	12	16	5/8

Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.

3. Support Spacing for PVC Pipe (Section 33 05 07.1 – Polyvinyl Chloride Pipe) Schedule 40 and Schedule 80. The table below is meant as a general guideline and it is recommended that the pipe manufacturer be consulted for specific spacing recommendations relating to their pipe, load conditions, operating temperatures, and service conditions.

Pipe Size (inches)	Maximum Span Schedule 40 (feet)				Maximum Span Schedule 80 (feet)			
	60°F	80°F	100°F	120°F	60°F	80°F	100°F	120°F
1/2	4.5	4.5	4	2.5	5	4.5	4.5	3
3/4	5	4.5	4	2.5	5.5	5	4.5	3
1	5.5	5	4.5	3	6	5.5	5	3.5
1-1/4	5.5	5.5	5	3	6	6	5.5	3.5
1-1/2	6	5.5	5	3.5	6.5	6	5.5	3.5
2	6	5.5	5	3.5	7	6.5	6	4
2-1/2	7	6.5	6	4	7.5	7.5	6.5	4.5
3	7	7	6	4	8	7.5	7	4.5
4	7.5	7	6.5	4.5	9	8.5	7.5	5
6	8.5	8	7.5	5	10	9.5	9	6
8	9	8.5	8	5	11	10.5	9.5	6.5
10	10	9	8.5	5.5	12	11	10	7
12	11.5	10.5	9.5	6.5	13	12	10.5	7.5
<p>Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.</p> <p>Data taken from Anvil International, Inc. Catalog PH-2006, page PH-213 and is based on continuous span and for un-insulated line carrying fluids of specific gravity up to 1.00.</p>								

4. Supports for Ductile Iron Pipe (Section 33 05 05 – Ductile Iron Pipe) should be installed in locations shown on the Drawings with a minimum of one support per 20-foot length of pipe. If longer spans are required, the supports should be designed in accordance with DIPRA – Design of Ductile Iron Pipe on Supports and the pipe manufacturer’s recommendations. Supports should be cradle type with a saddle angle of 120 degrees. The table below shows the recommended maximum spans per US Pipe – Long Span and Bridge Crossing Pipe guidelines.

Pipe Size (inches)	Maximum Span Water Service (feet)
6	28
8	30
10	30
12	35
14	35
16	40
18	42
20 to 64	45
<p>Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.</p>	

5. Support Spacing for ABS Pipe (Section 33 05 01 – ABS Pipe) Schedule 40. The table below is meant as a general guideline and it is recommended that the pipe

manufacturer be consulted for specific spacing recommendations relating to their pipe, load conditions, operating temperatures, and service conditions.

Pipe Size (inches)	Maximum Span Schedule 40 (feet)				
	60°F	80°F	100°F	120°F	140°F
1-1/2	6	6	5.5	3.5	3
2	6	6	5.5	3.5	3
3	7	7	7	4	3.5
4	7.5	7.5	7	4.5	4
6	8.5	8.5	8	5	4.5
Note: Plumbing code may require a maximum horizontal spacing of 4 feet for all pipe sizes. Verify requirement with the local governing agency.					

6. Support spacing for other pipe materials shall be based on recommendations from the pipe manufacturer.
7. Provide sway bracing for hangers where shown on the Drawings. If no bracing is shown, provide bracing at 10 foot maximum center-to-center intervals.

- END OF SECTION -

SECTION 05 50 00
MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers materials, fabrication, and installation of miscellaneous metals and appurtenances as specified and indicated.

1.2 RELATED SPECIFICATIONS

- A. Fabrication and erection of the platforms, ladders and stairs shall be in accordance with the Specification for the Design, Fabrication and Creation of Structural Steel for Buildings of the latest edition of the A.I.S.C. Manual, and Section 1910.27 of the latest edition of the OSHA standards, except as specified herein.

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

- B. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

- 1. Manual of Steel Construction

- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- 1. ASTM A 36 Standard Specification for Carbon Structural Steel
 - 2. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 3. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 4. ASMT A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 5. ASTM A 276 Standard Specification for Stainless Steel Bars and Shapes
 - 6. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength
 - 7. ASTM A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 8. ASTM F 593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
 - 9. ASTM F 594 Standard Specification for Stainless Steel Nuts

- D. NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

- E. AMP 510 Metal Stairs Manual

1.4 RELATED WORK

- A. Related work in other sections includes but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 09 90 00 Painting and Finishes

1.5 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. CONTRACTOR shall submit complete shop drawings of fabricated items, such as vents, ladders, stairs, platforms, beams, pipe supports, and miscellaneous metals for approval to Engineer.
- C. Shop drawings shall conform to AISC recommendations and specifications, and shall show holes, and the like, as may be required for other parts of the work.
- D. Shop drawings shall include complete details of members and connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams for the sequence of erection.
- E. Submit manufacturer's catalog data and dimensional drawings for lifting eyebolts and inserts; ladder safety posts, manhole covers and frames, and anchor bolts.
- F. Submit ICC ES Evaluation Reports for adhesive and wedge anchors and installer qualifications and procedures.

1.6 QUALITY ASSURANCE

- A. Field Measurements: Take field measurement prior to preparation of Shop Drawings and fabrication to ensure proper fitting of the Work.
- B. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units to the extent necessary for shipping limitations.
- C. Fabricator Qualifications: Fabricators shall be regularly engaged in the manufacture of the types of steel specialties they are providing and shall have at least 5 years of experience in this specialty.
- D. Qualifications: Qualify welding operators in accordance with requirements of current AWS Standard. Provide certification that all welders employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within the previous 12 months. Ensure that all certifications are kept current.

PART 2 MATERIALS

2.1 CARBON STEEL

- A. Materials for bolted or welded steel construction shall conform to ASTM A 36.

2.2 STAINLESS STEEL

- A. All bolts, expansion bolts, nuts, washers, and expansion sleeve inserts used to attach metal supports shall be stainless steel Type 316.
- B. All interior tank ladders, wall conduits, louvers, and other items required shall be stainless

steel unless noted otherwise.

2.3 **HOT-DIPPED GALVANIZED**

- A. All vents, stairs, vault ladders, handrail, stringers, beams and miscellaneous items shall be galvanized (zinc coated) unless noted otherwise.
- B. Zinc coating for plates, bolts, anchor bolts, and threaded parts shall in in accordance with ASTM A 153. Structural steel shall be zinc coated in accordance with ASTM A 123.

2.4 **BOLTS**

- A. Steel anchor and connection bolts for non-corrosive service shall conform to ASTM A 307, Grade A or B, unless otherwise noted. Bolts shall be hot-dip galvanized and provided with self-locking nuts or lock washers and plain nuts.
- B. Steel anchor and connection bolts for corrosive service shall be fabricated from stainless steel, unless indicated otherwise in the specifications or on the Drawings. Corrosive service locations are as listed below.
 - 1. Buried locations
 - 2. Submerged locations
 - 3. Locations subject to occasional flooding
 - 4. Inside hydraulic structures
 - 5. Chemical handling areas
 - 6. Inside buried manholes, vaults, and structures that do not have a gravity drain or sump pump
 - 7. Inside trenches, containment walls, and curbed areas.
- C. The nuts shall be capable of developing the full strength of the bolts. Bolts and cap screws shall have hexagon heads and nuts shall be heavy hexagon series. Bolts and nuts shall be installed with washers from material matching the base material of bolts. Lock washers fabricated from the material matching the bolts shall be installed where indicated.
- D. The length of the bolts shall be such that the bolt extends at least 1/8 inch beyond the outside face of the nut before tightening, except for anchor bolts which shall be flush with the face of the nut before tightening.

2.5 **LIFTING EYEBOLTS**

- A. Locate eyebolts and inserts over the centerline of the piping at locations shown on the Drawings. Eyebolts and inserts shall have a minimum safety factor of 3 and be rated for a working load of 3,000 pounds.
- B. Provide inserts of the ferrule wing nut design with threads to match the eyebolts. Cast inserts in the roof slab of the vault at the locations identified on the Drawings.

2.6 **THREADED INSERTS**

- A. Threaded inserts shall be of ductile iron construction with standard N.C. threads. Inserts shall be cast-in-place at the locations shown on the Drawings. Inserts shall be fabricated by **Meadow Burke**, or approved equal.

2.7 ADHESIVE ANCHORS

- A. Unless otherwise indicated, drilled concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered without an ICC ES Report verifying strength and material equivalency. Anchors used inside potable water reservoirs shall be ANSI/NSF 61 certified.
- B. Adhesive anchors shall be a two component system consisting of an all threaded anchor rod with nut and washer, and the adhesive capsule. Anchor rods shall be Type 304 stainless steel conforming to ASTM F 593 with nuts conforming to ASTM F 594. The adhesive capsules shall contain a polyvinyl or urethane methacrylate-based resin and accelerator within a sealed dual chamber foil capsule. Adhesive anchors shall be **Hilti HVA Capsule Adhesive Anchoring System**, or approved equal.

2.8 WEDGE ANCHORS

- A. Wedge type anchors shall be used only where indicated on the Drawings. Wedge anchors shall be a stud type expansion anchor, torque controlled, with impact section to prevent thread damage. Stud and wedge shall be Type 304 or Type 316 stainless steel conforming to ASTM A 276. Nut shall be Type 304 or Type 316 stainless steel conforming to ASTM F 594 with washer of similar material. Wedge anchor bolts shall be **Hilti Kwik Bolt 3**, or approved equal. Anchors installed in non-submerged or non-corrosive environments may be carbon steel and be **Simpson Strong-Tie Strong Bolt**, or approved equal.

2.9 STEEL PIPE

- A. Pipe for guard posts shall be Schedule 40 and pipe for vault vents shall be Schedule 10 conforming to ASTM A 53, unless noted otherwise on the Drawings, and shall be hot-dip galvanized.

2.10 LADDERS

- A. Ladders which may be partially or fully submerged or located inside a manhole or vault without a gravity drain or sump pump shall be fabricated entirely of Type 304 stainless steel. All ladder hardware and supports shall be Type 304 stainless steel. Ladders and hardware fully submerged or located inside a manholes or vault for wastewater facilities shall be Type 316 stainless steel.
- B. Other ladders shall be fabricated from carbon steel and hot-dip galvanized after fabrication unless noted otherwise on the Drawings. All ladder hardware and supports shall be the same material as the ladder.
- C. All ladders without a permanently mounted exterior ladder extension shall be provided with a telescoping safety post. The post shall be fabricated of steel with telescoping tubular section that locks automatically when fully extended. The upward and downward movement shall be controlled by a stainless steel spring balancing mechanism. The telescoping safety post shall be fabricated from the same material and finish as the ladder. The telescoping posts shall be **LadderUP Safety Post by Bilco**, or approved equal.

2.11 VAULT VENTS

- A. Fabricate vault vents as shown on the Drawings. Vault vents shall be welded steel construction and hot-dip galvanized after fabrication. Coating shall be in accordance with Section 09 90 00 – Painting and Finishes.

2.12 COVERS AND FRAMES

- A. Manhole covers and frames shall be cast iron and designed for AASHTO HS-20 loading, unless otherwise indicated. Castings shall be smooth, clean and free from blisters, blowholes, and shrinkage. Covers shall seat firmly into the frames without rocking. Covers and frames shall fit together evenly such that the cover fits flush with the surrounding finished surface.

2.13 METAL STAIRS

- A. Metal stairs shall be composed of steel stringers and supports, unless otherwise noted on the Drawings. Stairs shall be fabricated in accordance with the standard practice of NAAMM AMP 510.
- B. Metal stairs shall be galvanized and as noted on the Drawings.

2.14 POLYPROPYLENE STEPS

- A. Polypropylene steps shall have a 1/2-inch ASTM A 615 grade 60 steel reinforcement rod encased in polypropylene copolymer plastic. Steps shall have a tread width of 14-inches nominal.
- B. Steps shall be manufactured by **American Step Company, Inc., M.A. Industries, D & L Supply No. F-1981**, or approved equal.

2.15 GRATING

- A. Grating shall be supported around all sides of an opening with support members. Unless otherwise indicated, grating supported on concrete shall have embedded angles that match the grating material. Grating shall be serrated bar grating, unless noted otherwise on the Drawings.
- B. The grating shall be completely banded at edges and cutouts and the banding shall be welded to each cut bearing bar. The banding material and cross-section shall be the same as the bearing bars.
- C. Grating pieces shall be fastened to each support at a minimum of 2 locations.
- D. Grating deflection shall not exceed 1/4 inch or the span divided by 180, whichever is less.
- E. For standard duty grating, the loading to be used for determining stresses and deflections shall be the uniform load of the adjacent floor or 100 psf, whichever is greater, or a concentrated load of 1000 pounds. For heavy duty grating the loading used shall be in accordance with AASHTO HS-20.
- F. Standard duty grating shall be fabricated from steel and hot-dip galvanized, unless noted otherwise. Standard duty grating that will be submerged, partially submerged, or in a

corrosive environment shall be fabricated entirely of Type 316 stainless steel. No single piece of standard duty grating shall weigh more than 80 pounds, unless noted otherwise on the Drawings. All crossbars shall be welded into position.

- G. Heavy duty grating shall be fabricated from welded steel and hot-dip galvanized after fabrication. All crossbars shall be welded into position.
- H. Bar dimensions shall be 1-1/4 inch by 3/16 inch, minimum and shall be manufactured by **McNICHOLS, AMICO, Robertsons Grating Products**, or approved equal.

2.16 SAFETY STAIR NOSINGS

- A. Safety stair nosings shall be provided on concrete stairs and other locations indicated on the Drawings.
- B. The nosings shall be 3 inches wide and fabricated from extruded aluminum with cast-in-abrasive strips and integral extruded anchors.
- C. The color of the cast abrasive shall be as selected by OWNER.
- D. The safety stair nosing shall be **Style 231-A by Amstep, XRS-3 by Grating Pacific, Type 9511 by Robertson Grating Products**, or approved equal.

2.17 ALUMINUM HANDRAIL

- A. Aluminum handrails and railings shall be component systems, complete with anchors, attachments, balusters, brackets, caps, fasteners, gates, posts, sleeves, trim and other related items required for a complete installation.
- B. Railings shall conform to the Building Code and OSHA requirements.
- C. Aluminum shall be Alloy 6063-T52, T-5, T-6, or Alloy 6063-T832. Rail, posts, and fittings shall be a minimum 1-1/2 inch diameter Schedule 40 pipe.
- D. Railing systems shall be provided with a clear anodized finish, AA-M10-C22 (204R1) or AA-M12-C22-A41.
- E. Kick-plates or toe boards shall be attached to railing posts.
- F. Fasteners, screws, and bolts shall be concealed and shall be fabricated from stainless steel or aluminum.
- G. Provide expansion joints per the manufacturer's recommendations and match locations where the building or structure has expansion joints.
- H. Where aluminum surfaces are embedded or in contact with concrete, provide a zinc chromate primer or electrolysis protective material in accordance with Section 09 90 00 – Painting and Finishes.
- I. Manufacturer's shall be **Connectorail by Julius Blum & Co., Inc., CV Pipe Rail by CraneVeyor Corp.**, or approved equal.

2.18 STEEL PIPE HANDRAIL

- A. Railings shall conform to the Building Code and OSHA requirements.
- B. Handrails, brackets and related hardware shall be steel pipe and hot-dip galvanized after fabrication. Handrails, brackets, and related hardware that shall be submerged, partially submerged, or in a corrosive environment shall be fabricated from Type 316 stainless steel.

PART 3 EXECUTION

3.1 GENERAL

- A. Except as otherwise shown, the design, fabrication, and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction".
- B. Install miscellaneous specialties as indicated on the drawings or as recommended by the manufacturer.
- C. Store materials above ground on platforms, skids or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.
- D. Clean surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign matter before placing concrete.
- E. Set embedded metalwork accurately in position and support it rigidly before concrete is placed and prevent displacement during and after placement of concrete.
- F. Repair or replace metal items damaged during installation. Follow the manufacturer's procedures for repairing damaged surfaces.
- G. Welding shall be performed by metal-arc method or shielded metal arc method as per the American Welding Society's (AWS) "Welding Handbook". During welding component parts shall be adequately clamped or supported. Avoid irregular surface, non-uniform bead pattern, and high crown. Upon completion of welding, remove weld splatter, flux, slag, and burrs. Accomplish repair, chipping, and grinding of welds in a manner that will not gouge, groove, or reduce the base metal thickness.
- H. Adhesive Anchors. Do not install anchors until the concrete has reached the required 28-day compressive strength. Drill hole in concrete by means of a percussion hammer drill. Hole shall be roughened with a brush on a power drill and then cleaned and dried. Install anchor in accordance with the manufacturer's instructions. Do not load the anchor until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.
- I. Wedge Anchors. Do not install anchors until the concrete has reached the required 28-day compressive strength. Drill hole in concrete by means of a percussion hammer drill. Hole shall be roughened with a brush on a power drill and then cleaned and dried. Install anchor in accordance with the manufacturer's instructions.
- J. Galvanizing Field Repairs:

1. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.
2. The coating shall be applied to at least 3 mils dry film thickness and shall be **Zinc-Clad XI by Sherwin-Williams, Galvax by Alvin Products, Galvite by ZRC Worldwide**, or approved equal.

- END OF SECTION -

**SECTION 06 10 00
ROUGH CARPENTRY**

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section covers the rough carpentry work which includes wood framing, plates, joists, rafters, purlins, wood trusses, blocking, furring, backing, nailers, plywood sheathing, siding, and similar elements, material and accessories, complete and in place according to the contract documents.

1.2 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN PLYWOOD ASSOCIATION (APA)
1. APA AFG-01 Adhesives for Field-Gluing Plywood to Wood Framing
 2. APA Form E30 Design/Construction Guide, Residential and Commercial
- C. AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
1. AWPA M4 Standard for the Care of Preservative-Treated Wood Products
- D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 psi Tensile Strength
 2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 3. ASTM D 3498 Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
 4. ASTM F 1667 Standard Specification for Driven Fasteners: Nails, Spikes, and Staples
- E. AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
1. AWPA U1-13 Use Category System: User Specification for Treated Wood
- F. NATIONAL FOREST PRODUCTS ASSOCIATION (NFOPA)
1. NFOPA-01 National Design Specification for Wood Construction
 2. NFOPA-02 Manual for Wood Frame Construction
- G. TRUSS PLATE INSTITUTE (TPI)
1. TPI TPI-85 Design Specification for Metal Plate Connected Wood Trusses
 2. TPI QST 88 Quality Standard for Metal Plate Connected Wood Trusses Addendum to TPI-85

H. WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

1. WWPA-01 Western Lumber Grading Rules

1.3 RELATED WORK

- A. Related work in other sections includes but is not limited to:

1. Section 01 33 00 Submittal Procedures

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Manufacturer's catalogs showing rough hardware conforming to or equivalent to hardware indicated on the Drawings.
- C. Structural and Miscellaneous Wood Members: Design analysis and calculations of fabricated wood trusses shall show design criteria used to accomplish the applicable analysis. Calculations and drawings shall be stamped by a Professional Engineer licensed in the State of Utah.
- D. Shop Drawings: Drawings of fabricated wood trusses shall indicate materials and shop and field erection details including methods of fastening.
- E. Manufacturer's Certificates: Manufacturer's certificates attesting that lumber and material not normally grade marked or exempt from being grade marked meets the specified requirements.

1.5 DELIVERY AND STORAGE

- A. Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity.

1.6 QUALITY ASSURANCE

- A. Materials and assembly shall be inspected to determine compliance with the Building Code.
- B. At completion of fabrication of the trusses, the fabricator shall submit a certificate of compliance to Engineer stating that the work was performed in accordance with the contract documents.

1.7 MEASUREMENT AND PAYMENT

- A. Rough carpentry shall not be measured or paid as a separate item, but shall be included as part of the various items to which it relates.

PART 2 PRODUCTS

2.1 LUMBER AND SHEATHING

- A. Grading and Marking: Materials shall bear the grademark, stamp or other identifying marks indicating grades of material and rules or standards under which produced. Such identifying marks on material shall be in accordance with the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification. The inspection agency for lumber shall be certified by the Board of Review, American Lumber Standards Committee, to grade species used. Except for plywood and lumber; bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be architecturally exposed to view shall not bear grademarks, stamps, or other types of identifying marks.
- B. Sizes: Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.
- C. Trussed Rafters: Rafters shall be a prefabricated design. Connections shall be made with light-metal plate-connectors. Light-metal-plate-connected wood trusses shall be designed in conformance with TPI TPI-85 and fabricated in conformance with TPI QST-88.
- D. Plywood: Plywood shall be APA performance rated, Grade C-D with exterior glue. Sheathing for roof without corner bracing of framing shall have a span rating of 16/0 or greater for supports 16 inches on center and a span rating of 24/0 or greater for supports 24 inches on center.
- E. Wood: Provide dressed lumber, S4S, unless otherwise indicated. Provide seasoned lumber with 19 percent maximum moisture. For structural framing use No. 2 grade Douglas-fir or Larch or any species or grade meeting the following requirements:
 - 1. Fb: 900 psi
 - 2. E: 1,600,000 psi

2.2 TRUSSES

- A. Marking: Each truss shall be marked or have permanently affixed thereto the following information near the center of the span on the bottom chord: truss manufacturer's name and address, design load, and spacing of the trusses.
- B. Connector plates shall be designed by the truss manufacturer in accordance with TPI Standards. Structural plates shall be structural quality steel and hot-dip galvanized according to ASTM A 653. Connector plates shall be provided on both sides of the truss, i.e. 2 plates per joint.

2.3 PRESERVATIVE TREATMENT

- A. The treatment of lumber, timber, and plywood shall meet the requirements of AWWA UC3B for above ground use only. All products shall bear the appropriate AWPB Quality Mark. The wood shall then be dried to the moisture content specified and marked with the word "Dry." Surfaces of lumber that will be exposed shall not be incised. Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWWA M4. Wood preservative shall be **Wolman AG by Arch Treatment Technologies, Preserve CA by Viance**, or approved equal. Unless otherwise specified the following items will always be treated:
1. All wood members used in built-up roofing systems.
 2. All wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.
 3. All wood members used for rough framing of openings in exterior concrete or masonry walls.
 4. Nailing strips or nailers used in conjunction with roof systems.

2.4 ACCESSORIES AND NAILS

- A. Anchor Bolts shall conform to ASTM A 307, size as indicated, complete with nuts and washers.
- B. Expansion Shields shall be the Type and size best suited for intended use.
- C. Joist Hangers and Truss Clips shall be steel or iron, zinc-coated, size to fit members where used, sufficient strength to develop the full strength of supported member, complete with any special nails or bolts required. Framing devices shall be manufacturer by **Simpson Strong-Tie Company, Inc., USP Structural Connectors**, or approved equal.
- D. Nails and Staples shall be of the size and type best suited for purpose and shall conform to the requirements of ASTM F 1667. For sheathing, length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1-inch thick lumber and for toe nailing 2-inch thick lumber; 16-penny or larger nails shall be used for nailing through 2-inch thick lumber. Nails used with treated lumber and sheathing shall be galvanized.

PART 3 EXECUTION

3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS

- A. General: Members shall be closely fitted, accurately set to required lines and levels, and rigidly secured in place. Nailing shall be in accordance with the recommended Nailing Schedule as contained in NFOPA-02. Where detailed nailing requirements are not specified, nail size and nail spacing shall be sufficient to develop an adequate strength for the connection without splitting the members. Installation of timber connections shall conform to applicable requirements of NFOPA-01. Members shall be framed for passage of ducts and pipes shall be cut, notched, or bored in accordance with applicable requirements of NFOPA-02. Rafters, purlins, and joists shall be set with crown edge up. Leveling of joists, beams, and girders on masonry or concrete shall be with slate or steel; on wood or metal leveling shall be without shims.

- B. Cutting and Notching: Wood members shall not be cut, notched or bored more than 1/4 of their depth without adequate and approved reinforcing.
- C. Sill Plates: Sill plates shall be set level and square and anchor bolted at not more than 2 feet 8 inches on centers and not more than 12 inches from end of each piece. A minimum of two anchors shall be used for each piece. Sill plates and other wood resting on or embedded in concrete or masonry shall be pressure treated.
- D. Wall Framing: Wall studs shall be installed at a spacing of 16-inches on center unless otherwise indicated on the Drawings. A single plate shall be provided at the bottom and a double plate at the top of wall framing unless noted otherwise. Joints in the top plates shall be staggered not less than 4 feet.
- E. Roof Framing or Rafters: Tops of supports or rafters shall form a true plane. Valley, ridge, and hip members shall be of depth equal to cut on rafters where practicable, but in no case less than depth of rafters. Valleys, hips, and ridges shall be straight and true intersections of roof planes. Necessary crickets and watersheds shall be formed. Rafters, except hip and valley rafters, shall be spiked to wall plate and to ceiling joists with no less than three 8-penny nails. Rafters shall be toe-nailed to ridge; valley, or hip members with at least three 8-penny nails. Rafters shall be braced to prevent movement until permanent bracing, decking or sheathing is installed. Hip and valley rafters shall be secured to wall plates by clip angles. Openings in roof shall be framed with headers and trimmers. Unless otherwise indicated, headers carrying more than two rafters and trimmers supporting headers carrying more than one rafter shall be double. Hip rafters longer than the available lumber shall be butt jointed and scabbed. Valley rafters longer than the available lumber shall be double, with pieces lapped not less than 4 feet and well spiked together. Trussed rafters shall be installed in accordance with TPI TPI-85.
- F. Blocking and Backing: Blocking and backing shall be nominal 2-inch thick material and shall be provided as necessary to meet the latest codes for lateral bracing and for application of siding, sheathing, subflooring, wallboard, and other materials or building items, and to provide fire stopping. Blocking and backing shall be cut to fit between framing members and rigidly nailed thereto.

3.2 INSTALLATION OF SHEATHING

- A. Plywood: Sheathing shall be applied in accordance with APA standards and with edges 1/8 inch apart at side and end joints, and nailed at supported edges at 6 inches on center and at intermediate supports 12 inches on center. Nailing of edges shall be 3/8 inch from the edges. Wall sheathing shall extend over top and bottom plates, and if applied horizontally the vertical joints shall be made over supports and staggered. Roof sheathing shall be applied with long dimension at right angles to supports, end joints made over supports, and end joints staggered.

3.3 INSTALLATION OF ROOF TRUSSES

- A. Contractor shall be responsible for field erection of the trusses, including proper handling, safety precautions, temporary bracing to prevent toppling, and other safeguards which are consistent with good workmanship and building erection practices.
- B. Contractor shall comply with all applicable requirements and recommendations of TPI.

- C. Contractor shall not field repair, cut or otherwise alter trusses without consulting the truss manufacturer.

- END OF SECTION -

**SECTION 07 11 00
MOISTURE PROTECTION**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section provides specifications for all waterproofing and damp proofing of the valve vault concrete surfaces, including moistureproof underlays for concrete slabs.

1.2 RELATED WORK

- A. Related work in other sections includes but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures

1.3 QUALITY ASSURANCE

- A. Performance and Design Requirements. Prior to application of waterproofing, the Contractor shall cause a representative of the manufacturer of the materials to inspect and certify that the surfaces to be waterproofed are in a condition suitable for application of the waterproofing. Following application of the waterproofing, the Contractor shall cause a representative of the manufacturer of the materials to inspect and certify that the materials were applied in complete accordance with the manufacturer's current recommendations.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM D 450 Standard Specification for Coal-Tar Pitch Use in Roofing, Dampproofing, and Waterproofing
 - 2. ASTM D 1668 Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing.

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer product data, cut sheets, and recommended installation instructions.
- C. Prior to acceptance of the work, the Contractor shall deliver to the Engineer two copies of the specified certifications for material application.

PART 2 PRODUCTS

2.1 WATERPROOF COATING

- A. Waterproof coating shall be coal tar epoxy resin. Acceptable products are **Bitumastic 300M by Carboline, Targuard Low VOC Coal Tar Epoxy by Sherwin Williamns, PorterTuf 2000 HB Coal Tar Epoxy by Porter Coating, Series 46H-413 HB Tneme-Tar by Tnemec, Amercoat 78HB by PPG Protective & Marine Coatings**, or approved equal.

2.2 MOISTUREPROOF COATING

- A. Moistureproof coating shall be coal tar solution. Acceptable products are **Bitumastic 50 by Carbolite**, **Corothane I Coal Tar by Sherwin Williams, Series 46-465 HB Tnemecol by Tnemec, HE107 by Henry**, or approved equal.

2.3 WATERPROOF MEMBRANE

- A. Waterproof Pitch: Waterproof pitch shall be coal tar pitch.
- B. Membrane Fabric: Membrane fabric shall be coal tar pitch coated open mesh fabric per paragraph 1.2 B.
- C. Reglets: Reglets for anchoring membrane shall be fabricated of 16-ounce copper.
- D. Protective Board: Protective board shall be 2-inch celotex insulation board treated to prevent decay.

2.4 MOISTUREPROOF UNDERLAY

- A. Plastic Membrane. Plastic membrane for moistureproof underlay shall be polyethylene film having a film thickness of 6 mils.
- B. Pressure Sensitive Tape. Pressure sensitive tape shall be 2-inch wide pressure sensitive polyethylene tape.

PART 3 EXECUTION

3.1 WATERPROOF COATING

- A. Location. Waterproof coating shall be applied to the water side of walls and bottoms of channels or tanks which are common with areas to be occupied by equipment, piping or personnel. Waterproof coating shall not be applied to those surfaces to receive liquid waterproofing.
- B. Surface Preparation. New concrete to be waterproofed shall have aged at least 60 days and shall have a moisture content of less than 14%. Concrete surface shall be brush treated with a 10% muriatic acid solution and thoroughly flushed with water after 10 minutes.
- C. Walls of existing channels and tanks shall be steam cleaned prior to application of waterproofing material.
- D. Application. Prime coat shall be thinned and applied at the rate of approximately 200-300 square feet per gallon depending on surface condition. Finish coats shall be applied at the rate of 100 square feet per gallon. Final coat shall be black. Total dry film thickness shall be minimum 20 mils. Drying time between coats shall be as recommended by the paint manufacturer.

E. Application Procedures. Following the manufacturer's application instructions and these application procedures for waterproofing products as listed in paragraph 2.1 are as follows:

1. Prime coat shall consist of one coat of coal tar epoxy resin coating, black. Finish coats shall consist of two coats of coal tar epoxy resin coating, alternating red and black colors.

3.2 MOISTUREPROOF COATING

- A. Location. Moistureproof coating shall be applied to below grade, earth side of outside concrete walls which are common with areas to be occupied by equipment, piping, or personnel. Moistureproof coating is not required for walls to be provided with waterproof membrane or for walls which are poured directly against an excavated surface.
- B. Surface Preparation. Preparation of concrete and masonry walls shall conform to manufacturer's recommendations.
- C. Application. Prime and finish coats shall be applied at the rate of 70 square feet per gallon. The number of finish coats shall be sufficient to produce a dry film thickness of at least 13 mils. Drying time between coats shall be as recommended by the paint manufacturer.

3.3 WATERPROOF MEMBRANE

- A. Location. Waterproof membrane shall be applied to exterior surfaces as designated on the drawings.
- B. Surface Preparation. Concrete surfaces to receive waterproof membrane shall be clean, dry and shall have at least a Class II form finish.

3.4 MOISTUREPROOF UNDERLAY

- A. Location. Unless otherwise noted, moistureproof underlay shall be provided under all concrete floors or floating slabs-on-grade deposited on gravel base. Moistureproof underlay shall be provided under all concrete floors or floating slabs-on-grade with pressure relief valves and gravel base.
- B. Surface Preparation. Backfilled surfaces to receive moistureproof underlay shall be leveled off and smoothed over to minimize contact with sharp edges. Joints shall be sealed by means of pressure sensitive tape. Where pipes and conduits pass through the plastic membrane, they shall be wrapped tightly with separate sheets of membrane which shall then be sealed with tape to the main membrane. Reinforcing steel or mesh shall be supported by small precast placing chairs designed with flat bases to protect the membrane. The Contractor shall exercise care to maintain the integrity of the membrane at all times.

- END OF SECTION -

SECTION 07 21 00
INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section covers the work required to provide and install insulation in buildings and structures, complete and in place.

1.2 RELATED WORK

- A. Related work in other Sections includes but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 04 22 00 Reinforced Unit Masonry

1.3 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM C 516 Standard Specification for Vermiculite Loose Fill Thermal Insulation
2. ASTM C 518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
3. ASTM C 547 Standard Specification for Mineral Fiber Pipe Insulation
4. ASTM C 549 Standard Specification for Perlite Loose Fill Insulation
5. ASTM C 553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
6. ASTM C 578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
7. ASTM C 592 Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
8. ASTM C 612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation
9. ASTM C 665 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
10. ASTM C 1029 Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation
11. ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics
12. ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics
13. ASTM D 2842 Standard Test Method for Water Absorption of Rigid Cellular Plastics
14. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

15. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials

C. UNDERWRITERS LABORATORIES (UL)

1. UL1256 Fire Test of Rook Deck Constructions

D. FACTORY MUTUAL (FM)

1. Approval Standard for Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings and Exterior Wall Systems

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's literature, installation instructions, product test reports and technical data.
- C. Submit manufacturer's certification that the proposed materials comply with this Section.
- D. For foam-in-place insulation, submit a copy of the foam insulation contractor's certification and ICC-ES report and manufacturer's documentation confirming material conforms to ASTM C 1029.

1.5 DELIVERY AND STORAGE

- A. Materials shall not be allowed to become wet, soiled, or covered with ice and snow. Manufacturer's recommendations for handling storage and protection shall be strictly followed. If required, during cold weather, store in heated storage areas following the manufacturer's guidelines for minimum and maximum temperatures. Material shall not be exposed to sunlight and shall be protected against ignition. Materials shall be concealed as quickly as possible after completion of work.

1.6 MEASUREMENT AND PAYMENT

- A. There shall be no separate measurement and payment for Insulation. Full compensation for all insulation shall be considered as included in the contract unit or lump sum bid prices for the various items of the contract to which it relates.

PART 2 PRODUCTS

2.1 INSULATION

- A. Thermal resistance of insulation shall be not less than the R-values shown on the Contract Drawings. R-values shall be determined at 75 degrees F in accordance with ASTM C 518. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages.

- B. The materials and application of building insulation shall conform to the applicable requirement of the Underwriters Laboratories “Fire Resistance Index”, Factory Mutual requirements, and the manufacturer’s recommendations.
- C. Minimum R-Value in all roof insulation shall be R-30.

2.2 FOAMED-IN-PLACE THERMAL INSULATION

- A. Foamed-in-place or sprayed polyurethane foam plastic insulation conforming to the requirements of ASTM C 1029 shall be placed in cavities of masonry walls. Foamed-in-place thermal insulation in walls shall be 2-component spray polyurethane mix for producing rigid, closed-cell insulation by frothing/pouring in place. It shall have the following characteristics:

Property	Requirement	Standard
Core Density	1.5 to 2.5 pcf	ASTM D 1622
Thermal Resistance at 140°F/90 day Aged R Value, at 75°F mean Temp, min	R6.0/inch	ASTM C 518
Vapor Transmission, max	3.0 perm-inch	ASTM E 96
Water Absorption, max	3.0 %	ASTM D 2842

- B. Foamed-in-place insulation shall be **STYROFOAM (MX Series) by Dow Chemical, CertaSpray by CertainTeed, Corbond MCS by Johns-Manville, ICYNENE MD-C-200 by Icynene, Inc.**, or approved equal.

2.3 BLANKET INSULATION

- A. Blanket insulation shall be glass or other inorganic fibers and resinous binders formed into flexible blankets complying with ASTM C 665, Type III, with foiled back vapor barrier laminated to one face, with 1-inch flanges on long edges, and vapor transmission not more than 0.50 perms. Manufacturers shall be **Owens-Corning, CertainTeed, Johns-Manville**, or approved equal.

2.4 EXTRUDED POLYSTYRENE BOARD (RIGID) INSULATION

- A. Rigid insulation shall be polystyrene conforming to ASTM C 578, Type IV with surface burning characteristics per ASTM E84 maximum of 5 for flame-spread and 175 for smoke developed. Minimum thermal resistance per inch of R-5.0 per ASTM C 518 at 75°F mean temperature. Minimum compressive strength of 25 psi per ASTM D 1621.
- B. Insulation for roof decks shall be listed per UL 1256 and shall be in compliance with FM Class I roof decks.
- C. Insulation thickness in interior walls shall be 4 inches.
- D. Manufacturers shall be **Dow Chemical, Owens Corning**, or approved equal.

- E. Sill Sealer: Mineral wool, 1 inch thick and compressible to 1/32 inch, width of sill, designed to perform as an air, dirt, and insect seal.

2.5 ALUMINUM SHEETING WITH RIGID INSULATION

- A. Vaults with electric power shall be insulated with a combination of rigid insulation (see 2.4) and 24-mil thick (min) aluminum sheeting coated flat white.
- B. Accessories:
 - 1. Adhesive: As recommended by manufacturer. Adhesive shall be formulated specifically to bond insulation to steel (hatches and panels) and to concrete surfaces.
 - 2. Tape: Aluminum foil tape with facing to match rigid insulation as recommended by the manufacturer.
 - 3. J-Channel: PVC Closure strip as recommended by manufacturer for terminations.
 - 4. Clip Strip: PVC closure strip for vertical and horizontal seams.
 - 5. Fasteners: Hilti Insulation Fasteners (IZ-type), or approved equal.
- C. Aluminum Sheet Manufacturer: **Insul-Mate by RPR Products, Inc.**, or approved equal.

2.6 EXTRUDED POLYSTYRENE BOARD (RIGID) INSULATION (BURIED LOCATIONS)

- A. Rigid insulation for buried locations shall be polystyrene conforming to ASTM C 578, Type IV with surface burning characteristics per ASTM E84 maximum of 75 for flame-spread and maximum of 450 for smoke-developed. Minimum thermal resistance per inch of R-5.0 per ASTM C 518 at 75°F mean temperature. Minimum compressive strength of 25 psi per ASTM D 1621.
- B. Insulation thickness for exterior foundation walls shall be 1.5 inches minimum.
- C. Manufacturers shall be Dow Chemical, Owens Corning, or approved equal.
- D. Sill Sealer: Mineral wool, 1 inch thick and compressible to 1/32 inch, width of sill, designed to perform as an air, dirt, and insect seal.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify substrate and adjacent materials and insulation board are dry and ready to receive adhesive.
- B. Verify mechanical and electrical services within walls have been installed and tested.

3.2 INSTALLATION OF INSULATION

- A. Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the R-values shown. For acoustical insulation the installed thickness shall be as shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

3.3 INSTALLATION OF FOAMED-IN-PLACE THERMAL INSULATION

- A. The polyurethane foam shall be placed in 4-foot lifts. All insulation shall be done in close coordination with the masonry contractor to allow quality control.
- B. The polyurethane foam shall be applied by qualified firms with proper dispensing equipment.
- C. Apply in accordance with ASTM C 1029 guidelines and the manufacturer's instructions.

3.4 INSTALLATION - RIGID INSULATION

A. Foundation Perimeter:

- 1. Adhere a 6 inches wide strip of polyethylene sheet over joints with double beads of adhesive each side of the joint. Tape seal joints between sheets. Extend sheet full height of joint.
- 2. Install boards on foundation wall perimeter, horizontally. Place boards in a method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and to protrusions.
- 3. Extend boards over expansion joints, unbonded to foundation 12 inches either side of joint.

B. Exterior Walls:

- 1. Apply adhesive in 3 continuous beads per board length. Daub adhesive tight to protrusions.
- 2. Install boards on wall surface perimeter, vertically. Place membrane surface of insulation against adhesive.
- 3. Place boards in a method to maximize contact bedding. Stagger side joints. Butt edges and ends tight to adjacent board and to protrusions.
- 4. Place 24" side polyethylene sheet at perimeter of wall openings from adhesive vapor and air retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor and air retarder.

C. Cavity Walls:

- 1. Secure impale fasteners to substrate at a frequency of 6 per insulated board.
- 2. Apply adhesive in 3 continuous beads per board length. Daub adhesive tight to protrusions to ensure continuity of vapor and air retarder.
- 3. Install boards horizontally between wall reinforcement.

D. Under Concrete Slabs:

- 1. Place insulation under slabs on grade after base for slab has been compacted.
- 2. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.5 INSTALLATION - BATT INSULATION

- A. Install batt insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install batt insulation without gaps or voids
- C. Trim insulation neatly to fit spaces. Use batts free of damage.
- D. Fit insulation tight in spaces airtight to exterior side of mechanical and electrical services within the plane of insulation.
- E. Protect all insulation materials during storage and insulation from moisture, tears or other damage. All damaged material shall be replaced at no additional cost to OWNER.

- END OF SECTION -

SECTION 07 32 00
METAL ROOFING SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall furnish and install metal roofing and soffit panels, system support framing, and appurtenant work, complete and in place.
- B. The principal items of sheet metal work included in the metal roofing system shall include sheet metal flashing, covers, trim, enclosure batts, collars and sleeves at all roof penetrations, metal soffit panels, and all other sheet metal items necessary for a complete and watertight metal roofing system.
- C. The metal roofing applicator shall coordinate his work with sheet metal gutter work and shall report to CONTRACTOR and ENGINEER if any sheet metal work provided by others affects his work negatively.

1.2 RELATED WORK

- A. Related work in other sections includes but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures

1.3 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 2. ASTM A 924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
 - 3. ASTM D 226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 - 4. ASTM D 1938 Standard Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method
 - 5. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
 - 6. ASTM E 330 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
 - 7. ASTM E 1646 Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
 - 8. ASTM E 1680 Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems

C. UNDERWRITERS LABORATORY (UL)

1. UL 580 Test for Uplift Resistance of Prepared Roof Assemblies

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit detailed shop drawings showing materials, gages, finishes, layout, corners, trim, flashing, enclosures, edge conditions, jointing, profiles, supports, fasteners, fabrication of special shapes, and method of attachment to adjacent construction to Engineer prior to fabrication. Submit drawings indicating roof size, location and type of penetrations, perimeter and penetration details, roof insulation make-up and sheet layout that have been accepted by an authorized manufacturer's representative.
- C. Submit manufacturer's literature indicating materials, finish, construction, and method of installation of prefabricated items and sealant.
- D. Provide color samples for color selection by OWNER.
- E. Submit the following test reports, certified by an Independent Testing Laboratory or a professional engineer registered in the State of Utah to verify the proposed roofing will meet performance requirements of this Specification:
 1. Thermal Cycle Test
 2. ASTM E-330 Adapted to Test Formed Metal Panels
 3. Clip Fastener Pull-Out Tests and Calculations
 4. UL 580 Class 90
 5. Concentrated Load Test Data
 6. Air Infiltration (E-283) and Water Penetration (E-331) Test Results
 7. Coating Performance Testing
- F. Submit certification by the manufacturer that the roofing assembly is listed in the UL Building Materials Directory with a Class 1-90 wind uplift rating, including relevant construction number.

1.5 WARRANTIES

- A. Manufacturer shall provide to OWNER written warranty that the roof panels will not rupture, fail structurally, or perforate due to corrosion for a period of 20 years from the date of installation.
- B. Roofing manufacturer shall provide written 10-year material and labor warranty beginning at the date of final acceptance.
- C. CONTRACTOR shall provide to OWNER written warranty that the roof system is installed in accordance with the manufacturer's recommendations and will be free from defective workmanship and remain watertight and weatherproof with normal usage for two (2) years following Project Substantial Completion date.

1.6 QUALITY ASSURANCE

- A. A single installer shall perform the work of this Section and shall have completed projects

of similar scope and complexity.

1.7 MEASUREMENT AND PAYMENT

- A. There shall be no separate measurement and payment for roof systems. Full compensation for roofing systems shall be considered as included in the contract unit or lump sum bid prices for the various items of the Contract to which roof system relates.

PART 2 PRODUCTS

2.1 GENERAL

- A. Subject to compliance with the requirements, manufacturers who may offer metal roofing systems and products, which may be incorporated into the work, include **AEP Span**, **Fabral**, or approved equal.

2.2 ROOF PANELS

- A. Minimum Performance Ratings and Properties:
 - 1. Air infiltration: Panel shall have no air infiltration at 20 psf pressure differential and no air exfiltration at 20 psf pressure differential when tested in accordance with ASTM E 1680.
 - 2. Water penetration: Panel shall have no leakage through panel joints when tested in accordance with ASTM E 1646 at static pressure differential of 20.0 psf.
 - 3. Provide UL90 rated roofing system that has been tested in accordance with UL 580 test procedure. Panels shall be capable of spanning 5'-0" on-center purlins with UL90 rating.
- B. Profile:
 - 1. Roof panels shall be factory formed ribbed seam pattern with minimum 1" high seams and a nominal panel width of 16 inches.
 - 2. Soffit panels shall be 12-inches wide, 1-1/2" deep, 22- gauge, G90 galvanized finish steel, with concealed fastener, lock-joint design and shall be continuous-vented.
- C. Length:
 - 1. Provide panels of sufficient length to minimize end laps.
- D. Profile Composition:
 - 1. Base metal shall be a minimum 24-gage structural steel (minimum yield strength 50,000 psi) with G90 hot dipped galvanized coating conforming to ASTM A 653.
 - 2. Sheet metal trim, flashing, and accessories shall be the same material, gauge, finish, and color as the metal roofing.
 - 3. Paint Finish:
 - a. All panels shall receive a factory applied Kynar 500/Hylar 5000 finish applied to both sides of the panel over the base protective coating, or approved equal. The exposed side coating shall have a minimum total dry film thickness of 1.0 mil and the underside coating shall have a minimum total dry film thickness of 0.5 mil. Color to be as determined by OWNER.

E. Concealed-Clips:

1. Material: 18-gauge steel with class G60 galvanized coating.
2. Configuration: clips shall be designed so as to attach with two concealed fasteners, and fully attach two ribs of every panel.
3. Spacing: In accordance with the manufacturer's recommendations.

F. Fasteners:

1. Self-drilling or self-tapping galvanized steel screws and/or stainless-steel pop rivets painted to match the panels where visible, per the panel manufacturer's recommendations.

G. Sealants:

1. Sealants shall not contain oil, asbestos, or asphalt. Factory applied sealant shall be applied in the seam and designed for metal to metal concealed joints. Field applied panel end sealant shall be mastic tape sealant. Exposed sealant shall be one-part polyurethane joint sealant. All sealants used shall be as recommended by the metal roofing manufacturer for the job conditions and warranty requirements.

H. Weather resistive barrier:

1. Membrane underlayment shall be composed of a high-strength, spun-bonded polypropylene base sheet, co-extruded on both sides with UV stabilized polyolefin, weight 30-pound. Membrane underlayment shall conform to ASTM D 226, Type II. Permeability shall be 0.54 perms maximum in accordance with ASTM E 96, Procedure A, and tear strength shall be minimum 20 pounds in accordance with ASTM D 1938. Membrane underlayment shall be **Grace Tri-Flex 30 by Grace Construction Products**, or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify proper placement of all roof openings, pipes, curbs, sleeves, ducts, vents and drains.

3.2 SUBSTRATE PREPARATION

- A. Comply with manufacturer's instructions for preparation of substrate to receive roofing. Clean substrate of dust, debris and other substances detrimental to the roofing work.

3.3 NAILERS

- A. Install treated wood nailers at roof perimeters, at base of roof projections, and around specified roof penetrations.
 1. Total nailer height shall match total thickness of insulation being used. Install with 1/8" gap between each length and at changes in direction.
 2. Firmly fasten nailer to the deck, wall, or existing structurally sound and secured nailer at (16") o.c. maximum, so as to resist a force of 200 pounds per lineal foot in any direction.

3. Taper nailer where applicable to be flush at point of contact with membrane in either the vertical or horizontal applications.

3.4 GENERAL

- A. The metal roofing shall be installed by an applicator and fabricator approved by the roofing system manufacturer who has working experience with the roofing system. Contractor shall provide a letter signed by the roofing manufacturer that the installer is an approved applicator and fabricator of the roofing system.
- B. The metal roofing systems shall be installed in accordance with the manufacturer's instructions and recommendations applicable to the job conditions and supporting substrates.
- C. The panels and other components of the system shall be securely anchored and placed with concealed fasteners and shall be provided with provisions for thermal/structural movement.
- D. Shim and align panel units within installed tolerances of 1/4-inch in 20 feet on level/plumb/slope and location/line as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- E. Joint sealers shall be furnished and installed where necessary or where required for weatherproofing of the system.

3.5 INSTALLATION

- A. Metal panels shall be installed in accordance with the approved shop drawings and the manufacturer's recommendations.
- B. Remove any strippable protective coating on the panels and flashings prior to installation and in any case do not allow the strippable coating to remain on the panels in extreme heat, cold, or in direct sunlight or other UV source.
- C. Loosely lay roof insulation with end joints staggered. (Stagger joints between layers.) Joints shall be 1/4" or less in width. Neatly cut and fit insulation around roof penetrations and projections. Install only dry insulation and only as much insulation as can be covered the same day with membrane and completed.

3.6 CLEANING AND PROTECTION

- A. Panels and other components of the work which have been damaged or have deteriorated beyond successful repair by means of finish touch-ups or similar minor repair procedures, shall be removed and replaced at no cost to Owner.
- B. Temporary protective coverings and strippable films shall be removed from the materials during installation. Upon completion of the work, the roofing systems shall be cleaned as recommended by the roofing manufacturer and shall be maintained in a clean condition until acceptance of the work by Owner.

- END OF SECTION -

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 DESCRIPTION

- A. The CONTRACTOR shall provide and install sheet metal flashing and trim, and appurtenant work, complete in place, in accordance with the Contract Documents.

1.2 RELATED DOCUMENTS

- A. Related work in other Sections includes but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 06 10 00 Rough Carpentry
 3. Section 07 32 00 Metal Roofing Systems
 4. Section 07 92 00 Joint Sealants

1.3 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 2. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 3. ASTM A792 Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 4. ASTM C920 Standard Specification for Elastomeric Joint Sealants.
 5. ASTM C1311 Standard Specification for Solvent Release Sealants.
 6. ASTM D1187 Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 7. ASTM D4586 Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- C. Sheet Metal and Air Conditioning Contractors Association, SMACNA - Architectural Sheet Metal Manual

1.4 PERFORMANCE REQUIREMENTS

- A. Materials, anchorage, fastenings and workmanship shall qualify for U.L. Class 115 MPH (3 second gust) wind uplift rating.
- B. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation,

overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and night time-sky heat loss.

1. Temperature Change (Range): 120° F, ambient; 180° F, material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.5 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
4. Details of expansion-joint covers, including showing direction of expansion and contraction.

C. Submit manufacturer's specifications, literature, and published installation and maintenance instructions for all sheet metal products.

D. Provide samples of color where required.

1.6 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.8 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leak-proof, secure, and noncorrosive installation.

PART 2 MATERIALS

2.1 SHEET METAL

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 - 1. Thickness 0.0239-inch (24 U.S. Standard gauge), unless shown otherwise.
 - 2. Finish-factory applied to match color of metal frames, or trim.
- B. Manufacturers shall be **Cheney Flashing Company, Fry Reglet Corporation, Heckmann Building Products, Inc.**, or approved equal.

2.2 DOWNSPOUTS, GUTTER AND TRIM

- A. Downspouts, gutters and trim shall be same metal and thickness as roof panels. Fabricate gutters in minimum 96-inch long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from the same material as gutters. Fabricate expansion joints, expansion joints covers, gutter bead reinforcing bars, and gutter accessories from same material as gutters. Shop fabricate interior and exterior corners.
- B. Color shall match roof panels.

2.3 FASCIA AND RAKE TRIM

- A. Fascia and rake trim shall be same metal and thickness as roof panels.
- B. Color shall match roof panels.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
 - 1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating. Steel, galvanized per ASTM A153/A153M or stainless steel.
 - 2. Fasteners for Flashing and Trim: Steel, galvanized per ASTM A153/A153M or stainless steel. Blind fasteners or self-drilling screws, gasketed, with hex washer head.
 - 3. Blind Fasteners: High-strength stainless-steel rivets.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, non-staining tape.

- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 1. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flatlock seams. Tin edges to be seamed, form seams, and solder.
- D. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.
- H. Reinforcement and Supports; Provide same material as flashing, unless other material is shown. Steel, where shown or required, shall be galvanized or stainless.
- I. Rigid Joints and Seams: make mechanically strong. Solder galvanized and stainless steel metal joints. Do not use solder to transmit stress.
- J. Provide watertight closures at exposed ends of counterflashing.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Counterflashing: Fabricate from the following material:
 - 1. Galvanized Steel: 0.022 inch thick.
- B. Roof-Penetration Flashing: Fabricate from the following material:
 - 1. Galvanized Steel: 0.028 inch thick.

2.7 DOWNSPOUTS AND GUTTERS FABRICATION

- A. Form downspouts and gutters in maximum lengths as practicable to sizes and shapes indicated on the Drawings.
 - 1. Lock longitudinal joints of downspouts.
 - 2. Telescope end joints 1-1/2 inches.
 - 3. Provide elbows at bottom where downspouts discharge onto splash blocks.
 - 4. Anchor downspouts with straps of same material as downspouts.
 - 5. Install gutters at locations indicated on drawings.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following material:
 - 1. Galvanized Steel: 0.028 inch thick.

2.9 FLEXIBLE BASE PIPE SEALS

- A. Flexible base pipe seals shall be prefabricated on-piece aluminum flanged base with stepped, graduated EPDM profile which creates a compression seal between the piping and the flashing. Aluminum base shall be flexible to conform to profile of roof panels.
- B. Manufacturers and Products:
 - 1. Pate Co.; Dektite.
 - 2. Portals Plus, Inc.; Deck-Mate.
- C. Coat aluminum surfaces in contact with dissimilar metals in accordance with 3.2.B of this Section.
- D. Isolation tape shall be butyl or polyisobutylene, internally reinforced.
- E. Fasteners shall be stainless steel of type required.

2.10 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
 1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
 2. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
 3. Use only stainless steel fasteners to connect isolated dissimilar metals.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and [elastomeric] [butyl] sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 30 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing

hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

- G. Seal joints with elastomeric sealant as required for watertight construction.
 - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70° F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40° F.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 - "Joint Sealants."
- H. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.
 - 1. Pretinning is not required for lead-coated copper.
 - 2. Where surfaces to be soldered are lead coated, do not tin edges, but wire brush lead coating before soldering.
 - 3. Lead-Coated Copper Soldering: Wire brush edges of sheets before soldering.
 - 4. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

3.3 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.
 - 1. Secure in a waterproof manner by means of anchor and washer at 36-inch centers, or other method approved by ENGINEER.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
 - 1. Use appropriate flexible base pipe seal where pipe, conduit or cable, etc. penetrate roofing system.

2. Make work watertight and free of expansion and contraction noise. Seal and clamp flashing to pipes penetrating roof.

3.4 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

- END OF SECTION -

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Polyurethane Sealants
- B. Tape Mastic Sealants
- C. Non-skinning Sealants
- D. Silicone Sealants
- E. Acrylic Sealants

1.2 RELATED DOCUMENTS

- A. Related work in other Sections includes but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures

1.3 REFERENCES

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN ARCHITECTURAL MANUFACTURER'S ASSOCIATION (AAMA)
 - 1. AAMA 800-10 Voluntary Specifications and Test Methods for Sealants
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A 792 Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy Coated by the Hot-Dip Process.
 - 3. ASTM C 639 Standard Test Method for Rheological (Flow) Properties of Elastomeric Sealants
 - 4. ASTM C 661 Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
 - 5. ASTM C 681 Standard Test Method for Volatility of Oil- and Resin-Based, Knife Grade, Channel Glazing Compounds
 - 6. ASTM C 711 Standard Test Method for Low-Temperature Flexibility and Tenacity of One-Part, Elastomeric, Solvent-Release Type Sealants
 - 7. ASTM C 794 Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
 - 8. ASTM C 908 Standard Test Method for Yield Strength of Preformed Tape Sealants
 - 9. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
 - 10. ASTM D 56 Standard Test Method for Flash Point by Tag Closed Cup Tester

11. ASTM D 217 Standard Test Methods for Cone Penetration of Lubricating Grease
12. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
13. ASTM D 792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
14. ASTM D 925 Standard Test Methods for Rubber Property—Staining of Surfaces (Contact, Migration, and Diffusion)
15. ASTM D 2452 Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
16. ASTM D 2453 Standard Test Method for Shrinkage and Tenacity of Oil- and Resin Base Caulking Compounds
17. ASTM D 1475 Standard Test Method For Density of Liquid Coatings, Inks, and Related Products
18. ASTM D 2202 Standard Test Method for Slump of Sealants
19. ASTM D 2203 Standard Test Method for Staining from Sealants
20. ASTM G 154 Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

D. INTERIM FEDERAL SPECIFICATIONS (FS)

1. FS TT-S-00230C Sealing Compound: Elastomeric Type, Single Component
2. FS TT-C-1796A Caulking Compounds, Metal Seam and Wood Seam
3. FS TT-S-001543A Sealing Compounds: Silicone Rubber Base (For Caulking, Sealing, and Glazing in Buildings and Other Structures)

E. SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

1. Rule 1168 Adhesive and Sealant Applications

F. UNDERWRITER'S LABORATORIES (UL)

1. UL 580 Tests for Uplift Resistance of Roof Assemblies

1.4 SUBMITTALS

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Material Safety Data Sheets (MSDS): Provide in accordance with 29 CFR 1910.1200,
- C. Hazard Communication
- D. Product Test Reports: Reports of tests required by this section performed by a qualified testing agency, indicating that the sealants comply with the requirements.
- E. VOC Content: Provide documentation of the Volatile Organic Content (VOC) in accordance with SCAQMD Rule 1168
- F. USDA Approval: Provide documentation that the product is approved for use in meat and poultry processing areas by the USDA for the following types of sealants:
 1. Polyurethane
 2. Tape Mastic

3. Non-skinning Sealant

1.5 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within 5 years of installation.

PART 2 PRODUCTS

2.1 GENERAL MATERIAL REQUIREMENTS

- A. Substrate Requirements: When testing is required on a substrate, the material used shall be either ASTM A653 G-90 or ASTM A792 AZ50 and tests shall be conducted with each of the following coatings:
 - 1. Bare (No coating)
 - 2. Acrylic (Galvalume Plus)
 - 3. Polyester
 - 4. Siliconized Polyester
 - 5. Polyvinylidene Fluoride Resin (PVDF)

2.2 POLYURETHANE SEALANT

- A. General: Provide Sealants that meet the following specifications:
 - 1. ASTM C 920, Type S, Grade NS, Class 25, Use: NT, A, M, G and O paintable sealant
 - 2. AAMA 808.3
 - 3. FS TT-S-00230C, Type II, Class A
- B. Color: The sealant shall be selected by OWNER. :
- C. Physical Properties: The sealant shall have the following additional physical properties:
 - 1. Peel Adhesion: All panels shall have at least a 90% cohesive failure of at least 15 lb/in when tested in accordance with ASTM C 794.
 - 2. Tensile Strength: Sealant shall have a tensile maximum of 300 psi and an elongation of 500-600% when tested in accordance with ASTM D 412.
 - 3. Sag: There shall be no sag when tested in accordance with ASTM C 639.
 - 4. Hardness: Shore "A" hardness on all three samples shall not exceed 40 when tested in accordance with ASTM C 661
 - 5. Service Temperature Range: -40 degrees Fahrenheit to 200 degrees Fahrenheit.
 - 6. Water Resistance: There shall be no presence of voids, cracks, separation or breakdown of the compound when tested in accordance with AAMA 800-10, Section 2.11.1.
 - 7. Flash Point: No less than 145 degrees Fahrenheit when tested in accordance with ASTM D 56.
 - 8. Shelf Life: The compound shall have a shelf life of 9 months or more when stored at or below 80 degrees.
 - 9. Skin Time: The compound shall have a skin time of 2-4 hours

10. Cure Time: The compound shall have a cure time of 24-48 hours
11. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

2.3 TAPE MASTIC SEALANT

- A. General: Provide Sealants that meet the following specifications:
 1. AAMA 804.3
 2. AAMA 807.3
 3. FS TT-C-1796A, Type II, Class B
 4. Approved by Underwriters Laboratories for use in roof deck constructions classified under UL-518 Class 90
- B. Color: The sealant shall be selected by OWNER.
- C. Physical Properties: The sealant shall have the following additional physical properties:
 1. Specific Gravity: 1.4 or higher when tested in accordance with ASTM D 792
 2. Tensile Adhesive Strength: 20 psi or higher when tested in accordance with ASTM C 908
 3. Elongation: 1000% or higher when tested in accordance with ASTM C 908
 4. Cone Penetration: The sealant shall meet the following conditions when tested in accordance with ASTM D 217 with a 300g cone in 5 seconds:
 - a. 8.5 – 100 mm at 77 degrees Fahrenheit
 - b. 125-135 mm at 120 degrees Fahrenheit
 - c. 45-55 mm at Zero degrees Fahrenheit
 5. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

2.4 NON-SKINNING SEALANT

- A. General: Provide sealants that meet the following specifications:
 1. AAMA 809,2
 2. FS TT-C-1796A, Type 1, Class A
- B. Color: The sealant shall be selected by OWNER.
- C. Physical Properties: The sealant shall have the following additional physical properties:
 1. Extrudability: The sealant shall deposit in 30 to 50 seconds through a 0.104" orifice at 50 psi pressure in accordance with ASTM D 2452.
 2. Total Solids: At least 85% by weight when determined in accordance with ASTM C 681.
 3. Volume Shrinkage: Less than 15% when determined in accordance with ASTM D 2453.
 4. Weight per U.S. Gallon: 10.75 lbs. +/- 0.25 lbs. when determined in accordance with ASTM D 1475.
 5. Vehicle Bleed out: There shall be no visible exudation of vehicle from sealant after 21 days at 158 degrees Fahrenheit on the test panel.

6. Flexibility: There shall be no loss of adhesion at -60 degrees Fahrenheit when tested in accordance with ASTM C 711.
7. Sag: 0.20 in max, full button when tested in accordance with ASTM D 2202.
8. Staining: Sealant will not stain a painted test panel when tested in accordance with ASTM D 925, Method A.
9. UV Resistance: There shall be no cracking, bleeding, or loss of elasticity after 1,000 hours of QUV exposure in accordance with ASTM G 154.
10. Wet Flammability: No less than 110 degree Fahrenheit flash point when determined in accordance with ASTM D 56.
11. Coverage: Each gallon of sealant shall provide the following minimum coverage:
 - a. 500 lineal feet with 1/8 in bead
 - b. 690 lineal feet with 3/16 in bead
 - c. 390 lineal feet with 1/4 in bead.
12. Shelf Life: 18 months minimum in unopened container when stored at or below 90 degrees Fahrenheit.
13. Drying time: Non-skinning, remains permanently soft and tacky.
14. Engageability: Sealant will easily engage and transfer to male joint at 10 degrees Fahrenheit.
15. Service Temperature Range: -60 degrees Fahrenheit to 200 degrees Fahrenheit.
16. Application Temperature Range: 10 degrees Fahrenheit to 120 degrees Fahrenheit.
17. Non-Reactive: Will not darken, etch, or leave salt deposits on the test panel after two years.
18. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

2.5 SILICONE SEALANT

- A. General: Provide sealants that meet the following specifications:
 1. ASTM C 920, Type S, Grade NS, Class 25
 2. AAMA 802.3, Type I and II
 3. AAMA 805.2 Group C
 4. AAMA 808.3
 5. FS TT-S-001543A, Class A
 6. FS TT-S-00230C, Class A
- B. Color: Clear
- C. Physical Properties: The sealant shall have the following additional physical properties:
 1. Mechanical Properties: The sealant shall have the following mechanical properties as determined by ASTM D 412:
 - a. Tensile Strength: 150 psi minimum (Method A)
 - b. Modulus at 100% Elongation: 35 psi minimum
 - c. Elongation: 400% minimum
 - d. Recovery: 100%
 2. Hardness: Maximum Shore A hardness of 15 when determined in accordance with ASTM C 661.
 3. Tack-free Time: 1/4 in dia. bead at 77 degrees Fahrenheit, 50% relative humidity, 10-15 minutes.
 4. Cure Time: 1/4 in dia. bead at 77 degrees Fahrenheit, 50% relative humidity, 10-12 hours.

5. Service Temperature: -60 degrees Fahrenheit to 300 degrees Fahrenheit.
6. Shelf Life: 9 months when stored in unopened original containers at 80 degrees Fahrenheit or less.
7. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

2.6 ACRYLIC SEALANT

A. Color:

1. Clear
2. White
3. Gray

B. Physical Properties:

1. Percent Solids:
 - a. Colors: 75% minimum determined in accordance with ASTM D 1475
 - b. Clear: 70% minimum determined in accordance with ASTM D 1475
2. Peel Adhesion: All panels shall have at least a 90% cohesive failure of at least 5 lb./in when tested in accordance with ASTM C 794.
3. Weight per U.S. Gallon: 8.7 lbs. +/- 0.25 lbs. when determined in accordance with ASTM D 1475.
4. Viscosity: The sealant shall meet the following conditions when tested in accordance with ASTM D 2452 with a 20g cone with a 0.104 in orifice at 60 psi at 77 degrees Fahrenheit in the indicated time:
 - a. Colors: 40-60 seconds
 - b. Clear: 35-45 seconds
5. Elongation: 200% minimum when tested in accordance with ASTM D 412.
6. Hardness: Maximum Shore A hardness of 55 when determined in accordance with ASTM C 661.
7. Flash Point: No less than the following when tested in accordance with ASTM D 56
 - a. Colors: 52 degrees Fahrenheit
 - b. Clear: 40 degrees Fahrenheit
8. Slump: 0.10" maximum when tested in accordance with ASTM D 2202.
9. Vehicle Migration: No vehicle migration from the sealant edge when tested in accordance with ASTM D 2203 as modified by Section 2.8.1 of AAMA 800-10.
10. Paintability: Compatible with Alkyds, enamels and lacquers post-solvent release.
11. Service Temperature Range: Zero degrees Fahrenheit to 180 degrees Fahrenheit.
12. Shelf Life: 18 months when stored in original, unopened containers at or below 80 degrees Fahrenheit.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install joint sealants in accordance with manufacturer's specifications and requirements.

- END OF SECTION -

SECTION 08 10 00
DOORS AND FRAMES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section covers all the work necessary to furnish and install the new doors, frames, and hardware, complete and operable.
- B. All doors and their pressed steel frames shall be steel, insulated, and the type and size as indicated on the Door Schedule on the Drawings.

1.2 RELATED WORK

- A. Related work in other Sections includes but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 09 90 00 Painting and Finishes

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - 1. ANSI A 115.IG Installation Guide for Doors and Hardware
 - 2. ANSI A 156.6 Standard for Architectural Door Trim
 - 3. ANSI A 156.16 Standard for Auxiliary Hardware
 - 4. ANSI A 250.8 SDI-100 Recommended Specifications for Standard Steel Doors and Frames
 - 5. ANSI A 250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
 - 6. ANSI A 250.11 Recommended Erection Instructions for Steel Frames
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 36 Standard Specification for Carbon Structural Steel
 - 2. ASTM A 108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
 - 3. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 4. ASTM A 229 Standard Specification for Steel Wire, Quenched and Tempered for Mechanical Springs
 - 5. ASTM A 653 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
 - 6. ASTM A 1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

7. ASTM A 1011 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
8. ASTM C 177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
9. ASTM D 256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
10. ASTM D 635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
11. ASTM D 790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
12. ASTM D 792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
13. ASTM D 882 Standard Test Method for Tensile Properties of Thin Plastic Sheeting
14. ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics
15. ASTM D 2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
16. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
17. ASTM E 330 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

D. AMERICAN WELDING SOCIETY (AWS)

1. AWS D1.1 Structural Welding - Steel
2. AWS D1.3 Structural Welding Code – Sheet Steel

1.4 SUBMITTALS

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Manufacturer's catalog data and preprinted installation instructions of doors.
- C. A schedule showing the location of each door shall be included with the drawings. Submittal drawings shall include elevations of each door type, details and method of anchorage, details of construction, method of assembling sections, location and installation of hardware, shape and thickness of materials, details of joints and connections.
- D. Manufacturer's certificates that certify products meet or exceed the specified requirements.
- E. Warranty: Provide documentation of the manufacturer's standard written one (1) year warranty.

1.5 DELIVERY AND STORAGE

- A. Doors shall be delivered to the job site wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dust or water, and in a manner that permits easy access for inspection and handling. Doors shall be handled carefully to prevent damage to the faces, edges, and ends. Damaged items that cannot be restored to like-new condition shall be replaced.

1.6 MEASUREMENT AND PAYMENT

- A. There shall be no separate measurement and payment for doors, frames, and hardware. Full compensation for all doors, frames, and hardware shall be considered as included in the contract unit or lump sum bid prices for the various items of the Contract to which doors relate.

PART 2 PRODUCTS

2.1 STEEL DOORS

- A. Steel doors and frames shall be of hollow metal construction and shall be full flush design with no visible seams. Interior and Exterior door face sheets shall be hot-dip galvanized according to the requirements of ASTM A 653. Manufacturer's shall be **Republic Doors and Frames, Steelcraft, Ceco Door Products**, or approved equal. Doors shall conform to ANSI A 250.8 and to the following requirements:
 1. Hollow metal door, 1 3/4 inches thick flush type, constructed of two sheets of not less than stretcher leveled, 16-gauge steel sheets formed and welded for flush pan assembly, with internal 20-gauge vertical reinforcing channels spaced not over 8 inches on centers the full height of the door. There shall be no visible joints on the face of the doors. Reinforcing channels shall be uniformly spot welded to face plates at top and bottom of all doors. Filler channels shall be provided at the top and bottom of doors to provide a flush closure. The top of exterior doors shall be provided with flush, water- and weather-tight top enclosures.
 2. All interior void spaces shall be completely filled with EPS foam or polyurethane.
 3. Concealed sheet or bar steel reinforcement shall be provided for mortise type hardware. Reinforcing shall not be less than the following: 9-gauge for butts, 12-gauge for locksets and 14-gauge for surface applied hardware. Reinforcing shall be drilled and tapped to template requirements. Concealed reinforcing shall be provided for closures. Door bottom weather stripping shall be included to match thresholds.
 4. Door frames shall be pressed steel constructed of not less than 16-gauge steel and shall be of the shape indicated on the plans and as required to fit the various wall constructions. Frames shall be of welded unit construction assembled and welded in the shop. Welding shall be to a hairline joint with all exposed beads ground smooth.
 5. Concealed reinforcing of the frames for the mortise hardware shall be not less than the following: 3/16 inch for butts, 12-gauge for lock strike, 14-gauge for surface applied items and 18-gauge for plaster guards over mortised hardware reinforcement. Frames shall be mortised drilled, and tapped to template requirements. Lock reinforcing units shall be supplied by finishing hardware supplier. Frames shall be anchored as shown in the drawings.
 6. Hinges shall be heavy duty ball bearing hinges with non-removable pins.

7. Pull plates shall be chrome plated or stainless steel and mounted on interior and exterior sides of all doors.
8. All double doors are to be supplied with a "Z" astragal of 14-gage steel for 1-3/4-inch doors and 16-gage for 1-3/8-inch doors.
9. Hardware including locksets and hinges shall be stainless steel.

2.2 DOOR HARDWARE

- A. Trim material shall be stainless steel, unless noted otherwise.
- B. Pull Plates: 8" CTC pull, 4" x 16" plate, stainless steel, No. 110 x 70C by **Rockwood Mfg. Co.**, or approved equal, conforming to ANSI A 156.6.
- C. Hinges: satin stainless steel, 5 knuckles minimum, non-rising pin for interior doors and non-removable pin for exterior doors, number of hinges per door manufacturer's recommendation (minimum of 3 hinges per door). Where necessary to keep door leaf clear of walls, casings, jambs or reveals in door opening, wide throw hinges of an approved type shall be furnished. Finish shall be stainless steel satin (32D or 630). Manufacturer shall be **Mckinney T4A3386, Hager, Stanley Works FBB199 (32D)**, or approved equal.
- D. Cylinder Lock Set: **Best Access Systems**, Lockset 47H-7-AB-15-J-630-SH-S6-VT for exterior doors and 45H-7-N-15-M-630 for interior doors. Locks must be compatible with Owners existing keys. Contractor shall provide lock sets and keys that will match Owner's requirements.
- E. Lever Extension Flush Bolt, Upper, **Rockwood No. 555**, or approved equal, cadmium plated finish (inactive leaf only), conforming to ANSI A 156.16.
- F. Lever Extension Flush Bolt, Lower, **Rockwood No. 555**, or approved equal, cadmium plated finish (inactive leaf only), conforming to ANSI A 156.16.
- G. Threshold: **#277AS by Pemko Corporation**, or approved equal, raised interior, extruded aluminum threshold with neoprene seal.
- H. Drip Cap: Provide drip cap on all exterior doors. Drip cap shall be clear anodized aluminum, **Pemko 346C**, or approved equal.
- I. Door Closers: Door closers shall be full rack and pinion, cast iron, with adjustable regulators for closing and latching speed, back check and spring power. Closers shall be mounted for 180 degrees of swing whenever possible. All closers shall be LCN Model 4040XP with 4041-3071 DEL cylinder with extra duty hold open arm. Mounting plates shall be supplied as necessary. All door closers attached to mineral core or particle filled doors shall be installed with hex bolts. Cover shall be metal 4040XP-72MC with 689 Aluminum finish.
- J. Lock Strikes: Strikes shall have extended curved lips where required to protect trim from being marred by latch bolt. Strike lips shall not protrude more than 1/8-inch beyond door frame trim. Wrought box strikes shall be furnished on all locks, latches and deadlocks.
- K. Door Stop: Solid cast brass, DuraFlex bumper, **Rockwood #445**, or approved equal (Inactive leaf only)

- L. Non-Mortise Door Edge with Astragal: 0.06" thick stainless steel, **Rockwood HD306B-AST**, or approved equal (double doors only)
- M. Kick Plates: Unless otherwise indicated, kick plates shall be provided and shall be satin stainless 18-8, 18 gage, **Rockwood No. K1050F**, or approved equal.
- N. Weatherstripping and Seals: silicone gasketing, **Pemko S88D**, or approved equal.

2.3 ACCESS DOORS AND FRAMES

- A. Fabricate doors and frames as shown on the drawings and in accordance with best shop practices. Frames shall be rigid, neat in appearance and free from defects. Field measurements shall be taken as required for coordination with adjoining work.
- B. Form exposed surfaces free from warp, wave and buckle, with all corners square, unless otherwise shown. Set each member in proper alignment and relationship to other members with all surfaces straight and in a true plane.
- C. Reinforce members and joints with plates, tubes or angles for rigidity and strength.
- D. Doors and frames shall be mortised and reinforced for hardware in accordance with the hardware manufacturer's instructions and templates. The reinforcing shall be designed to receive hinges, locks, strikes, closures, etc.
- E. Mortar guard boxes shall be provided for hardware cutouts in frames.
- F. Furnish at least three (3) metal anchors or polymer spacers in each jamb of frames up to 84" high and one (1) additional anchor for each 24" in height above 84", in shapes, sizes and spacing shown or required for anchorage into adjoining wall construction. Fabricate joint anchor of stainless steel.
- G. Terminate bottom of frames at the indicated finished floor level.
- H. Provide clearance for doors of 1/8" at jambs and heads; 1/4" clearance above threshold.
- I. Where glazing is required, flush integral stops on one side and screw-on stops on the opposite side shall be provided.

2.4 FINISH

- A. Surfaces shall be provided with a shop-primed galvanized finish. Prior to receiving primer, all surfaces shall be cleaned thoroughly and phosphate-treated to assure maximum paint adherence. Primer shall be a metallic oxide or synthetic resin primer of the manufacturer's standard type and shall be applied by dipping or spraying in accordance with ANSI A 250.10.
- B. Field painting of doors and frames shall be in accordance with Section 09 90 00 – Painting and Finishes. Finish coat shall be compatible with the shop applied primer coating.

2.5 ACCESSORIES

- A. Locking: Provide a master keyable cylinder operable from both sides of door knob, options for all types of operation. Cylinder shall be **Best Lock Double Barrel** cores.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions and in accordance with ANSI A 115IG. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be weather tight and shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.
- B. Access Door Frame Installation
 - 1. Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged. Frame must not be drilled for brace supports as finish may be damaged. Install frames in accordance with ANSI A 250.11.
 - 2. Locate three (3) wall anchors per jamb at hinge and strike levels. Frames may be grouted full of mortar at jambs and anchors shall be built into the joints as walls are laid up. A continuous bead of silicone sealant is to be applied between the head and jamb at the miter joint.
- C. Adjust doors for free swing without binding. Adjust hinge sets, locksets, and other hardware. Lubricate using a suitable lubricant compatible with the door and frame coatings.
- D. Install work of this Section in strict accordance with approved shop drawings and manufacturer's recommended installation instructions. Where installations require field welding, all work must be performed by certified welders in accordance with AWS D1.1/D1.3.
- E. Upon installation, secure the services of a qualified representative of the manufacturer to visit the jobsite and inspect the complete installation of the door and frame assemblies, test all components thru a minimum of ten (10) cycles of operation and direct installer in correcting any non-conforming items found.
- F. Remove temporary coverings. Repair or replace damaged installed products. Clean installed products in accordance with the manufacturer's instructions before acceptance by OWNER.
- G. Clearances at edge of doors:
 - 1. Between door and frame at head and jambs: 1/8 inch.
 - 2. At meeting edges pairs of doors and at mullions: 1/8 inch.
 - 3. At transom panels, without transom bars: 1/8 inch.
 - 4. At sills without thresholds: 5/8-inch maximum above finish floor.
 - 5. At sills with thresholds: 1/8-inch above threshold.

3.2 HARDWARE SCHEDULE

- A. The hardware schedule is arranged for convenience of locating hardware and does not preclude in any way the requirements that all necessary hardware shall be furnished and

properly installed. Hardware not specifically called out shall be similar to that required for similar uses.

- B. Hardware equal in quality and utility will be accepted provided it conforms in operation, quality, weight, size, workmanship, and finish to the products hereinafter described. All component parts of locksets shall be the product of one manufacturer.

Hardware Set 1 (Door 101A)				
Each to Receive:				
Quantity	Item	Model No.	Finish	Manufacturer
3 each*	Hinge	T4A3386 4.5"x4.5"	32D	McKinney
1 each	Lockset	47H-7-AB-15- J-630-SH-S6- VT	630	Best Access Systems
1 each	Closer	4040XP	689	LCN
1 each	Kickplate	K1050F	630	Rockwood
1 each	Wall Stop	409	32D	Rockwood
3 each	Silencer	608	Gray	Rockwood
1 each	Threshold	277AS	Alum	Pemko
1 each	Drip Cap	346C	Alum	Pemko
1 set	Perimeter Seal	S88D	Alum	Pemko
*Five Knuckle, Stainless Steel, Non-removal Pin Hinges (size and quantity by door manufacturer)				

Hardware Set 2 (Door 101B)				
Each to Receive:				
Five Knuckle, Stainless Steel, Non-removal Pin Hinges (size and quantity by door manufacturer)				
Quantity	Item	Model No.	Finish	Manufacturer
1 each*	Lockset	47H-7-AB-15J- M-630-SH-S6- VT	630	Best Access Systems
3 each***	Hinge	T4A3386-NRP 4.5"x4.5"	32D	McKinney
1 each	Closer	4040XP	689	LCN
1 each	Kickplate	K1050F	630	Rockwood
1 each	Astragal	HD306B-AST	630	Rockwood
1 each**	Flush Bolt, upper	555	626	Rockwood
1 each**	Flush Bolt, lower	555	626	Rockwood
1 each	Threshold	277AS	Alum	Pemko
1 each	Drip Cap	346C	Alum	Pemko
1 set	Perimeter Seal	S88D	Alum	Pemko
* Deadbolt required on Active Leaf only				
** Inactive Leaf Only				
***Five Knuckle, Stainless Steel, Non-removal Pin Hinges (size and quantity by door manufacturer)				

- END OF SECTION -

SECTION 08 31 00
ACCESS HATCHES

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers all the work necessary to furnish and install all hatches and appurtenances, complete and in place.

1.2 RELATED WORK

- A. Related work in other sections includes but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 09 90 00 Painting and Finishes

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 123 Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
 - 2. ASTM A 229 Standard Specification for Steel Wire, Quenched and Tempered for Mechanical Springs
 - 3. ASTM A 36 Standard Specification for Carbon Structural Steel
 - 4. ASTM A 653 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

1.4 DESIGN REQUIREMENTS

- A. Any hatch in a roadway or located where occasional, slow traffic may drive over the hatch shall be designed to meet H-20 highway wheel loading. For continuous or heavy traffic, use hinged cast iron castings with lift assist type covers.
- B. Flush mounted hatches for vaults not subject to traffic loading shall be designed to handle a minimum live loading of 300 psf.
- C. Shoe-box type hatches for potable water reservoirs shall be designed to handle a live load of 100 psf.
- D. Hatches for water reservoirs or spring boxes shall meet the requirements of the Utah Administrative Code Section R309-545-14.

1.5 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

- B. Submit manufacturer's catalog data and preprinted installation instructions for the hatches.
- C. Submit a schedule showing the location of each hatch. Shop drawings shall include details and method of anchorage, details of construction, method of assembling sections, location and installation of hardware, shape and thickness of materials, details of joining and connections.

1.6 DELIVERY AND STORAGE

- A. Hatches shall be delivered to the job site wrapped in a protective covering with the brands and names clearly marked thereon.

1.7 WARRANTY

- A. Manufacturer shall provide to OWNER written guarantee against defects in material or workmanship for a period of five (5) years. Manufacturer must be able to have a representative on site within 48 hours to address any complaint or issues.

1.8 MEASUREMENT AND PAYMENT

- A. There shall be no separate measurement and payment for hatches. Full compensation for all hatches shall be considered as included in the contract unit or lump sum bid prices for the various items of the contract to which they relate.

PART 2 PRODUCTS

2.1 HATCHES AND ACCESS DOORS

- A. Hatches or access doors shall be as noted on the drawings and meet the requirements specified herein. All hardware shall be stainless steel throughout. Each hatch shall be provided with a permanent label showing the manufacturer's name and address and the model number. Hatches shall have stainless steel hold open arm with positive locking. The hold open arm shall be coated red.
- B. Hatches or access doors shall be Type 316 stainless steel, unless noted otherwise, in corrosive conditions or environments and steel or aluminum as noted in all other areas. Aluminum frames to be cast in concrete shall be mill finished with a bituminous coating applied to the exterior of the frame. Steel hatches and access doors shall be hot-dip galvanized per ASTM A 123 or ASTM A 653. All hardware shall be stainless steel throughout.
- C. Hatch hardware, including the hinges, shall be fabricated from Type 316 stainless steel.
- D. Hatches shall be provided with an automatic hold-open arm with release handle.
- E. Hatches shall be designed to be watertight and equipped with an EPDM gasket.
- F. Unless otherwise indicated on the Drawings, a fall protection system shall be provided on all hatches. Fall protection systems shall be grating panels that conform to OSHA 29 CFR 1910.23 requirements. The fall protection grating shall be epoxy coated with an OSHA type safety orange color. Safety nets or safety grates fabricated from fiberglass or fiberglass blend are not acceptable.

- G. Hatches for water reservoirs shall have the interior and exterior handles eliminated and shall have a concealed padlock hasp. The hasp shall be protected from tampering on at least three (3) sides.
- H. Hatches for water reservoirs or spring boxes shall have a close fitting shoebox type cover which extends down around the frame at least two inches with a gasket between the cover and the frame. The three non-hinged sides of the hatch shall be provided with adjustable cam levers to tighten the cover against the gasket to ensure the hatch is water tight. Hinge fasteners must be completely concealed to inhibit tampering.
- I. Hatches shall be supplied with built-in or Contractor installed position intrusion switches as specified on the drawings.
- J. Manufacturer's shall be **USF Fabrication, Inc., East Jordan Iron Works, Bilco Corp.,** or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Hatches shall be installed in accordance with the approved detailed shop drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, hatches shall be weather tight and shall be free from warp, twist, or distortion. Hatches shall be lubricated, properly adjusted, and demonstrated to operate freely.
- B. All surfaces that come in contact with the concrete shall have a protective coating.
- C. Unless otherwise indicated on the drawings, a 1/2 inch PVC Schedule 80 drain pipe shall be provided from all roof or vault hatches to within 6 inches of the floor if the structure has a floor drain. If a floor drain is not available, the hatch drain shall be extended to drain to the ground surface to a location that will not promote surface ponding of the drain water.

- END OF SECTION -

SECTION 09 20 00
GYPSUM BOARD

PART 1 GENERAL

1.1 DESCRIPTION

- A. The CONTRACTOR shall provide gypsum board and appurtenances, complete and in place, as shown on the Contract Drawings and in accordance with the specifications.

1.2 RELATED WORK

- A. Related work in other sections includes but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 01 60 00 Product Requirements
3. Section 09 90 00 Painting and Finishes

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

- B. American Society for Testing and Materials (ASTM)

1. ASTM C 473 Standard Test Methods for Physical Testing of Gypsum Panel Products
2. ASTM C 475 Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board
3. ASTM C 754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
4. ASTM C 840 Standard Specification for Application and Finishing of Gypsum Board
5. ASTM C 919 Standard Practice for Use of Sealants in Acoustical Applications
6. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
7. ASTM C 1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
8. ASTM C 1177 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
9. ASTM C 1178 Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel
10. ASTM C 1280 Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing
11. ASTM C 1325 Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units
12. ASTM C 1396 Standard Specification for Gypsum Board
13. ASTM C 1629 Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
14. ASTM C 1658 Standard Specification for Glass Mat Gypsum Panels
15. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

- 16. ASTM E 72 Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
- 17. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
- 18. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- 19. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
- 20. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Materials
- 21. ASTM E 136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C
- 22. ASTM E 814 Standard Test Method for Fire Tests of Penetration Firestop Systems
- 23. ASTM G 21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

C. American National Standards Institute (ANSI)

- 1. ANSI A 108.11 Specifications for Interior Installations of Cementitious Backer Units
- 2. ANSI A 118.9 Test Methods and Specifications for Cementitious Backer Units

D. Gypsum Association (GA)

- 1. GA-214 Recommended Levels of Finish – Gypsum Board, Glass Mat & Fiber-Reinforced Gypsum Panels
- 2. GA-216 Application Finishing Gypsum Panel Products
- 3. GA-234 Control Joints for Fire-Resistance Rated Systems
- 4. GA-253 Application of Gypsum Sheathing
- 5. GA-600 Fire Resistance Design Manual

E. Wall and Ceiling Bureau (WCB)

- 1. TB-52010 Control Joints for Gypsum Board

1.4 SUBMITTALS

- A. CONTRACTOR shall submit documents per the requirements of Section 01 33 00 Submittal Procedures.
- B. Submit manufacturer’s literature, product data sheets, and installation instructions for plaster and gypsum products and appurtenances to be used in the Work.

1.5 DELIVERY AND STORAGE

- A. Delivery, storage, and handling of gypsum products shall be in accordance with Section 01 60 00 – Product Requirements, the manufacturer’s printed instructions, and as indicated below.
- B. Manufactured materials shall be delivered in original unbroken packages, containers, or bundles, bearing the manufacturer’s label.

C. Verify products undamaged before acceptance at the Project Site. Do not use products with visible signs of mold and damage.

D. Storage

1. Store the materials in an area that is protected from the elements as recommended by the manufacturer.
2. Storage shall be in a manner that will prevent damage to the material and its finish.
3. Materials shall be stored above ground in a dry and ventilated space,
4. Boards that will be directly applied to masonry walls shall be stored at 70° F for 24 hours prior to installation.

1.6 PROJECT CONDITIONS

A. Do not install gypsum board when the ambient temperature is below 40° F.

1.7 MEASUREMENT AND PAYMENT

A. There shall be no separate measurement and payment for plaster and gypsum board. Full compensation for plaster and gypsum board shall be considered as included in the contract unit or lump sum bid prices for the various items of the contract to which it relates.

PART 2 PRODUCTS

2.1 MANUFACTURERS OR APPROVED EQUAL:

- A. National Gypsum Company
- B. United States Gypsum Company (USG Corporation)
- C. Georgia Pacific Corporation
- D. Certainteed (a Saint-Gobain Company)

2.2 MOLD AND MOISTURE RESISTANT GYPSUM BOARD

A. Panel Physical Characteristics

1. Core: Mold and moisture resistant gypsum core
2. Surface Paper: 100 percent recycled content moisture/mold/mildew resistant paper on front, back, and long edges
3. Long Edges: Tapered
4. Overall Thickness: 1/2 inch
5. Panel complies with requirements of ASTM C 1396
6. Mold/Mildew Resistance: 10 when tested in accordance with ASTM D 3273
7. Environmental Requirements: Provide products that comply with testing and product requirements for low emitting materials

2.3 ACCESSORY PRODUCTS

A. Acoustical Sealant

1. Conform to ASTM C 919
2. VOC content less than 15 g/L
3. Manufacturer, or approved equal:
 - a. Grabber Acoustical Sealant GSCS
 - b. USG Acoustical Sealant
 - c. STI SpecSeal Smoke N Sound Caulk
 - d. BOSS 824 Acoustical Sound Sealant

B. Firestopping

1. Conform to ASTM E 90
2. Manufacturer, or approved equal:
 - a. STI SpecSeal SSP Putty Pads
 - b. USG Firecode Smoke-Sound Sealant
 - c. 3M Fire Barrier Moldable Putty Pads MPP+
 - d. BOSS 818 Fire Rated Putty Pads

C. Metal trim, corner beads, edge, casing beads, and accessories shall be manufactured from galvanized sheet steel unless noted otherwise.

2.4 FASTENERS

A. General: Fastener screws shall be of the self-drilling, self-tapping, bugle head type for use with power tools, with a length as recommended by the Gypsum Association referenced standards and in accordance with the local Building Code.

1. Types:
 - a. Type "S" for board-to-sheet metal application
 - b. Type "W" for board-to-wood application
 - c. Type "G" for board-to-board application
 - d. Type "S" or "S-12", for tile backing board-to-metal studs application

B. Tile Backer Fasteners

1. Fasteners for 1/2 inch thick panels:
 - a. Wood Framing: [1-1/2 inch minimum galvanized roofing nail][1-1/4 inch minimum corrosion resistant course thread bugle head].
 - b. Metal Framing: 1 inch minimum corrosion resistant sharp point or drill point bugle head screw.

2.5 TAPE

A. General: Joint reinforcing tape shall conform to ASTM C 475 and ASTM C 840.

B. Tape:

1. Paper Tape: 2- 1/16 inches wide, **ProForm Joint Tape – Heavy, USG Heavy Joint Tape, CertainTeed Marco Spark-Perf 94# Heavy Weight**, or approved equal.
2. Fiberglass Mesh Tape: Nominal 2-inch wide self-adhering tape, **ProForm Fiberglass Mesh Tape, FibaTape Drywall Joint Tape**, or approved equal.
3. Cement Board Tape: Alkali-resistant fiberglass tape, 2-inch wide polymer-coated for interior applications and 4-inch wide polymer coated for exterior applications, **PermaBase Cement Board Tape, FibaTape Cement Board Tape, USG Durock Cement Board Tape**, or approved equal.

2.6 JOINT COMPOUND

A. General: Joint compound shall conform to ASTM C 475.

B. Drying Type Compound:

1. Ready Mix vinyl base compound, **ProForm All Purpose Ready Mix Joint Compound, USG All Purpose Joint Compound - Select, CertainTeed All Purpose**, or approved equal.
2. Ready Mix vinyl base compound formulated for enhanced mold and mildew resistance, **ProForm XP Ready Mix Joint Compound, CertainTeed Mold Resistant Lite All-Purpose**, or approved equal, conforms to ASTM D 3273
3. Ready Mix vinyl base topping compound for finish coating, **ProForm Topping Compound, CertainTeed Topping, USG Topping Joint Compound**, or approved equal
4. Ready Mix vinyl base compound for embedding joint tape, cornerbeads or other accessories, **ProForm Taping Joint Compound, CertainTeed Heavy Taping Joint Compound, USG Ready-Mixed Taping Joint Compound**, or approved equal
5. Field Mix vinyl base compound, **ProForm Triple-T Compound**, or approved equal

C. Setting Compound:

1. Field mixed hardening compound, **ProForm Quick Set Setting Compound, USG Durabond Setting-Type Compound**, or approved equal
2. Field mixed hardening compound for fire resistance rated construction and penetrations, **ProForm Fire Shield 90, USG Firecode Compound**, or approved equal, conforms to ASTM E 136 and ASTM E 814.
3. Field mixed hardening compound for mold and moisture resistance, **CertainTeed M2Tech 90 Setting Compound**, or approved equal.

D. Joint Sealant

1. Joint sealants shall conform to ASTM C 920
2. Joint sealants shall have VOC content less than 2 g/L

2.7 ACCESS PANELS

A. Provide access panels where indicated or where required for access to valves and equipment

- B. Standard access panels: flush installation type, grey powder coated steel, double-acting concealed spring hinges, screw type lock, **Milcor Type DW, KARP Model KDW**, or approved equal.
- C. Acoustical access panel: recessed panel, with screw type lock, **Milcor Type AP**, or approved equal.
- D. Fire rated access panel: UL listed, self-closing, self-latching, **Milcor Type UFR**, or approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide gypsum board over framing and furring members.
- B. Gypsum board installation and fire-rated gypsum board construction shall conform to applicable codes, reference standards, manufacturer's printed recommendations, the Gypsum Association's recommendations, and the following requirements:
 - 1. Gypsum board shall be applied first to the ceiling and then to the walls.
 - 2. Fastening
 - a. Gypsum board shall be screwed to metal framing and furring.
 - b. The fastener spacing shall be in accordance with the referenced standards.
 - c. Do not attach gypsum board to metal roof decking.
 - 3. The gypsum wall board surface finish shall be as indicated below.
 - 4. The installation of the steel framing shall be in accordance with ASTM C 754 and code requirements.

3.2 EXAMINATION

- A. Verify installation conditions are satisfactory to receive work of this Section before beginning.
- B. Verify framing systems, including backing, insulation, vapor barriers, and other systems ready for work of this Section.
- C. Do not begin work until building envelope is fully enclosed and temperature, ventilation, and humidity are controlled.
- D. Do not begin work under conditions that gypsum board installation may be exposed to contact with water.

3.3 PREPARATION

- A. Protect surrounding areas and surfaces to preclude damage.
- B. Avoid soiling, spatter, and damage to work of other trades. Use cover cloths, or other means of protection. Remove, clean, and repair soiled or damaged work.

3.4 INSTALLATION

- A. Conform to ASTM C 840, GA-216, and manufacturer's instructions.
- B. Corner Trim: Reinforce external corners with specified corner beads.
- C. Edge Trim: Install square edged metal trim bead at exposed edges and boundaries of areas where abutting dissimilar materials.
- D. Reveal Trim:
 - 1. Install with screws at 12 inch on center in 10 foot lengths, except where shorter lengths are sufficient for dimension of wall plane.
 - 2. Make butt joints tight and in alignment.
 - 3. Miter corners.
 - 4. Promptly remove excess joint compound.
- E. Control Joints: Conform to WCB TB-52010 and GA-234, except as otherwise indicated. Verify that required double framing is in place before installing control joints.
 - 1. Door and Other Openings: Install control joints at each side of wall opening and at both sides of wall, except alcoves and similar wall configurations.
 - 2. Continuous Wall Planes: Install control joints floor to ceiling at each 30 lineal foot of wall.
 - 3. Ceilings: Install across ceiling at each 50 lineal foot distance and each 2,500 square foot of ceiling area.
 - 4. Joints with Other Materials: Install where gypsum board meets masonry, concrete, and other materials, except where joints are concealed under horizontal chair rails or other trim.
- F. Other Trim: Install as indicated or required for complete and finished installation.
- G. Panel Joints:
 - 1. Layout: Design to reduce joints to minimum.
 - 2. Install board in maximum lengths to minimize horizontal and vertical joints.
 - 3. Start installation of panels at exterior wall to position butt joints as far away from exterior wall as possible.
 - 4. Place edges in contact and fit neatly, without forcing into place.
 - 5. Stagger joints on opposite sides of partitions and on same side of wall surface at adjacent joints.
 - 6. Maintain 1/2 inch clearance from bottom of wall panel and top of floor. Seal with acoustical sealant.
 - 7. In order to prevent wicking of moisture, do not let gypsum board rest on floor after installation.
- H. Single Layer Systems: Install in accordance with ASTM C840. Where modified, amended, or required by fire resistive or sound isolation system, conform to the requirements of the manufacturer's tests, as approved.

- I. Double Layer Systems: Install in accordance with ASTM C840, including System VIII for double layer gypsum wallboard installations applied with screws. Conform to required fire resistance standards.
- J. Moisture and Mold Resistant Gypsum Board: Install at restrooms, kitchen, janitorial closets, and areas where moisture is present. Do not install as backer board for ceramic tile.
- K. Ceramic Tile Backerboard: Install per manufacturer's recommendations. Moisture resistant (green board) gypsum board not accepted as backer for ceramic tile.
- L. Joint Sealant and Acoustical Sealant: Install to completely fill void between wallboard edges and adjacent surface.
- M. Firestopping and Smoke Sealants: Install in accordance with manufacturer's recommendations.
- N. Plumbing, HVAC, and Electrical: Coordinate work with other Divisions. Provide for installations and penetrations of ductwork, equipment, receptacles, and other work.

3.5 TOLERANCES

- A. Shim panels as necessary to conform to tolerances.
- B. Between Board Faces: 1/16 inch offset.

3.6 ADJUSTING

- A. Remove and replace the following gypsum board installations:
 - 1. Board in contact with water for over 18 hour time period
 - 2. Gypsum core exhibiting dampness or water intrusion
 - 3. Facing paper exhibiting delamination
 - 4. Facing of core exhibiting mold growth or turning black
 - 5. Board sagging or warped
 - 6. Board directly exposed to water determined to be contaminated

3.7 CLEANING

- A. Clean beads, screeds, metal base, metal trim, mechanical and electrical items, and other work.
- B. Wipe clean, leaving work ready for finish specified under other Sections.
- C. As work is completed in each space, clean all rubbish, utensils, and surplus materials from the space. Leave floors broom-clean.

3.8 SURFACE FINISH

- A. Gypsum board joints shall be taped, and joints, end trim, corner beads, fasteners, and other depressions shall be treated with joint and finishing compounds, applied in accordance with the manufacturer's printed recommendations for Level 5 Finish (3-coat work) according to ASTM C 840 and the table below.
- B. The gypsum board shall be sanded smooth, dusted, and provided with a smooth finish coat.

3.9 PAINTING

- A. The surface shall be painted in accordance with Section 09 90 00 Painting and Finishes.

LEVEL OF FINISH	
Finish Level	Description
Level 0	No taping, finishing or corner beads are required.
Level 1	All joints and interior angles shall have tape embedded in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges shall be acceptable.
Level 2 (1-coat work)	All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife or trowel leaving a thin coating of joint compound over all joints and interior angles. Fastener heads and accessories shall be covered with a coat of joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable. Joint compound applied over the body of the tape at the time of tape embedment shall be considered a separate coat of joint compound and shall satisfy the conditions of this level.
Level 3 (2-coat work)	All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife or trowel leaving a thin coating of joint compound over all joints and interior angles. One additional coat of joint compound shall be applied over all joints and interior angles. Fastener heads and accessories shall be covered with two separate coats of joint compound. All joint compounds shall be smooth and free of tool marks and ridges. The prepared surface shall be covered with a drywall primer prior to the application of the final decoration.
Level 4 (3-coat work)	All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife or trowel leaving a thin coating of joint compound over all joints and interior angles. Two separate coats of joint compound shall be applied over all flat joints. One separate coat of joint compound shall be applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. All joint compounds shall be smooth and free of tool marks and ridges. The prepared surface shall be covered with a drywall primer prior to the application of the final decoration.
Level 5 (3-coat work)	All joints and interior angles shall have tape embedded in joint compound and shall be immediately wiped with a joint knife or trowel leaving a thin coating of joint compound over all joints and interior angles. Two separate coats of joint compound shall be applied over all flat joints. One separate coat of joint compound shall be applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. A thin skim coat of joint compound shall be trowel-applied to the entire surface. Excess compound is immediately sheared off, leaving a film of skim coating compound completely covering the paper. As an alternate to a skim coat, a material manufactured especially for this purpose shall be applied. The surface shall be smooth and free of toll marks and ridges.

- END OF SECTION -

SECTION 09 90 00
PAINTING AND FINISHES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers furnishing, surface preparation, and applying paints and coatings, complete and in place, to all specified surfaces including exposed valves, piping or fittings.
- B. Definitions
 - 1. The term "paint", "coatings", or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
 - 2. The term "DFT" means minimum dry film thickness, without any negative tolerance.
 - 3. The term "mil" means thousandths of an inch.
 - 4. The term "SSPC" means The Society for Protective Coatings.
- C. The following surfaces shall not be coated:
 - 1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.
 - 2. Stainless steel
 - 3. Machined surfaces
 - 4. Grease fittings
 - 5. Glass
 - 6. Equipment nameplates
 - 7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.
- D. The protective coatings applicator (Applicator) shall possess a valid state license as required for the performance of the painting and coating work called for in this specification and shall provide 5 references which show the Applicator has previous successful experience with the indicated of comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the Applicator provided the protective coating.

1.2 RELATED WORK

- A. Related work in other sections includes, but is not limit to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 33 05 05 Ductile Iron Pipe
 - 3. Section 33 11 10 Miscellaneous Appurtenances
 - 4. Section 33 92 10 Steel Pipe, Specials, and Fittings

1.3 REFERENCES AND STANDARDS

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:

1. OSHA Occupation Safety and Health Act: State of Utah and Federal
2. ICRI International Concrete Repair Institute Guideline No. 310.2 –
Selecting and Specifying Concrete Surface Preparation for
Sealers, Coatings, and Polymer Overlays

B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI A 13.1 Standard for Scheme for the Identification of Piping Systems
2. ANSI Z 535 Standard for Safety Colors

C. AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

1. ASTM C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
2. ASTM D 6943 Standard Practice for Immersion Testing of Industrial Protective Coatings Linings
3. ASTM D 1653 Standard Test Methods for Water Vapor Transmission of Organic Coating Films
4. ASTM D 2370 Standard Test Method for Tensile Properties of Organic Coatings
5. ASTM D 2794 Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
6. ASTM D 4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
7. ASTM D 4414 Standard Practice for Measurement of Wet Film Thickness by Notch Gages
8. ASTM D 4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
9. ASTM D 7234 Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
10. ASTM D 7682 Standard Test Method for Replication and Measurement of Concrete Surface Profiles Using Replica Putty
11. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
12. ASTM F 1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
13. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

D. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
2. AWWA C 222 Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings

E. AMERICAN CONCRETE INSTITUTE (ACI)

1. ACI 301 Specifications for Structural Concrete

F. NACE International (NACE)

1. NACE RP0287 Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape

2. NACE SP0188 Standard Practice for Discontinuity (Holiday) Testing of Protective Linings
 3. NACE SP0892 Standard Practice for Coatings and Linings over Concrete for Chemical Immersion and Containment Service
 4. NACE No. 1/SSPC-SP 5 White Metal Blast Cleaning
 5. NACE No. 2/SSPC-SP10 Near White Metal Blast Cleaning
 6. NACE No. 3/SSPC-SP6 Commercial Blast Cleaning
 7. NACE No. 6/SSPC-SP13 Surface Preparation of Concrete
- G. SSPC: The Society for Protective Coatings (SSPC)
1. SSPC PA1 - Shop, Field, and Maintenance Painting of Steel
 2. SSPC-PA2 – Paint Application Specification No. 2: Measurement of Dry Coating Thickness with Magnetic Gages.
 3. SSPC-PA11 - Protecting Edges, Crevices, and Irregular Steel Surfaces by Stripe Coating
 4. SSPC-SP 6/NACE No. 3 - Commercial Blast Cleaning.
 5. SSPC-SP10/NACE 2 - Near White Metal Blast Cleaning
 6. SSPC-SP16 – Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
 7. SSPC-VIS 1 - Guide to Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. CONTRACTOR shall supply shop drawings for approval on all paint materials at least 30 days prior to installation. Submittals shall include the following data sheets:
 1. For each paint system used herein, furnish a Paint System Data Sheet (PSDS), Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system, except for products applied by equipment manufacturers.
- C. Where ANSI/NSF 61 approval is required, submit ANSI/NSF 61 certification letter for each coating in the system indicating the product application limits on size of tank or piping, dry film thickness, number of coats, specific product tests, colors certified, and approved additives.
- D. Quality Control Submittals:
 1. Furnish a list of references for the Applicator substantiating the requirements as specified.
 2. Manufacturer's certification stating factory applied coating systems meets or exceeds requirements specified herein.
 3. If the manufacturer of finish coating differs from that of shop primer, provide both manufacturers' written confirmation that materials are compatible.

1.5 PAINT DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint to the project site in unopened containers that plainly show, at the time of use, the designated name, date of manufacture, color, and name of manufacturer.

- B. Store paints in a suitable protected area that is heated or cooled as required to maintain temperatures within the range recommended by the manufacturer.

1.6 QUALITY ASSURANCE

- A. All inspection for quality assurance shall ultimately be the responsibility of CONTRACTOR. OWNER retains the right to observe, accept, or reject the work based on the results of CONTRACTOR's inspection or observations by ENGINEER, at OWNER's discretion, in accordance with the specifications.
- B. Repair and recoat all runs, overspray, roughness, or any other signs of improper application in accordance with paint manufacturer's instructions and as reviewed by ENGINEER.
- C. Observations by OWNER or ENGINEER, or the waiver of inspection of any particular portion of the work, shall not be construed to relieve CONTRACTOR of his responsibility to perform the work in accordance with these specifications.

1.7 MANUFACTURER'S SERVICES

- A. Furnish paint manufacturer's representative to visit jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer's products furnished under this Contract.

1.8 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

- A. An inspection may be conducted during the eleventh month following completion of coating work. The CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. Defective work shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the inspection to another date within the one year correction period or may cancel the inspection altogether. The CONTRACTOR is not relieved of its responsibilities to correct defects whether or not the inspection is conducted.

PART 2 PRODUCTS

2.1 GENERAL

- A. CONTRACTOR shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.
- B. Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and CONTRACTOR shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

- C. In any coating system 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. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- D. Colors and shades of colors of coatings shall be as indicated or selected by ENGINEER. Each coat shall be of a slightly different shade to facilitate observation of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the OWNER.
- E. Substitute or "Or-Equal" Products
 - 1. Basis of Design: The Coating Systems listed below in paragraph 2.3 are based on products from Tnemec Company Incorporated, except where indicated below.
 - 2. Product Substitution: To establish equality under Section 01 60 00 – Product Requirements, The specified coating systems are the minimum standard of quality for this project. Equivalent materials of other manufacturers may be substituted only by approval of ENGINEER. Requests for material substitutions shall be in accordance with requirements of the project specification.
 - 3. Product Requirements: The CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or equal" product that the material meets the indicated requirements and is equivalent or better in the following properties: Quality, Durability, Resistance to abrasion and physical damage, Life expectancy, Ability to recoat in the future, Solids content by volume, Dry film thickness per coat, Compatibility with other coatings, Suitability to chemical attack, Temperature limitations during application and in service, Type and quality of recommended undercoats or topcoats, Ease of repairing damaged areas, and stability of colors.
 - 4. Manufacturers of "or equal" products shall provide direct performance comparison with the materials specified, in addition to complying with all other requirements of these Specifications. "Or equal" products shall employ the same generic type materials and system components as the specified coating systems.
 - 5. Requests for product substitution shall be made and approved at least 10 days prior to bid date.
 - 6. CONTRACTOR shall bear any additional costs, if a proposed substitution requires changes or additional work.

2.2 COLORS

- A. Provide colors as selected by OWNER or ENGINEER.
- B. Colors shall be formulated with colorants free of lead, lead compounds, or other materials which might be affected by the presence of hydrogen sulfide or other gas likely to be present at the project.
- C. Proprietary identification of colors is for identification only. Any authorized manufacturer may supply color matches.
- D. Equipment colors;
 - 1. Equipment shall mean the machinery or vessel itself plus the structural supports and fasteners.

2. Paint non-submerged portions of equipment in the same color as the process piping it serves, except as indicated 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: OSHA Yellow
 3. Fiberglass reinforced plastic (FRP) equipment with an integral colored gel coat does not require painting, provided the color is as specified.
- E. Piping color coding shall be in accordance with ANSI A13.1, Division of Drinking Water R-309-525, and International Plumbing Code.
1. Color code non-submerged metal piping except electrical conduit. Paint fittings and valves the same color as the pipe unless otherwise specified.
 2. Pipe supports: If pipe supports are not galvanized or stainless steel, supports shall be painted ANSI No. 70 light gray as specified in ANSI Z535.
 3. Fiberglass reinforced plastic (FRP) pipe and polyvinyl chloride (PVC) pipe located outside of buildings and enclosed structures will not require painting, unless noted otherwise on the Drawings.

2.3 COATING SYSTEMS

A. System No. 1 Steel – Immersion Potable Water NSF 61 Certification

1. Materials

Type	Epoxy conforming to AWWA C 210 and D 102.
VOC content, max, g/L	250
Volume Solids, min, %	67
Demonstrated Suitable for	Long term immersion in water, resistant to corrosion, good color retention
Certification	NSF 61 if in contact with potable water

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP10 Near-White Blast Cleaning with minimum angular profile of 1.5 mils	Primer: Tnemec 140 Pota-Pox Plus Intermediate: Tnemec 140 Pota-Pox Plus Finish: Tnemec 140 Pota-Pox Plus	Primer: 3-5 DFT Intermediate: 4-6 DFT Finish: 4-6 DFT
	Primer: Sherwin Williams Tank Clad HS Intermediate: Sherwin Williams Tank Clad HS Finish: Sherwin Williams Tank Clad HS	

3. Application

- a. For use on the interior and exterior of steel tanks, pipes, valves, pumps, equipment in potable water service including concrete embedded surfaces of metallic items under submerged conditions, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel, except reinforcing steel, and the following specific surfaces unless noted otherwise:

- 1) Buried dished heads and associated non-shop coated buried piping.

B. System No. 2 Steel – Immersion Non-Potable Water

1. Materials

Type	High Solids Polyamide Epoxy
VOC content, max, g/L	250
Volume Solids, min, %	67
Demonstrated Suitable for	Ferrous surfaces, superior color and gloss retention, exceptional resistance to weathering, chemical fumes, and salt spray

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP10 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils	Primer: Tnemec Series 69 Hi-Build Epoxoline II Intermediate: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 69 Hi-Build Epoxoline II	Primer: 4 -6 DFT Intermediate: 4 -6 DFT Finish: 4 - 6 DFT
	Primer: Sherwin Williams Dura-Plate UHS Primer Finish: Sherwin Williams Dura-Plate UHS	

3. Application

- a. For use on the interior and exterior of steel tanks not in potable water service, including concrete embedded surfaces of metallic items under submerged conditions, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel, except reinforcing steel.

4. Special Requirements

- a. The surface preparation and primer shall be shop applied to all surfaces prior to installation.

C. System No. 3 Steel – Interior Exposed

1. Materials

Type	Polyamide Epoxy
VOC content, max, g/L	250
Volume Solids, min, %	67

Demonstrated Suitable for	Ferrous, galvanized, surfaces in industrial exposure, resistant to mild corrosion and chemical fumes, has good color and gloss retention
Certification	None

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Ferrous Metal: SSPC-SP6 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils	Primer: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 69 Hi-Build Epoxoline II	Primer: 3-5 DFT Finish: 4-6 DFT
Galvanized and Non-Ferrous: SSPC-SP16 with a minimum angular anchor profile of 1.5 mils	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams Macropoxy 646 Fast Cure Epoxy	

3. Application

- a. All exposed metal surfaces located inside of structures.

4. Special Requirements

- a. The surface preparation and primer shall be shop applied to all surfaces prior to installation. Finish coats need only be applied to the surfaces exposed after completion of construction.

D. System No. 4 Steel – Exterior Exposed

1. Materials

Type	Zinc-Rich primer with Polyamide Epoxy (intermediate coat), and Aliphatic Acrylic Polyurethane (topcoat)
VOC content, max, g/L	340 Zinc Primer 250 Intermediate and Finish Coats
Demonstrated Suitable for	Ferrous, galvanized, surfaces in industrial exposure, highly resistant to abrasion, wet conditions, corrosive fumes, and exterior weathering
Certification	None

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP6 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils	Primer: Tnemec Series 90-97 Tneme-Zinc Intermediate: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 1095 Endura-Shield	Primer: 2.5-3.5 DFT Intermediate: 4-6 DFT Finish: 3-5 DFT
	Primer: Sherwin Williams Zinc Clad III HS Intermediate: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams HS Polyurethane 250	

3. Application
 - a. All exposed steel surfaces located outside of structures.
4. Special Requirements
 - a. The surface preparation and primer shall be shop applied to all surfaces prior to installation. Finish coats need only be applied to the surfaces exposed after completion of construction.

E. System No. 5 Buried Steel Pipe

1. Materials

Type	Polyurethane per AWWA C222
VOC content, max, g/L	No VOC content
Demonstrated Suitable for	Buried or immersed steel pipelines
Certification	NSF 61 if in contact with potable water

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Abrasive Blast, or Centrifugal Wheel Blast SSPC-SP5	Futura Coatings - Protec II (White NSF 61 certified)	35-50 mils DFT
	Tnemec Series 406 Elasto-Shield (NSF 61 Certified) or Series 431 Perma-Shield PL (Non-NSF)	
	Lifelast, Inc. – Durashield 210 (NSF 61 certified)	
	Chemiline – Chemline 2265 (NSF 61 certified)	

3. Application
 - a. Shop applied on steel pipe where indicated in Section 33 92 10 – Steel Pipe, Specials, and Fittings.

F. System No. 6 Steel – Doors and Frames

1. Materials

Type	Modified Polyamidoamine Epoxy with Aliphatic Acrylic Polyurethane (topcoat)
VOC content, max, g/L	250
Demonstrated Suitable for	Interior and Exterior Industrial, Architectural, and Commercial applications

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP2/SP3 Hand and Power Tool Cleaning; feather rough edges; remove loose rust, dirt, and other contaminants with sandpaper	Primer: Tnemec Series 135 Chem-Build Finish: Tnemec Series 1095 Endura-Shield	Primer: 3-5 DFT Finish: 3-5 DFT
	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams HS Polyurethane 250	

3. Application

- a. Factory primed steel doors and frames
- b. Exterior and Interior steel in corrosive and non-immersion environments.
- c. Maintenance of existing marginally prepared rusty steel and tightly adhering old coatings.

G. System No. 7 Galvanized Steel and Cast/Ductile Iron – Exterior Exposed

1. Materials

Type	Polyamide Epoxy with Aliphatic Acrylic Polyurethane (topcoat)
VOC content, max, g/L	250
Demonstrated Suitable for	Ferrous, galvanized, nonferrous, cast/ductile iron surfaces in industrial exposure, highly resistant to abrasion, wet conditions, corrosive fumes, and exterior weathering

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
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Galvanized Steel and Non-Ferrous: SSPC-SP16 brush-off blast cleaning of coated and uncoated galvanized steel and non-ferrous metals to achieve a uniform anchor profile of 1.0-2.0 mils.	Primer: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 1095 Endura-Shield	Primer: 3-5 DFT Finish: 2.5-4 DFT
Ductile and Cast Iron: Prepare all surfaces as per NAPF 500-03 - Uniformly abrasive blast the entire exterior surface using abrasive to an NAPF 500-03-04 with a minimum angular anchor profile of 1.5 mils.	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams HS Polyurethane 250	

3. Application

a. Exposed galvanized and cast/ductile iron surfaces located outside of structures requiring painting and the following specific surfaces unless noted otherwise:

- 1) All exposed galvanized pipe
- 2) All exposed cast/ductile iron pipe

H. System No. 8 Galvanized Steel and Cast/Ductile Iron – Interior Exposed

1. Materials

Type	Polyamide Epoxy
VOC content, max, g/L	250
Demonstrated Suitable for	Ferrous, galvanized, nonferrous, cast/ductile iron surfaces in industrial exposure, resistant to mild corrosion and chemical fumes, has good color and gloss retention

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
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Galvanized Steel and Non-Ferrous: SSPC-SP16 brush-off blast cleaning of coated and uncoated galvanized steel and non-ferrous metals to achieve a uniform anchor profile of 1.0-2.0 mils. Ductile and Cast Iron: Prepare all surfaces as per NAPF 500-03 - Uniformly abrasive blast the entire exterior surface using abrasive to an NAPF 500-03-04 with a minimum angular anchor profile of 1.5 mils.	Primer: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 69 Hi-Build Epoxoline II	Primer: 3-5 DFT Finish: 3 – 5 DFT
	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams Macropoxy 646 Fast Cure Epoxy	

3. Application

- a. Exposed galvanized and cast/ductile iron surfaces located inside of structures requiring painting and the following specific surfaces unless noted otherwise:
 - 1) All exposed galvanized pipe
 - 2) All exposed cast/ductile iron pipe
- b. Do not paint galvanized steel mechanical pipe and equipment supports unless noted otherwise.

I. System No. 9 Concrete Floors – Light Traffic, Low Impact

1. Materials

Type	Modified Polyamine Epoxy
VOC content, max, g/L	75
Demonstrated Suitable for	Concrete floors providing protection against various acids and alkalis and frequent cleaning

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP13 Concrete Surface Preparation, ICRI CSP 2-4	Primer: Tnemec Series 201 Epoxoprime Intermediate: Tnemec Series 281 Tneme-Glaze Finish: Tnemec Series 281 Tneme-Glaze	Primer: 6-8 DFT Intermediate: 6-8 DFT Finish: 6-8 DFT

	Primer: Sherwin Williams Armorseal 33 Intermediate: Sherwin Williams 650 SL/RC Finish: Sherwin Williams 650 SL/RC	
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3. Application
 - a. Concrete floors not exposed to wastewater or chemicals unless noted otherwise.

J. System No. 10 Concrete Floors – Chemical Exposure

1. Materials

Type	Modified Polyamine Epoxy (primer) with Polyamine Novolac Epoxy (topcoats)
VOC content, max, g/L	75
Demonstrated Suitable for	Highly chemical- and solvent-resistant on concrete floors and walls providing protection against abrasion, impact, most acids, alkalis, and solvents

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP13 Concrete Surface Preparation, ICRI CSP 2-4	Primer: Tnemec Series 201 Epoxoprime Intermediate: Tnemec Series 282 Tneme-Glaze Finish: Tnemec Series 282 Tneme-Glaze	Primer: 6-8 DFT Intermediate: 6-8 DFT Finish: 6-8 DFT

3. Application
 - a. Concrete floors exposed to wastewater or chemicals unless noted otherwise.

K. System No. 11 – Gypsum Wallboard and Plaster

1. Materials

Type	Waterborne Epoxy/Acrylic Polymer
VOC content, max, g/L	175/94
Demonstrated Suitable for	long term protection in both interior/exterior exposures

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
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Sand joint compound smooth and feather edge. Clean and dry.	Primer: Tnemec Elasto-Grip FC Series 151-1051 Intermediate: Tnemec Enduratone Series 1028 Finish: Tnemec Enduratone Series 1028	Primer: 0.7-1.5 DFT Intermediate: 2-3 DFT Finish: 2-3 DFT
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3. Application

- a. Interior gypsum wallboard and plaster on walls and ceilings.

L. System No. 12 – Concrete Walls and Concrete Masonry Units, Interior – Not Exposed to Chemicals

1. Materials

Type	Latex Filler/Water Based Acrylic Epoxy
VOC content, max, g/L	<50/244
Demonstrated Suitable for	long term protection for interior exposures

2. Coating System

Products	Total System (mils)
Filler: Tnemec Series 54 Intermediate: Tnemec H.B. Tnem-Tufcoat Series 113 Finish: Tnemec H.B. Tnem-Tufcoat Series 113	Surfacer/Filler Intermediate: 4-6 DFT Finish: 4-6 DFT
Filler: Sherwin-Williams PrepRite B25W25 Finish: Sherwin-Williams Water Based Catalyzed Epoxy B70 Series	

3. Surface preparation

- a. Surface cracks, holes, or other imperfections in concrete surfaces only that exceed 1/64 of an inch shall be filled with pointing mortar. Masonry joints found to be unsound, hollow, or otherwise defective shall be raked out to a depth of 1/2 inch and pointed with mortar.
- b. Remove loose particles and foreign matter. Remove oil or foreign substance with a cleaning agent which will not affect the coating.
- c. Scrub and rinse surfaces with water, and let dry.
- d. Protect adjacent surfaces not scheduled to receive coating and landscaping, property and vehicles from over spray and drift.
- e. Concrete shall cure a minimum of 28 days before application.
- f. Apply coating per manufacturer's recommendations and instructions.

4. Application

- a. Interior concrete and concrete masonry unit walls not subject to splashing from wastewater and/or chemicals.

M. System No. 13 – Concrete Walls and Concrete Masonry Units, Interior – Exposed to Chemicals

1. Materials

Type	Epoxy
VOC content, max, g/L	<50/244
Demonstrated Suitable for	long term protection for interior exposures

2. Coating System

Products	Total System (mils)
Filler: Tnemec Series 130 Environfill Intermediate: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Hi-Build Series 69 Epoxoline II	Surfacers/Filler: 60 to 115 sq ft per gallon Intermediate: 4-6 DFT Finish: 4-6 DFT

3. Surface preparation

- a. Masonry joints found to be unsound, hollow, or otherwise defective shall be raked out to a depth of 1/2 inch and pointed with mortar.
- b. Remove loose particles and foreign matter. Remove oil or foreign substance with a cleaning agent which will not affect the coating.
- c. Scrub and rinse surfaces with water, and let dry.
- d. Protect adjacent surfaces not scheduled to receive coating and landscaping, property and vehicles from over spray and drift.
- e. Concrete shall cure a minimum of 28 days before application.
- f. Apply coating per manufacturer’s recommendations and instructions.

4. Application

- a. Interior concrete and concrete masonry unit walls not subject to splashing from wastewater and/or chemicals.

N. System No. 14 Concrete – Concrete Exposed to Severe Wastewater

1. Materials

Type	Epoxy Modified Cementitious Mortar Modified Aliphatic Amine Epoxy Mortar Modified Polyamine Epoxy Finish
VOC content, max, g/L	50
Demonstrated Suitable for	Severe Wastewater immersion and fume environments. Withstand high levels of hydrogen sulfide gas, sulfuric acid, as well as other gases common to sewer exposures.

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP13 Concrete Surface Preparation, ICRI CSP 5	Surfacer/Filler: Tnemec Series 218 MortarClad Intermediate: Tnemec Series 434 PermaShield H2S Finish: Tnemec Series 435 Perma-Glaze	Surfacer/Filler: Entire Surface at a minimum 1/16-inch Basecoat: 125 mils Finish: 15 -20 mils

3. Application
 - a. Concrete exposed to severe wastewater immersion and fume environments, abrasions and impacts– high levels of hydrogen sulfide gas (H₂S), sulfuric acid (H₂SO₄).
 - b. Use on concrete Digesters, Lift Stations, Wet Wells, Splitter Box, Scum Pit, Process Basin.
 - c. Manufacturer Training Required
 - d. Application according to manufacturer application guides.

2.4 SPECIAL COATING SYSTEMS

- A. System 200 - PVC Tape: Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils. PVC Tape wrap buried pipe where indicated on the Drawings.
- B. System 201 – Water Retardant, Concrete and Masonry
 1. Materials and Coating System

Type	Silane-modified siloxane
Demonstrated suitable for	Repelling water from vertical concrete and masonry surfaces
VOC Content, g/L, max	250
Products, or approved equal	TAMMS Barracade M.E./9 Rainguard Blok-Lok Tnemec Dur A Pell 20 Series 636

2. Preparation
 - a. Surface cracks, holes, or other imperfections in concrete surfaces only that exceed 1/64 of an inch shall be filled with pointing mortar. Masonry joints found to be unsound, hollow, or otherwise defective shall be raked out to a depth of 1/2 inch and pointed with mortar.
 - b. Remove loose particles and foreign matter. Remove oil or foreign substance with a cleaning agent which will not affect the coating.
 - c. Scrub and rinse surfaces with water, and let dry.
 - d. Protect adjacent surfaces not scheduled to receive coating and landscaping, property and vehicles from over spray and drift.
 - e. Concrete shall cure a minimum of 28 days before application.
 - f. Apply coating per manufacturer's recommendations and instructions.
3. Application

- a. Exterior concrete walls of pump station
- C. System 202 – Polyethylene Encasement: Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C. Provide polyethylene encasement where indicated on the drawings or per Section 30 05 05 – Ductile Iron Pipe.
- D. System 203 - Cement Mortar Coating: A 1-1/2-inch minimum thickness mortar coating reinforced with 1/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than one part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of ASTM C 309, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all edges and joints lapped by at least 6-inches. Cement mortar coat buried steel pipe where indicated on the drawings or in Section 33 92 10 – Steel Pipe, Specials, and Fittings.
- E. System 204 – Ductile or Cast-Iron, Valves and Gates - Immersion in Water and Wastewater

1. Materials

Type	High Solids Epoxy
VOC content, max, g/L	285
Demonstrated Suitable for	Ductile or Cast-Iron immersion in water or wastewater

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Prepare all surfaces by uniformly abrasive blasting the entire exterior surface to insure cleanliness and to create a minimum angular anchor profile of 2.0 mils.	Primer: Tnemec Hi-Build Epoxoline II Series N69 ⁽¹⁾ Intermediate: Tnemec Hi-Build Epoxoline II Series N69 ⁽¹⁾ Finish: Tnemec Hi-Build Epoxoline II Series N69 ⁽¹⁾	Primer: 3 - 5 DFT Intermediate: 4 - 6 DFT Finish: 4 - 6 DFT
	Primer: Ameron Amerlock 400 Intermediate: Ameron Amerlock 400 Finish: Ameron Amerlock 400	
	Primer: International Interseal 670 HS Intermediate: International Interseal 670 HS Finish: International Interseal 670 HS	
	⁽¹⁾ For NSF 61 certified potable water applications use Tnemec Pota-Pox Plus Series N140.	

3. Application

- a. Ductile or Cast-Iron Slide Gate Covers and Frames

2.5 CONCRETE FINISHES

- A. Exterior Above Grade Concrete: Concrete surfaces exposed to view outside the building and including 6 inches below finished grade on the building or structure should be finished with a "Class B" finish. Products for the "Class B" finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.
- B. Interior Above Grade Concrete: Interior above grade concrete shall be finished with a "Class B" finish. Products for the "Class B" finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.
- C. Interior Concrete Floors: Interior concrete floors shall be finished with a "Trowel" finish. Products for the "Trowel" finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.
- D. Exterior Concrete Flat Surfaces: Exterior concrete flat surfaces shall be finished with a "Broom" finish. Products for the "Broom" finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.

PART 3 EXECUTION

3.1 GENERAL

- A. The intention of this specification is for all new, interior and exterior, masonry, concrete, and metal, whether atmospheric or submerged exposure surfaces to be painted whether specifically mentioned or not, except as modified herein. Concealed structural steel surfaces shall receive a prime coat only unless modified herein.
- B. Surface preparation and coating application shall be in accordance with these specifications and the coating manufacturer's written product data sheets and written recommendations of the manufacturer's technical representative. Where conflict occurs between the manufacturer's recommendations and these specifications, the more stringent of the two shall apply unless approved by ENGINEER.
- C. For immersion coatings, obtain full cure for completed system before immersing or allowing exposure to water of condensation for more than 12 hours.

3.2 REGULATORY REQUIREMENTS

- A. Meet federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposures.
- B. Protect workers and comply with applicable federal, state, and local air pollution and environmental regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, coating application, and dust prevention including but not limited to the following Acts, Regulations, Standards, and Guidelines:
 - 1. Clean Air Act
 - 2. National Ambient Air Quality Standard
 - 3. Resource Conservation and Recovery Act (RCRA)
 - 4. SSPC Guide 6
- C. Comply with applicable federal, state, and local regulations for confined space entry.

- D. Provide and operate equipment that meets explosion proof requirements.

3.3 ENVIRONMENTAL CONDITIONS

- A. Do not apply paint in extreme heat, temperatures below 40 degrees F, nor in dust, smoke-laden atmosphere, damp or humid weather. The Applicator shall adhere to the manufacturer's recommendations regarding environmental conditions. The Applicator shall monitor humidity, air temperature, and surface temperature with properly calibrated instruments.
- B. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, nor whenever surface temperature is less than 5 degrees F above dew point of ambient air. Strictly adhere to manufacturer's recommendations.
- C. Surface preparation power tools and blast equipment shall contain dust collection devices that will prevent discharge of dust particles into the atmosphere around electrical or mechanical equipment unless otherwise permitted by ENGINEER.
- D. Where weather conditions or project requirement dictate, the Applicator shall provide and operate dehumidification equipment to maintain environmental conditions suitable for abrasive blasting and coating application as specified.

3.4 WORKMANSHIP

- A. Skilled craftsmen and experienced supervision shall be used on coating work.
- B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.
- C. Damage to other surfaces resulting from the work shall be cleaned, repaired, and refinished to original condition.

3.5 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.
- B. Coating materials shall be used within the manufacturer's recommended shelf life.
- C. Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

3.6 SURFACE PREPARATION

- A. All surfaces which receive paint or other coatings shall be prepared in accordance with the recommendations of the manufacturer of the material being used. The Applicator shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application.
- B. Perform sandblasting for piping and any other items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, and procedures shall meet requirements of the Society for Protective Coatings (formerly the Steel Structures Painting Council).

3.7 PROTECTION OF MATERIALS NOT TO BE PAINTED

- A. Surfaces that are not to receive coatings shall be protected during surface preparation, cleaning, and coating operations.
- B. Remove, mask or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted.
- C. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
- D. Protect working parts or mechanical and electrical equipment and motors from damage.
- E. Care shall be exercised not to damage adjacent work during blasting operations. Spraying shall be conducted under carefully controlled conditions. CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blasting or coating operations.

3.8 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the the Society for Protective Coatings shall form a part of this specification:
 - 1. Solvent Cleaning (SSPC SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
 - 2. Hand Tool Cleaning (SSPC SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
 - 3. Power Tool Cleaning (SSPC SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
 - 4. White Metal Blast Cleaning (SSPC SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
 - 5. Commercial Blast Cleaning (SSPC SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
 - 6. Brush-Off Blast Cleaning (SSPC SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.

7. Near-White Blast Cleaning (SSPC SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
8. Surface Preparation of Concrete (SSPC-SP13): Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.
9. Surface Preparation (SSPC-SP16): Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

3.9 FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

- A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these requirements and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.
- B. Oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPC SP1 - Solvent Cleaning prior to blast cleaning.
- C. Round or chamfer all sharp edges and grind smooth burrs and surface defects and weld splatter prior to blast cleaning.
- D. Surfaces shall be cleaned of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.
- E. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.
- F. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.
- G. If the required abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP2 or SSPC SP3 may be used as per manufacturers recommendations.
- H. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP1 before the abrasive blast cleaning has been started.
- I. Shop primed equipment shall be solvent-cleaned in the field before finish coats are applied.
- J. Exposed ductile iron pipe shall be given a shop coat of rust-inhibitive primer conforming to these specifications. Abrasive blasting of the asphaltic coating on ductile iron pipe will not be allowed.

3.10 FERROUS METAL SURFACE PREPARATION (GALVANIZED)

- A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system, followed by blast cleaning per SSPC SP16.
- B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

3.11 CONCRETE BLOCK MASONRY SURFACE PREPARATION

- A. Surface preparation shall not begin until at least 30 Days after the masonry has been placed.
- B. Oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC SP1 before abrasive blast cleaning.
- C. Concrete block masonry surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, deteriorated concrete, and to roughen the surface equivalent to the surface recommended by manufacturer.
- D. If acid etching is required by the coating application instructions, the treatment shall be made after abrasive blasting. After etching, rinse surfaces with water and test the pH. The pH shall be between neutral and 8.
- E. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.
- F. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as Delmhorst Model BD-2100, or equal.

3.12 CAST-IN-PLACE CONCRETE SURFACE PREPARATION

- A. Concrete surfaces to receive protective coating shall be cast with a Smooth Form Finish in accordance with ACI 301. Surfaces shall not be rubbed, sacked, troweled or otherwise finished in any manner that will obscure or cover the parent concrete surface with materials other than materials as specified in this Section.
- B. All surfaces must be clean, dry and free of oil, grease and other contaminants, prior to preparation in accordance with NACE No. 6/SSPC-SP13. Concrete surfaces must be sound and capable of supporting the corrosion protection lining system.
- C. Prepare concrete surfaces in accordance with NACE No. 6/SSPC-SP13 Joint Surface Preparation Standards and ICRI Technical Guidelines. Abrasive blast, shot-blast, water jet or mechanically abrade concrete surfaces to remove laitance, curing compounds, hardeners, sealers, existing coatings, and other contaminants and to provide the recommended ICRI-CSP Profile.
- D. Level or grind concrete substrates to produce a uniform and smooth surface, including removal of sharp edges, ridges, form fins, and other concrete protrusions.

- E. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as Delmhorst Model BD-2100, or equal.

3.13 SHOP COATING REQUIREMENTS

- A. Unless otherwise indicated, items of equipment or parts of equipment which are not submerged in service shall be shop-primed and then finish-coated in the field after installation with the indicated or selected color. The methods, materials, application equipment, and other details of shop painting shall comply with this Section. If the shop primer requires topcoating within a specific period of time, the equipment shall be finish coated in the shop and then be touched up after installation.
- B. Items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have surface preparation and coating performed in the field.
- C. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.
- D. For certain small pieces of equipment the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- E. Shop-painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being topcoated, or less time if recommended by the coating manufacturer.
- F. CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.
- G. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

3.14 APPLICATION

- A. General
 - 1. Schedule inspection with ENGINEER in advance for cleaned surfaces and all coats prior to each succeeding coat.
 - 2. Apply coatings in accordance with the paint manufacturer's recommendations and these specifications, whichever is more stringent. Allow sufficient time between coats to assure thorough drying of previously applied paint.

3. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same day.
4. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
5. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.
6. Non-buried steel piping shall be abrasive blast cleaned and primed before installation.
7. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

3.15 CURING OF COATINGS

- A. CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.
- B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

3.16 SHOP AND FIELD OBSERVATION AND TESTING

- A. CONTRACTOR shall give ENGINEER a minimum of 3 Days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 Days advance notice of the start of any surface preparation activity in the shop.
- B. Observation by ENGINEER, or the waiver of inspection of any particular portion of the work, shall not relieve CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.
- C. CONTRACTOR shall furnish inspection devices in good working condition for the detection of holidays and measurement of dry film thicknesses of coatings. Dry-film thickness gauges shall be made available for ENGINEER's use while coating is being done, until final acceptance of such coatings. CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of ENGINEER.
- D. CONTRACTOR shall test for continuity (holiday test) all coated surfaces inside reservoirs, other surfaces that will be submerged in water or other liquids, surfaces that are enclosed in a vapor space in such structures, and surfaces coated with any of the submerged and severe service coating systems. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturers' printed instructions and then be retested.
 1. Coatings with thickness exceeding 20-mils total DFT: Pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.
 2. Coatings with thickness of 20-mils or less total DFT: Tinker & Razor Model M1 nondestructive type holiday detector, K-D Bird Dog, or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10- and 20-mils, a

nonsudsing type wetting agent, such as Kodak Photo-Flo or equal, shall be added to the water prior to wetting the detector sponge.

- E. On ferrous and non-ferrous the dry film coating thickness shall be measured in accordance with the SSPC PA 2 using a magnetic type dry film thickness gauge such as Mikrotest Model FM, Elcometer Model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.
- F. Evaluation of blast cleaned surface preparation will be based upon comparison of the blasted surfaces with the standard samples available from SSPC and NACE, such as using NACE standards TM-01-70 and TM-01-75.
- G. Visually inspect concrete, nonferrous metal, plastic, drywall, and wood surfaces to ensure proper and complete coverage has been attained.

3.17 CLEANUP

- A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at the end of each day.
- B. Upon completion of the work, remove staging, scaffolding, and containers from the site or destroy in a legal manner.
- C. Completely remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.
- D. Damages due to overspray on buildings, vehicles, trees, or other surfaces not specified to be painted would be the responsibility of CONTRACTOR.

3.18 MANUFACTURER' SERVICES

- A. Furnish paint manufacturer's representative to visit jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer's products furnished under this Contract.

- END OF SECTION -

SECTION 09 98 10
PIPELINE COATINGS AND LININGS

PART 1 GENERAL

1.1 DESCRIPTION

- A. The CONTRACTOR shall apply external coating and internal lining on steel pipe, field coating of joints, and field repair of coating damage, complete and in place, in accordance with the specifications.
- B. Buried steel pipe shall be cement mortar lined and coated.
- C. Exposed steel pipe shall be epoxy lined and coated in accordance with Section 09 91 00 – Painting and Finishes, unless noted otherwise.

1.2 RELATED WORK

- A. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
- B. Related work in other sections includes but is not limit to:
 - 1. Section 01 33 00 Submittals
 - 2. Section 09 91 00 Painting and Finishes
 - 3. Section 33 11 10 Miscellaneous Appurtenances
 - 4. Section 33 92 10 Steel Pipe, Specials, and Fittings (AWWA C200, modified)

1.3 REFERENCES AND STANDARDS

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract.
- B. Occupation Safety and Health Act: State of Utah and Federal
- C. AMERICAN STANDARD FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM D 4541 Standard Test for Pull-Off Strength of Coatings Using Portable Adhesion Testers
- D. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - 1. AWWA C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe-4-inch and Larger- Shop Applied.
 - 2. AWWA C210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
 - 3. AWWA C216 Heat-shrinkable Cross-linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
 - 4. AWWA C217 Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines

E. FEDERAL INTERNATIONAL ORGANIZATION (ISO)

1. ISO 8502-3 Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness – Part 3: Assessment of dust on steel surfaces prepared for painting (pressure-sensitive tape method)

F. NATIONAL ASSOCIATION OF CORROSION ENGINEERS INTERNATIONAL (NACE)

1. NACE RP 274 High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation
2. NACE RP 287 Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surface Using Replica Tape

G. SOCIETY FOR PROTECTIVE COATINGS (SSPC)

1. SSPC-SP-1 Solvent Cleaning Surface Preparation
2. SSPC-SP-2 Hand Tool Cleaning Surface Preparation
3. SSPC-SP-3 Power Tool Cleaning Surface Preparation
4. SSPC-SP-5 White Metal Abrasive Blast Surface Preparation
5. SSPC-SP-6 Commercial Abrasive Blast Surface Preparation
6. SSPC-SP-10 Near White Metal Abrasive Blast Surface Preparation
7. SSPC-SP-11 Power Tool to Bare Metal

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittals.
- B. Submit catalog cuts and other manufacturer's performance information for products proposed that demonstrate compliance with the Specifications herein described. Provide a copy of approved coating system submittals to the coating applicator. Provide Paint System Data Sheets (PSDS) and/or Material Safety Data Sheets (MSDS) for coating and lining materials.
- C. Quality Control Submittals
 1. Applicator's experience with list of references substantiating compliance.
- D. If the manufacturer of field-applied coating differs from that of the shop-applied primer, furnish written confirmation from both manufacturers that the 2 coating materials are compatible

1.5 QUALITY ASSURANCE

- A. All inspection for quality assurance shall ultimately be the responsibility of CONTRACTOR. OWNER retains the right to observe, accept, or reject the work based on the results of CONTRACTOR's inspection or observations by ENGINEER, at OWNER's discretion, in accordance with the specifications.
- B. Coating applicator shall have a minimum of 2 years experience applying the specified coating system and the application supervisor (Certified Applicator) for the coating application personnel shall have a minimum of 5 years practical experience in application of the indicated products.

- C. Coating and/or lining manufacturer technical representative shall be present for a minimum of 3 days to furnish technical assistance and instruction at the start of coating and/or lining operations within the shop and at the Site. During these visits, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to insure conformance with application instructions, recommended methods, and conditions.
- D. Coating and/or lining manufacturer shall furnish 8 hours per month of field or shop coating technical support if requested by ENGINEER.
- E. Technical representative shall provide a written report to ENGINEER for each visit. Report shall include copies of test data collected, description of observations, and recommended corrective actions. Report shall be submitted within 10 working days after the visit. When deemed necessary by ENGINEER, work will not be permitted to proceed until the recommended corrective actions have been implemented. After corrective recommendations have been implemented; the manufacturer representative shall return and certify that the application complies with the manufacturer's coating application recommendations.
- F. Additional visits by the manufacturer's representative shall be made at sufficient intervals during surface preparation and coating or lining 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.
- G. Repair and recoat all runs, overspray, roughness, or any other signs of improper application in accordance with paint manufacturer's instructions and as reviewed by ENGINEER.
- H. CONTRACTOR shall notify OWNER and minimum of 14 days prior to the commencement of any work. CONTRACTOR shall provide OWNER and/or ENGINEER with full access to facilities and application documentation. Observation by OWNER and/or ENGINEER, or the waiver of inspection of any particular portion of the work, shall not be construed to relieve CONTRACTOR of his responsibility to perform the work in accordance with these specifications.

1.6 DEFINITIONS

- A. **Manufacturer's Representative:** Employee of coating manufacturer who is factory trained and knowledgeable in technical aspects of manufacturer's products and systems. Sales representatives are not acceptable as a technical representative unless written authorization from the coating manufacturer is furnished stating the sales representative has full authority to act on behalf of the coating manufacturer.

1.7 ABBREVIATIONS

ANSI	American National Standards Institute
AWWA	American Water Works Association
MDFT	Minimum Dry Film Thickness
Mil	Thousandths of an Inch
OSHA	Occupation Safety and Health Act
SSPC	Society for Protective Coatings

1.8 SPECIAL WARRANTY REQUIREMENT

- A. CONTRACTOR and coating applicator shall warrant the work under this Section against defective workmanship and materials for a period of two (2) years commencing on the date of final acceptance of the pipeline.
- B. This warrantee shall be in addition to the prime CONTRACTOR's warrantee that covers repair of all defective work, including linings and coatings.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply paint in extreme heat, temperatures below 40 degrees F, nor in dust, smoke-laden atmosphere, damp or humid weather.
- B. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, nor whenever surface temperature is less than 5 degrees F above dew point of ambient air. Strictly adhere to manufacturer's recommendations.

1.10 MEASUREMENT AND PAYMENT

- A. Pipeline Coatings and Linings shall not be measured or paid as a separate item but shall be included as part of the item to which it relates.

PART 2 PRODUCTS

2.1 GENERAL

- A. Exterior and interior pipe and fitting surfaces shall be prepared and coated in accordance with referenced standards, written directions of the coating or lining manufacturers, and this Section, whichever is more stringent.
- B. Pipeline coating or lining materials shall be the products of a single manufacturer. Product substitutions during the project will not be considered or permitted.
- C. Coating applicator shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, surface preparation, holiday test and other parameters applicable to the type of coating.
- D. Coatings and linings will be stored, handled and applied per the manufacturer's written directions.

2.2 CONTRACTOR FURNISHED TEST EQUIPMENT

- A. Contractor shall provide the following coating test equipment for field testing of pipe for holidays.
 - 1. Holiday Test Equipment:
 - a. Elcometer Model D236, 0 to 30 kV high voltage tester
 - b. External Pipe rolling spring probe, sized for the Project pipe diameter.
 - c. Right Angle Wire Brush Probe, 20 inches or larger.
 - d. Telescopic probed extension handle, 2- to 4-foot length range.

- B. Equipment to be turned over to the OWNER upon completion of the Work. Equipment shall be in full working condition with all manuals, cases, and accessories supplied with equipment or required to be provided.

2.3 SHOP-APPLIED BURIED COATINGS

A. General

1. Buried steel pipe shall be shop-coated with the required coating system and a 1-inch thick cement mortar coating with $\pm 1/4$ " tolerance, as specified herein.
2. Buried coated pipe and fittings passing through a structure wall or floor shall be coated for a minimum of 2-inches beyond the interior wall or floor surface.
3. Pipe that is atmospherically exposed shall be shop primed as specified herein and in accordance with Section 09 91 00 – Painting and Finishes.

B. Cement Mortar Coat:

1. Apply cement mortar coat on steel pipe and fittings in accordance with AWWA C205, except as modified herein.
2. Shop Applied Coating System
 - a. Cement: Conform to ASTM C150, Type II or V.
 - b. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
 - c. Cement mortar mixture shall consist of 1 part cement to not more than 3 parts aggregate.
 - d. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities. Use no more than 4-1/2 gallons of water per sack of cement.
 - e. Cement mortar coating: Nominal 1 inch thick coating with permitted tolerance of $\pm 1/4$ inch.

2.4 EXTERIOR COATING FOR EXPOSED STEEL PIPE

A. Exterior Coating System

1. All atmospherically exposed or vault piping shall be shop primed with the coating system as specified in Section 09 91 00 – Painting and Finishes.
2. Exposed pipe to be shop primed per Section 09 91 00 – Painting and Finishes, with intermediate and finish coats to be applied in the field after installation is complete.
3. Shop applied inorganic zinc primer shall not be applied at thickness greater than recommended by manufacturer. Excess primer to be removed using method recommended by coating manufacturer.
4. Manufacturer of shop-applied primer shall be coordinated with field application to provide a completed system by a single manufacturer as specified in Section 09 91 00 – Painting and Finishes. OWNER approval of a coating system with two or more coating manufacturer's will required written approval from all coating manufacturer's as to compatibility and acceptance under warranty.

2.5 INTERIOR SHOP-APPLIED LININGS

A. Cement Mortar Lining

1. Clean and cement mortar line steel pipe and fittings in accordance with AWWA C205.
2. Cement shall conform to ASTM C150, Type II.
3. Shop applied cement mortar lining shall be uniform in thickness over the full length of the pipe joint.
4. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
5. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities.

B. Liquid Applied Epoxy Lining

1. Exposed steel pipe inside vaults shall be epoxy lined in accordance with Section 09 91 00 – Painting and Finishes, unless noted otherwise.
2. Provide liquid epoxy primer and lining in accordance with Section 09 91 00 – Painting and Finishes in all cement mortar lined metallic pipe at insulating joints for a minimum of two pipe diameters on each side of the insulated joint.
 - a. Epoxy shall be applied over the cement mortar lining where specified for the pipeline lining material.
 - b. Prepare the cement mortar lining by abrasive blasting to remove all laitance and provide a surface profile.
 - c. Cement mortar shall be allowed to cure for a minimum of 15 days prior to surface preparation and coating application or 7 days with steam curing.
 - d. Mortar lining shall be dry when epoxy lining is applied.
3. Epoxy coatings shall be NSF certified coatings suitable for potable water contact in accordance with ANSI/NSF Standards 60 and 61.

2.6 SPECIALS, FITTINGS, AND CONNECTIONS

- A. Coating and lining application for special sections, connections, and fittings shall conform to coating system and application requirements in this Section. Internal Mortar lining shall be applied to all specials, fittings and pipes with outlets.
- B. Specials, fittings, and pipes with outlets shall be defined as any pipe section with turnouts for blowoffs, interconnects, any valve, or other appurtenances; tees; crosses; wyes; laterals; manholes; mitered angles or elbows; and pipes that require special fabrication that prevents mechanical production application of the indicated coating system from end to end of pipe joint as defined herein.
- C. In addition to the items listed above as specials, the following items shall also be considered as specials: Pipe joints with pass through holes.
- D. Hand-applied tape coatings will not be permitted on any specials, fittings, connections, pipes with outlets and elbow fittings.
- E. Provide a cement mortar coating on specials, fittings, and connections to match pipeline, where pipeline coating requires a cement mortar coating.

2.7 EXTERIOR FIELD JOINT COATING

- A. Pipe joints shall be field coated after pipe assembly in accordance with AWWA C216, except as modified herein.

- B. Field joint coating shall be compatible with the shop-applied coating system and be provided by the same manufacturer or a manufacturer approved by the pipe coating manufacturer.
- C. Field joint coating materials shall be as follows or an equal.
 - 1. Heat Shrink Sleeves
 - a. Filler Material: Provide filler material for push-on, flange, and coupling type joints. Filler material shall adhere to pipe and heat shrink sleeves and shall not melt under joint welding temperatures. Size and type shall be as recommended by the sleeve manufacturer for type of pipe and joint. Filler material shall be applied in a manner and of sufficient thickness that no tenting or voids remain under the heat shrink sleeve. Filler material shall be **Canusa Aqua Seal SG79 or Raychem Covalence 939 Filler**.
 - b. Joint Coating: Heat shrink, cross-linked polyolefin wrap or sleeve with an adhesive, backing and sleeve with a total of 200-mils minimum thickness, suitable for pipeline operating temperature, as recommended by the manufacturer and shall meet the requirements of AWWA C 216.
 - c. Provide standard recovery sleeve for girth weld or bell and spigot steel pipe joints. High recovery sleeves shall be provided for flange joints, coupling style joints.
 - d. Width of heat shrink sleeves shall be sufficient to overlap existing coating 3 inches minimum. Overlap on tape coated steel pipe shall be based on a sequential 3-inch wide step from outer wrap to middle wrap to inner wrap.
 - e. Consider sleeve shrinkage during installation and joint profile in determining sleeve width required. Overlapping of 2 or more heat shrink sleeves to achieve the necessary width on pipe joints will not be permitted without OWNER approval.
 - f. Manufacturers: **AquaSleeve by Canusa-CPS, Covalence by Berry CPG**, or approved equal.
 - 2. Hand Applied Tape Wrap – Not Allowed.
 - 3. Wax Tape Coating
 - a. Wax tape coatings shall be limited to field application on joints, fittings, or irregular shapes or complex configurations that are not suited for the use of heat shrink wrap coating systems.
 - b. Apply coating in accordance with AWWA C217, except as modified herein.
 - c. Provide filler material to fill and smooth irregular surfaces, such that no tenting or voids remain under the applied wax tape.
 - d. Protect coating from damage and provide special sand backfill protect wax coating from damage.
 - e. Coating System
 - 1) Surface Preparation: SP3 Power Tool or SP11 Power Tool to Bare Metal.
 - 2) Primer: Petroleum or petrolatum wax.
 - 3) Filler Material: Filled petroleum or petrolatum wax.
 - 4) Inner Tape: Petroleum or petrolatum wax impregnated fabric, 6-inch width maximum, 40-mils thick.
 - 5) Outer Wrap: PVC or tape suitable for application to inner tape.
 - f. Wax tape coating system shall per Ductile Iron Fittings for PVC Pipe 33 05 05.

2.8 INTERIOR FIELD JOINT COATING

- A. Surface preparation and field lining of pipe joints shall be with the same coating system as the shop-applied lining.
- B. Field application shall be performed by qualified personnel trained on the proper application of the coating system.
- C. Field coating application requirements shall be the same as the shop-applied coating requirements. Provide heating and/or dehumidification equipment as required to meet the environmental conditions necessary for proper coating application.

2.9 REPAIR OF COATINGS AND LININGS

A. General

- 1. Coating or lining repair materials shall be compatible with the shop-applied coating or lining system and shall be approved by the coating or lining manufacturer.

B. Coating Repair Materials

- 1. Heat Shrink Sleeves (major repair)
 - a. Filler Mastic: Provide mastic filler to fill tape void as required.
 - b. Full Wrap Coating: Cross-linked polyolefin wrap with a mastic sealant, 85-mil thickness minimum, suitable for pipeline operating temperature, sleeve material recovery as recommended by the manufacturer. Sleeve length shall provide a minimum of 3-inches overlap onto intact pipe coating.
 - c. Manufacturers: **AquaSleeve by Canusa-CPS, Covalence by Berry CPG**, or approved equal.
- 2. Heat-Applied Patches (minor repair)
 - a. Heat applied adhesive, polyolefin-backed, mastic coated tape, 12-inches maximum size.
 - b. Patch shall provide a minimum of 2-inches overlap onto intact pipe coating.
 - c. Manufacturers: **CRP patch by Canusa, PERP patch Berry CPG**, or approved equal.

C. Exposed Pipe Coating System

- 1. Touch-up repair all damage to primer and/or intermediate coats with the specified coating system prior to final coating of the pipeline in accordance with Section 09 91 00 – Painting and Finishes.

PART 3 EXECUTION

3.1 ENVIRONMENTAL LIMITATIONS

A. General

- 1. Products shall comply with federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposure.
- 2. 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.

3. Do not perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent or whenever surface temperature is less than 5 degrees above the dew point of the ambient air.
4. Do not apply coatings when:
 - a. Surface and ambient temperatures exceed the maximum or minimum temperatures recommended by the coating manufacturer or these specifications.
 - b. 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.
 - c. When it is expected that surface temperatures would drop below 5 degrees above dew point within 4 hours after application of coating.
5. Where weather conditions or project requirements dictate, CONTRACTOR shall provide and operate heaters and/or dehumidification equipment to allow pipe surfaces to be abrasive blasted and coated as indicated and in accordance with the manufacturer's coating application recommendations.
6. Work activities may be restricted until adequate temperature and humidity controls are in place and functioning within the environmental limits given.
7. Coating applicator shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, surface preparation, holiday test, and other parameters applicable to the type of coating.

B. Temperature Control

1. In cold weather or if moisture collects on the pipe, if the temperature of the pipe is less than 45 degrees F, preheat the pipe to a temperature of 50 degrees F or 5 degrees above dew point, whichever is greater.
2. When temperatures are above or below the coating manufacturer's recommended application temperatures, CONTRACTOR shall provide temperature controls as necessary to permit the work to proceed within the manufacturer's temperature limitations.
3. Provide tenting, insulating blankets, baffles, or bulkheads as required to zone and control heating or cooling effectiveness.
4. Heating shall be with indirect propane fired heaters that do not increase humidity levels within the working area. Heaters shall be sized for the area to be heated.

C. Dehumidification

1. CONTRACTOR shall provide dehumidification equipment when necessary for shop or field environmental control during surface preparation and/or coating application. Dehumidification equipment shall be properly sized to maintain dew point temperature 5 degrees or more below surface temperature of metal surfaces to be cleaned and coated.
2. Cleaned metal surfaces shall be prevented from flash rusting throughout the project duration; condensation or icing shall be prevented throughout surface preparation and coating application.
3. Daily environmental condition monitoring and maintenance requirements of the equipment shall be documented in writing and posted near the equipment for review if required by ENGINEER.
4. Re-blasting of flash rusted metal surfaces or removal of damaged coatings because of equipment malfunction, shutdown, or other events that result in the loss of

- environmental control, will be at the sole expense of CONTRACTOR. Cleaned metal surfaces subject to flash rusting shall be cleaned to the same cleanliness as prior to the flash rust formation and shall be approved by the ENGINEER.
5. If the required environmental conditions cannot be maintained throughout the coating process, the CONTRACTOR will be required to provide the following:
 - a. CONTRACTOR shall provide and operate desiccant dehumidification equipment to maintain environmental conditions for 24 hours a day during abrasive blasting and coating application and cure. Liquid, granular, or loose lithium chloride drying systems will not be acceptable.
 - b. CONTRACTOR shall provide dehumidification equipment sized to maintain dew point temperature 5°F or more below surface temperature of metal surfaces to be cleaned and coated. System shall provide ventilation within the environmentally controlled areas to meet the following requirements:
 - 1) Two air exchanges per hour, minimum
 - 2) Maintenance of personnel exposure limits (PEL) at 50 percent of OSHA PEL limits for all chemicals used in the performance of the Work.
 - 3) Maintenance of lower explosive limits (LEL) to less than 50 percent of the most volatile solvent used in the performance of the Work.
 - c. Dehumidification equipment shall also provide ventilation at a minimum of 0.75 air exchanges per hour within all non-accessible work areas for worker protection or as required for maintaining PEL and LEL explosive limits as defined herein, whichever is more stringent.
 - d. Dehumidification equipment type, size, air flow, and power requirements shall be designed by a qualified company knowledgeable in dehumidification equipment, and its operation based on Project requirements and anticipated seasonal weather conditions for the Project schedule. Design to include evaluation of existing conditions, humidity, and temperature, proper air exchange requirements, ventilation requirements, ducting requirements for adequate air flow, and any other issues necessary to achieve the specified performance and environmental conditions throughout the duration of the Project.
 - e. CONTRACTOR to submit written recommendations from dehumidification Subcontractor for enclosure work area size, bulkhead venting, duct work for each bulkhead section, any secondary ventilation requirements for coating cure, dust collection equipment CFM requirements, and drying requirements for blast hose compressed air necessary to maintain environmental control as specified herein.
 - f. At a minimum, work area shall be separated into surface preparation work zones, coating application zones, and coating cure zones.
 - g. Dehumidification Subcontractor shall either operate the equipment or provide training to CONTRACTOR on the proper operation and setup of dehumidification equipment. Dehumidification Subcontractor shall provide a technical representative on-site for a minimum of two 8 hour days to insure proper operation of the equipment, achievement of desired environmental control, and to insure CONTRACTOR can properly setup, operate, monitor, and maintain equipment.

3.2 OBSERVATION OF WORK

- A. CONTRACTOR shall give ENGINEER a minimum of 14 days advance notice of the start of any coating work to allow scheduling for shop or field observation. Notify ENGINEER a minimum 3 days in advance of actual start of surface preparation and coating application Work.

1. Provisions shall be made to allow ENGINEER full access to facilities and appropriate documentation regarding coating application.
2. Observation by ENGINEER or the waiver of observation of any particular portion of the coating work shall not be construed to relieve CONTRACTOR of responsibility to perform the coating in accordance with these Specifications.
3. Materials shall be subject to observation for suitability as ENGINEER may determine, prior to or during incorporation into the work.

3.3 SURFACE PREPARATION

A. General

1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of coating manufacturer whose product is to be applied.
2. Visible oil, grease, dirt, and contamination shall be removed in accordance with SSPC-SP1, solvent cleaning.
3. Surface imperfections such as metal slivers, burrs, weld splatter, gouges, or delaminations in the metal shall be removed by filing or grinding prior to abrasive surface preparation.
4. Protect prepared pipe from humidity, moisture, and rain. Flash rust, imperfections, or contamination on cleaned pipe surface shall be removed by reblasting.
5. Priming and coating of pipe shall be completed the same day as surface preparation.

B. Weld Surface Preparation

1. Application
 - a. Spray applied coating systems do not require weld grinding.
 - b. Grind welds on tape wrap coated pipe or apply weld stripe tape over the weld, at the pipe fabricator's option, unless otherwise indicated.
2. Weld Grinding: Under the weld grinding option, welds taller than 3/32-inch above pipe surface shall be ground to a tolerance of +3/32-inch to zero-inches above the pipe surface as measured on the highest side of the weld.
3. Weld Stripe Tape
 - a. Weld stripe tape shall be applied to primed metal.
 - b. Tape shall either have no polyethylene backing or be double sided adhesive tape to permit adhesion of the inner corrosion protection layer to the weld stripe tape.
 - c. Apply tape with a pressure roller to fully conform the tape to the weld surface.
 - d. Adhesion of the weld stripe tape shall be the same as for the coating system.

C. Steel Surface Preparation

1. Surface preparation of steel pipe shall be in accordance with SSPC surface preparation standards utilizing the degree of cleanliness appropriate to the coating system to be applied.
2. Grit and/or shot abrasive mixture and gradation shall be as required to achieve the degree of cleanliness and coating adhesion required.
3. Pipe cleaned by abrasive blasting with recyclable steel grit and/or shot or other abrasive shall be cleaned of debris and spent abrasive in an air wash separator.
4. Work shall be performed in a manner that does not permit the cleaned metal surface to rust back or flash rust.

5. Rust back or flash rust shall be fully removed with the steel surface cleanliness equal to the required metal surface cleanliness prior to rust back or flash rusting. Determination of the equivalent surface cleanliness shall be at ENGINEER'S sole discretion.

3.4 SHOP-APPLIED COATING SYSTEMS

A. Cement Mortar Coatings

1. Buried steel pipe shall have a cement mortar coating applied in accordance with AWWA C205, except as modified herein.
2. Cement Mortar Coating:
 - a. Reinforcement:
 - 1) For pipe and specials smaller than 48-inches in diameter, reinforce coating with spirally-wound No. 12 gage steel wire spaced at 1-inch centers or with No. 4 gage steel wire at 1/2-inch centers positioned approximately in center of mortar coating.
 - 2) For pipe and specials 48-inches in diameter and larger, reinforce coating with 2 layers of spirally-wound No. 12 gage steel wire spaced at 1-inch centers or with No. 4 gage steel wire at 1/2-inch centers positioned approximately in center of mortar coating.
 - 3) Lap ends of reinforcement strips 4-inches and tie or loop free ends to assure continuity of reinforcement.
 - 4) All steel wire reinforcement placed in the mortar coating shall be electrically isolated from the pipe. Electric isolation will be tested using high voltage spark test by the manufacturer prior to shipment to the project site. Provide certification that electrical isolation of reinforcement wire from steel pipe.
 - b. Specials Fittings:
 - 1) Special fittings shall be mortar coated as specified.
 - c. Coating Defects:
 - 1) Coating defects shall be repaired as specified in AWWA C205, except as modified herein.

B. Epoxy Coatings

1. Exposed steel pipe inside vaults shall have an epoxy coating per Section 09 91 00 – Painting and Finishes, unless noted otherwise.

3.5 EXTERIOR COATING HOLDBACK

- A. Coating holdbacks shall be straight and cut through the full thickness of the coating.
- B. Cutbacks shall be completed in a manner that permits field coating of joints in accordance with the manufacturer's recommendations and these requirements.
- C. Holdbacks shall be as required for proper jointing of pipe, considering joint welding requirements, and be as follows:

Mortar Coating

All joints	As shown on the details
Epoxy coating	
Push-on joint, spigot	Flush with spigot end
Push-on, bell	Flush with bell end
Welded, spigot	3-inches, minimum
Welded, Bell	4-inches, minimum

D. Holdback Corrosion Protection

1. Holding primer for corrosion protection of cutbacks or holdbacks shall be compatible with the joint coating system, shall prevent corrosion of prepared pipe ends for duration of storage and construction, and be recommended for buried exposures.
2. Primer shall be compatible with welding operations and shall not result in running or melting of the coating during welding operations.
3. Application and thickness of holding primer shall be in accordance with the primer manufacturer's recommendations, but shall not impair the clearances required for proper joint installation.
4. Any corroding holdback areas shall be abrasively blasted to SP10 or power tool cleaned to bare metal in accordance with SP11 prior to applying joint coating.

3.6 PIPE LINING APPLICATION

A. Shop-Applied Cement Mortar Lining

1. Place mortar lining used in steel piping and steel plate specials in pipe to thickness below.

Pipe Diameter, Inches	Lining Thickness, Inches	Tolerances, Inches
4 through 10	3/8	-1/16, +1/8
11 through 24	5/16	-1/16, +1/8
24 through 36	3/8	-1/16, +1/8
Greater than 36	1/2	-1/16, +3/16

2. Centrifugally line straight sections of pipe. Lining of special pieces or fittings shall be by mechanical, pneumatic, or hand placement. Provide cement mortar lining of uniform thickness. Finish to a smooth dense surface.
 - a. Steel plate specials larger than 16-inches in diameter shall have lining reinforced with 2-inch by 4-inch No. 13-gauge welded steel wire mesh.
 - b. Brace and support pipe during lining application to minimize pipe distortion or vibration. Bracing and supports shall not damage the pipe, coating, or lining.

- c. Tightly close ends of pipe and fittings with plastic sheet caps within 30 minutes of lining application. Plastic end caps shall be of sufficient thickness and strength to resist shipping, handling, and storage stresses.
- d. Damage to the cement mortar lining, including disbondment, cracking, or blistering, caused by improper curing, shipping, handling, or installation shall be repaired in accordance with AWWA specifications.
- e. Other requirements of mortar lining materials and processes are in AWWA C205.

B. Liquid Epoxy Lining:

- 1. Epoxy lining shall be applied in accordance with Section 09 91 00 – Painting and Finishes.
- 2. Clean and coat the interior of cement mortar lined pipe at insulating joints or where specified with two coats of epoxy coating
 - a. Epoxy coating applied at insulating joints shall be applied to both sides of the insulating joint for a minimum of one pipe diameter. If only one side of the joint can be coated, the coating shall be applied for a minimum of two pipe diameters.
 - b. Mortar lining shall be allowed to cure 15 days or steam cured not less than 7 days prior to surface preparation of the mortar and epoxy coating application. Hand applied mortar lining shall be allowed to cure a minimum of 15 days or as required to meet the coating manufacturer's requirements for application on cement or concrete, whichever is greater.
 - c. Prepared mortar lining by abrasive blasting to remove all laitance and create a suitable anchor profile.
 - d. Epoxy coating shall be applied in two coats minimum, at a total coating thickness of 16 mils dry film thickness. Coating applied over cement mortar lining shall be applied in a manner that will minimize gassing and pinholes in the completed lining.
 - e. Mortar lining shall be dry during epoxy lining application.

3.7 FIELD COATING JOINTS

A. General

- 1. Remove oil or grease contamination by solvent wiping the pipe and adjacent coating in accordance with SSPC-SP1, Solvent cleaning.
- 2. Clean pipe surface and adjacent coating of mud, rust, and other foreign contaminants in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal or abrasively field blast joints in accordance with SSPC-SP10, near white blast, that exhibit any surface rust. Clean the full circumference of the pipe and a minimum of 6-inches onto the existing coating.
- 3. Remove loose or damaged pipe coating at joint and either repair the coating or increase the length of the joint coating, where reasonable and practical.
- 4. Complete joint bonding (where shown) of pipe joints before application of joint coating. Joint bonds shall be installed per Section 26 42 00 – Galvanic Cathodic Protection Systems. Joint bonds shall be low profile bonds, and gaps and crevices around the bonds shall be filled with mastic sealant.
- 5. CONTRACTOR shall electrically test completed joint coating for holidays with high voltage spark tester.

B. Post-Welding of Joints:

1. Post-welded joints are defined as welded pipe joints that are coated prior to completing interior welds.
2. Post welded joints shall be coated and protected as follows:
 - a. Joint coating shall be heat shrink joint sleeves only. Tape wrapped joints will not be acceptable.
 - b. Provide 6-inch wide non-shrinking layer centered over the interior weld location, such as **CRP patch by Canusa or PERP by Berry CPG** patch materials. Heat resistant tape will not be acceptable.
 - c. Finished external joint coatings shall be fully buried with a minimum of 12-inches of soil cover, prior to any interior welding.
3. CONTRACTOR shall demonstrate that the joint welding procedures will not significantly damage the coating by fully excavating the first 2 post-welded joints for inspection of the coating condition. Up to 3 additional post-welded joints for excavation by CONTRACTOR will be selected for inspection of joint coating condition.
4. Any damage to the external joint coating system will require the CONTRACTOR to modify welding methods and or coating materials until a non-damaged system is attainable. All weld damaged joint coatings shall be removed and replaced with the new suitable system.

C. Heat Shrink Sleeve Joint Coating

1. Store, handle, and apply field heat shrink sleeve coatings in accordance with AWWA C216 and these specifications.
2. Store sleeves in shipping box until use. Keep dry and sheltered from exposure to direct sunlight. Store off the ground or concrete floors and maintain at a temperature between 60 and 100 degrees F as recommended by the sleeve manufacturer.
3. Metal pipe surface shall be free of dirt, dust, and flash rusting prior to sleeve application. Surface preparation shall be in accordance with the joint coating manufacturer's recommendations. At a minimum, surfaces shall be prepared by abrasive blasting to SSPC-SP10 or by power tool cleaning to bare metal in accordance with SSPC-SP11.
4. Preheat pipe uniformly as recommended by the sleeve manufacturer. Monitor pipe temperature using a surface temperature gauge, infrared thermometer, or color changing crayons. Protect preheated pipe from rain, snow, frost, or moisture with tenting or shields and do not permit the joint to cool.
5. Fill cracks, crevices, gaps, and step-downs greater than 1/4- inch with filler mastic in accordance with the manufacturer's recommendations for the full circumference of the pipe.
6. Apply heat shrink sleeve when it is at a minimum temperature of 60 degrees F and while maintaining the pipe temperature above the preheat temperature above. Apply sleeve in accordance with the manufacturer's instructions and center the sleeve over the joint to provide a minimum 3 inch overlap onto the existing pipe coating.
7. Completed joint sleeve shall be fully bonded to the pipe and existing coating surface without voids. Mastic beading shall be visible along the full circumference of the sleeve. There shall be no wrinkling or excessive burns on the sleeves. Sleeves that do not meet these requirements shall be removed and the joint recoated. Minor coating repairs may be made using heat applied patch material indicated.
8. Allow the sleeve to cool before backfilling. In hot climates, provide shading from direct sunlight. Water quenching will be allowed only when permitted by the sleeve manufacturer.

9. Heat shrink joint coatings which have become wrinkled or disbonded because of prolonged exposure to UV light or thermal cycling shall be removed and replaced.
10. Double coating of defective or damaged heat shrink coatings will not be permitted. Any double coated heat shrink sleeves shall be immediately rejected and CONTRACTOR shall remove and recoat the joint.

D. Cement Mortar Coating

1. Field repair cement mortar coating in accordance with AWWA C205.
2. Joint Diapers
 - a. Polyethylene Foam:
 - 1) Cut into strips wide enough to match uncoated field joint area.
 - 2) Slit to thickness of 1/4-inch that will expose a hollow or open cell surface on one side.
 - 3) Foam liner shall be attached to fabric backing with open or hollow cells facing towards pipe.
 - 4) Foam strip shall cover full interior circumference of grout band with sufficient length to permit 8-inch overlap of foam at or near top of joint.
 - 5) Splices to provide continuity of material will be permitted.
 - 6) Protect polyethylene foam material from direct sunlight.

3.8 REPAIR OF COATING AND LININGS

A. General

1. Areas where holidays are detected or coating is visually damaged, such as blisters, tears, rips, bubbles, wrinkles, cuts, or other defects shall be repaired. Areas where no holidays are detected, but are visually damaged shall also be repaired.
2. Maximum defects allowable shall be as indicated for the coating system.

B. Cement Mortar Coating and Lining

1. Cement mortar coating that is cracked or disbonded shall be repaired in accordance with AWWA C205, except for mortar overcoat on tape wrapped steel.
2. Disbonded mortar coating shall be removed and patched.
3. Mortar coating with disbondment greater than 25 percent of the pipe surface shall be rejected and recoated.
4. Cracks in mortar coating and lining shall be repaired in accordance with AWWA C205.

C. Epoxy Coating and Lining

1. Epoxy coating and linings shall be repaired in accordance with Section 09 91 00 – Painting and Finishes.

3.9 INSPECTION AND TESTING

A. Inspection

1. Applicator shall inspect and test the coating system in accordance with referenced standards and these specifications, whichever is more stringent.

2. The frequency of the testing shall be determined by the applicator, but shall not be less than the requirements of this specification.
3. CONTRACTOR will conduct random independent inspections and tests for the final acceptance or rejection of pipe coating or lining.
4. CONTRACTOR to perform holiday testing in the field using equipment provided as specified in Paragraph 2.2. Tests will be completed in the presence of the OWNER's representative on each joint of pipe and fitting once the pipe has been lifted and lowered into the trench. Holidays shall be repaired as specified.

B. Surface Profile Testing

1. Surface profile of abrasive blasted surfaces to be tested with "Press-O-Film" tester tape or equivalent in accordance with NACE RP287.
2. Tester tape shall be suitable for the intended profile height.
3. Profile shall be measured to a minimum tolerance of 0.1 mils, maximum.
4. Electronic surface profilometers shall be used, as deemed necessary, to verify tester tape measurements.

C. Adhesion Testing, General

1. Adhesion testing shall be conducted at the shop prior to shipment. Pipe shipped without adhesion testing will be field-tested. Pipe rejected in the field will be returned to the shop for repair at the sole expense of the CONTRACTOR.
2. A minimum of 2 pipes will be tested for adhesion from each lot of pipe coated up to 4,000 square feet of pipe. An additional adhesion test will be conducted on every increment up to 3,000 square feet of pipe coated in excess of the first 4,000 square feet of pipe. (i.e. if one workday of production is 8,000 square feet of pipe, 4 adhesion tests will be conducted on the pipe lot.
3. A pipe lot is defined as the quantity of pipe that is coated by a single crew within a work shift, but not to exceed 12 hours.
4. The pipe coating applicator shall repair coating damage from adhesion testing.
5. Adhesion tests will be performed not less than 24 hours after coating application. Tests conducted prior to 24 hours will be acceptable only if the test meets or exceeds the adhesion criterion and the test was requested by the pipe fabricator.
6. Pipe will be randomly selected for adhesion testing. OWNER reserves the right to perform adhesion testing at any time or location.
7. If any pipe tested fails the adhesion test, all pipes within the lot will be rejected. Each pipe within the rejected pipe lot will then be individually tested for adhesion and accepted or rejected on a pipe-by-pipe basis.
8. Rejected pipe shall have the coating fully removed from the pipe and the pipe abrasive blasted and recoated.

D. Holiday Testing

1. Coating thickness used for holiday testing shall be the minimum coating thickness.
2. Dry Film Thickness Testing
 - a. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off or eddy current equipment.
 - b. Coating thickness measurements shall be conducted as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this specification.

3.10 HANDLING, TRANSPORTATION, AND STORAGE

- A. Pipe shall be handled in such a manner as to protect the pipe and coating from damage.
- B. Coated pipe shall not be shipped or installed until coating has developed full adhesion and cure.
- C. During coating application, storage, loading, and transportation, every precaution shall be taken to protect and prevent damage to pipe, lining, and coating. Forklift equipment shall have load-bearing surfaces padded with suitable material. Lift pipe with web slings a minimum of 12-inches wide and of a type that will not damage the coating. Metal chains, cables, tongs, forklifts or other equipment likely to damage the coating will not be permitted. Dragging or skidding of pipe on grade or in the trench will not be permitted.
- D. Provide transportation vehicles with padded bolsters between each layer of pipe and heavy padding under load ties. Bolsters shall be curved to fit the outside of the pipe and 12-inches wide, minimum. Pipe contact locations shall be heavily padded with carpet and strips of the outer tape wrap material (adhesive side against the carpet) during shipment to the Site and from the storage yard to the point of installation.
- E. Pipe shall not be stored on rocks, gravel, or other hard materials that might damage the coating. Provide padded 12-inch wide skids and chucks, sand bags, select loamy or sand berms, or suspended from cutback ends, where possible, to minimize coating damage. Pipe shall not be laid on asphalt without suitable padding at contact points.
- F. Pipe shall be inspected by CONTRACTOR at the Site for damage. Any damage to the pipe, lining, or coating shall be repaired if a satisfactory repair can be made; otherwise, the damaged section shall be replaced at the sole expense of CONTRACTOR.
- G. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workers shall not be permitted to walk on the coating except when absolutely necessary. When required, shoes with rubber or composition soles and heels or other suitable footwear that will not damage coating shall be used.
- H. Long-term Exposure: Pipe shall either be provided with UV inhibitor for length of above grade exposure or covered to prevent UV degradation of outer wrap. Amount of UV stabilizers required shall depend on the project location, laying schedule, anticipated length of exposure, and type of outer wrap. Coating manufacturer shall be consulted for recommended UV inhibitors requirements or pipe shall be stored under a protective cover. Protective covering can be colored plastic sheeting, canvas, or other UV blocking material. Clear plastic sheets are not acceptable. Areas of coating that display UV degradation shall be removed and repaired at sole cost of CONTRACTOR.
- I. End Caps: Pipe ends of mortar lined pipe and fittings shall be tightly closed with a plastic wrap to aid in curing and to minimize drying out of and contamination of the lining. Plastic end cap shall consist of a minimum of one 10-mil sheet of polyethylene or other suitable material. End caps shall be substantial enough to resist shipment, handling, and storage loads and to remain firmly attached in place. The plastic end cap shall remain intact and in place until pipe installation. Damaged or missing plastic end caps shall be repaired or replaced.

J. Bracing

1. The manufacturer shall install adequate bracing or strutting to keep the pipe from becoming deformed or damage from occurring to the coating or linings. Strut-type bracing shall be installed as soon as possible after application of lining. Struts shall remain in place during handling, storage, transportation, and installation of pipe and fittings until after the pipe zone material is compacted. Adequate strutting shall be provided by pipe manufacturer, so that after completion of backfilling, pipe deflection or elongation shall not exceed one percent of the nominal inside diameter of cement-mortar-lined pipe.
2. The minimum bracing shall consist of crossed struts (horizontal and vertical). The maximum spacing along the pipe shall be near each end and at the one-third points for each 48-foot section of pipe, with a minimum of 4 sets of struts per 48-foot section of pipe. Random lengths of pipe shall have an equivalent number of sets of struts, with a minimum of one set of struts in a 10-foot section of pipe
3. The struts shall be installed with pads and wedges in such a manner that the pipe lining will not be damaged and the struts will not be dislodged during shipping and handling of the pipe. If struts are welded, they shall be installed and removed in such a manner to prevent damage to the steel cylinder, lining, or coatings. Damage shall be repaired to the satisfaction of ENGINEER.

- END OF SECTION -

SECTION 11 54 00
PROCESS EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers the work necessary to install a ready to use and tested process and analysis system. The Contractor shall provide all components required for a complete and functional system.

1.2 SUBMITTALS

- A. Submit catalog cuts on all process equipment including switches, meters, sensors, or other items shown on the Drawings referencing each item by mark number. Information shall indicate manufacture specification compliance and dimensional data.
- B. Submit complete Product Data, Shop Drawings, Test Reports, Operating Manuals, Record Drawings, Manufacturer's certifications, Manufacturer's Field Reports catalog cuts on all process equipment including switches, meters, sensors, or other items shown on the Drawings referencing each item by mark number. Information shall indicate manufacture specification compliance and dimensional data.

1.3 WARRANTY

- A. Manufacturer shall provide to the Owner written guarantee against defects in material or workmanship for a period of one (1) year.

1.4 DELIVERY AND STORAGE

- A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

1.5 MEASUREMENT AND PAYMENT

- A. There shall be no separate measurement and payment for any systems. Full compensation for the system shall be considered as included in the contract unit or lump sum bid prices for the various items of the contract to which it relates.

1.6 QUALITY ASSURANCE

- A. Manufacture facilities shall be certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

PART 2 PRODUCTS

2.1 FLOW METER

- A. The flow meter shall be Endress+Hauser Promag W 400.
- B. The flow meter shall be an electromagnetic full bore magnetic flow meter for permanent installations both above and below ground? and with or without the typical inlet/outlet

straight pipe run mounting requirements. The full-bore magnetic flowmeter shall maintain zero pressure loss while achieving 0.5% of rate accuracy even when mounted directly before or after a piping elbow, T-fitting, or insertion device. The meters shall utilize bipolar pulse DC coil excitation to measure voltage induced by the flow of conductive liquid through a magnetic flux. The voltage shall be linearly proportional to flow velocity from 0.033 to 33 feet per second.

- C. The flow meter shall be a flanged sensor (by application and instrument schedule) which complies with AWWA C751 and transmitter which may be mounted integral (compact) to the sensor or remote with interconnecting cables up to 650 feet in length.
- D. The flow metering system shall be microprocessor-based and possess a non-volatile memory to store the sensor calibration and transmitter setup information. The electronics shall be interchangeable for meters sizes 1"- 120".
- E. The sensor shall consist of a stainless-steel flow tube with ANSI B16.5 or AWWA C207 Class D carbon steel flanges. The flanges shall be Class 150.
- F. The sensor tube shall be lined with polyurethane
- G. The sensor shall have NSF-61 approval.
- H. The sensor shall house four measuring electrodes (1"-2.5") and six measuring electrodes (3"-120"), plus a grounding electrode, and one empty pipe detection electrode with no exceptions. The electrodes shall be bullet-nosed shaped and made of 316L SS, Alloy C22, or Tantalum (listed by the application and instrument schedule).
- I. The external sensor housing shall enclose the coil assemblies and internal wiring. The materials shall be designed and constructed to prevent moisture ingress and promote corrosion resistance.
- J. The electrode circuit shall have a minimum impedance of 1012 ohms to overcome moderate coating buildup.
- K. The sensor shall be rated for NEMA 4X service as standard.
- L. An optional sensor rating for NEMA 6P/IP68 service shall allow for permanent immersion in water depths up to 10 feet.
- M. If NEMA 6P is specified in the instrument schedule, the transmitter shall be remotely mounted, and custom length cables shall be attached at the factory.
- N. The transmitter (series 400 or 300 or 500) shall be a three-stage microprocessor controller mounted integrally or remotely as specified in the instrument schedule. The transmitter shall incorporate a universal 100-240 VAC/18-30 VDC power supply. The transmitter housing will carry a NEMA 4X rating and shall be constructed to prevent moisture ingress, promote corrosion resistance, and be impervious to saline environments.
- O. Magnetic flow meters shall be factory calibrated on an ISO-17025 accredited test stand per "General Requirements for the Competence of Testing and Calibration Laboratories" with certified accuracy traceable to NIST.
- P. Evidence of accreditation shall originate from a national verification agency such as A2LA.

- Q. Each meter shall ship with a certificate of a 2-point calibration report exceeding stated standard accuracy of 0.5% of rate. The 0.5% accuracy shall be maintained with zero upstream/downstream piping requirements I.E., mounted directly before or after a piping elbow, T-fitting, or insertion device.
- R. Optional factory calibration of 0.2% of rate accuracy (magnetic flowmeter must be installed with the proper upstream (5) and downstream (2) pipe run requirements)
- S. An optional performance calibration for a Flat Accuracy Specification shall be performed in the event of low initial design flow rate.
- T. Meters shall include grounding rings.

2.2 CHLORINE ANALYZER

- A. The chlorine analyzer shall be ATI Q46H/62-63 residual chlorine monitor.
- B. The chlorine monitor shall use a sealed flowcell.
- C. The chlorine monitor shall also measure and transmit pH value.
- D. The monitor shall be set to measure free chlorine concentration.
- E. The chlorine monitor shall be rated for 150 psi operating pressure.
- F. The analyzer shall be provided complete with all necessary components.

2.3 TURBIDIMETER

- A. The turbidimeter shall be ATI Q46/76 turbidity monitor.
- B. The turbidimeter shall be rated for 150 psi operating pressure.
- C. The turbidimeter shall include appurtenances needed for a complete and operable system.
- D. The range of the turbidimeter shall be set for a range of 0-20 NTU with resolution of 0.01 NTU minimum.
- E. The analyzer shall be provided complete with all necessary components.
- F. The turbidimeter shall be equipped with an automatic cleaning system using air pressure (Q-Blast Auto-Clean). The turbidimeter shall be equipped with an integral compressor and all necessary components to operate the automatic cleaning system.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All equipment shall be mounted and installed as per manufacturer recommendations. Coordinate final location with Engineer.

3.2 TESTING

- A. After installation of the equipment is complete, operating tests shall be carried out to assure that the equipment operates properly. All piping shall be tested hydrostatically and for leaks. If any deficiencies are revealed during any tests, such deficiencies shall be corrected, and the tests shall be reconducted.

- END OF SECTION -

SECTION 22 10 10
PLUMBING PIPING AND SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The CONTRACTOR shall furnish and install plumbing piping and specialties, complete and operable, as indicated on the Drawings and in accordance with the Contract Documents.
- B. Plumbing piping and specialties includes piping, pipe hangers, sleeves, supports, brackets, valves, drains, cleanouts, hose bibs, yard hydrants, and related items.

1.2 RELATED WORK

- A. Related work specified in other Sections includes but is not limited to:

- 1. Section 01 33 00 Submittal Procedures
- 2. Section 05 45 00 Mechanical Metal Supports
- 3. Section 09 90 00 Painting and Finishes
- 4. Section 33 05 03 Copper Pipe
- 5. Section 33 05 26 Utility Identification
- 6. Section 33 12 00 Mechanical Appurtenances
- 7. Section 33 13 00 Pipeline Testing and Disinfection
- 8. Section 40 05 13.19 Stainless Steel Process Piping

1.3 MEASUREMENT AND PAYMENT

- A. Plumbing piping shall not be measured or paid as a separate item, but shall be included as part of the various items to which it relates.

1.4 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - 1. B31.1 Power Piping
- C. AMERICAN STANDARDS FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 74 Standard Specification for Cast Iron Soil Pipe and Fittings
 - 2. ASTM B 43 Standards for Seamless Red Brass Pipe
- D. CAST IRON SOIL PIPE INSTITUTE (CISPI)
 - 1. CISPI 301 Standard Specification for Hub-less Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- E. INTERNATIONAL MECHANICAL CODE (IMC)

F. INTERNATIONAL PLUMBING CODE (IPC)

G. FACTORY MUTUAL INSURANCE COMPANY (FM GLOBAL)

1. FM 1680 Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/Commercial and Residential

1.5 PIPING SYSTEM LAYOUTS

- A. Piping system drawings are diagrammatic and are intended to show approximate location of equipment and piping. Verify dimensions, whether in figures or scaled, in the field. CONTRACTOR is responsible for the installation of complete and workable systems whether completely detailed on the plans or not.
- B. Ascertain locations of apparatus, fixtures, equipment, and piping in the field, and layout work accordingly. ENGINEER reserves the right to make minor changes in location of piping and equipment up to the time of installation without additional cost to OWNER.

1.6 SUBMITTALS

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit general arrangement drawings of system components.
- C. Submit product catalog cut sheets and other manufacturer information.

1.7 REQUIREMENTS OF REGULATORY AGENCIES

- A. Install work per applicable provisions of codes, rules, regulations, statutes, and ordinances of authorities having jurisdiction.

PART 2 PRODUCTS

2.1 GENERAL

- A. Plumbing piping and specialties shall be as recommended by the manufacturer for the intended use.
- B. Any pipe, plumbing fitting or fixture, solder, or flux used in the installation or repair of any potable water system shall be “lead free” except where necessary for the repair of leaded joints of cast iron pipes.

2.2 PIPING AND FITTINGS

- A. Cast iron sanitary, storm, vent pipe and fittings shall be manufactured in accordance with ASTM A 74.
- B. Hub-less cast iron soil pipe and fittings with **Camp-All** type pipe couplings, or approved equal, shall be used for above ground sanitary, storm, and vent piping where approved for use by local authorities.

- C. Hub-less cast iron soil pipe and fittings shall meet CISPI Standard 301.
- D. Pipe couplings shall have high-torque capacity and shall meet FM Standard 1680.
- E. Copper tubing and fittings for potable water shall be in accordance with Section 33 05 03 – Copper Pipe.
- F. Brass piping shall match iron pipe size standards and meet ASTM B 43 Standards for Seamless Red Brass Pipe.
- G. Stainless Steel Pipe shall be Type 304 Stainless Steel, unless otherwise specified, and shall be in accordance with Section 40 05 13.19 – Stainless Steel Process Pipe.

2.3 PIPE HANGERS AND SUPPORTS

- A. Pipe hangers and supports shall meet the requirements of IMC Section 305 Pipe Support, Section 05 45 00 – Mechanical Metal Supports, and the following. If there is a discrepancy in the requirements of these documents the more stringent requirement shall apply.
- B. Properly support, suspend, or anchor all piping and fittings to prevent sagging, over stressing, or longitudinal movement of piping, and to prevent thrust or loads on or against other equipment.
- C. Support horizontal piping on adjustable split steel ring or clevis hangers. The following schedule shows minimum spacing.
 - 1. Steel, Brass and Copper:

a. 1-1/4" and smaller	6'-0" on center
b. 1-1/2" thru 3"	8'-0" on center
c. 4" and larger	12'-0" on center
 - 2. PVC, CPVC, AND ABS:

a. 1" and smaller	4'-0" on center
b. 1-1/4" thru 2"	5'-0" on center
c. 2-1/2" thru 4"	6'-0" on center
d. 5" and larger	8'-0" on center
- D. Support insulated piping with pipe saddles and hangers that fit on outside of insulation. Do not compress or damage pipe insulation with hangers or supports.
- E. Provide all rigid hangers with a means of vertical adjustment after erection.
- F. Use copper or copper plated hangers for supporting uninsulated copper pipe.
- G. All vertical and horizontal piping supports shall be fiberglass **EnduroStrut by Enduro Systems, Inc.**, or approved equal.
- H. Perforated strap hangers or wire supports will not be permitted.

2.4 INSERTS

- A. Furnish and set inserts in concrete forms; provide reinforcing rods for pipe sizes over 3 inches or equivalent.

- B. Furnish concrete inserts as follows: Black, malleable iron, universal type for threaded connections with lateral adjustment. Inserts shall be galvanized unless noted otherwise on the Drawings.

2.5 INSULATION

- A. Hot water piping, valves, fittings, and exposed horizontal sanitary, storm, and vent piping shall be provided with one-inch thick insulation.
- B. Covering valves, flanges, fittings, and ends of insulation with pre-molded high- and low-temperature PVC fitting cover, end cap, or similar pre-formed unit. The pre-formed unit covers shall be sized to receive the same thickness insulation as used in adjacent piping.
- C. Exposed supply and drain piping for lavatories shall be insulated under the wash basins in order to prevent burns and abrasions to handicapped persons. Removeable insulated covers shall be **Handy-Shield Type by Plumberex Specialty Products**, or approved equal.

2.6 SHIELDS

- A. Provide shields to protect insulation in all areas.
- B. Provide approved galvanized form shields to isolate pipe in contact with hangers and supports.
- C. Furnish low compressive insulation protector shields. Size the shields per the manufacturer's recommendations.

2.7 SLEEVES

- A. Where pipes pass through floors, footings, foundations, walls, or ceilings, furnish and install pipe sleeves. Sleeves for concealed piping shall be of Schedule 40 galvanized steel pipe one size larger than the pipe passing through. For exposed piping Schedule 40 black steel pipe installed so as to be completely covered by escutcheons. Extend sleeves through floors 1/2 inch above finish floor.

2.8 ESCUTCHEONS

- A. Fit pipe passing through walls, floors, or ceilings with escutcheons with set screws.
- B. Use prime painted escutcheons where surface is to receive a paint finish; otherwise, use escutcheons that are nickel or chromium plated.
- C. Where piping is insulated, use escutcheon outside the insulation.

2.9 JOINTS

- A. For screwed pipe make ends with sharp, clean tapered threads using Teflon tape on the male thread only. Do not use mill cut threads. Ream cut pipe to full inside diameter.
- B. Welding may be done by either the arc or acetylene process conforming to the requirements for the ASME B31.1.

- C. For solder joints use fittings specifically made for soldering. Clean all burrs and roughen pipe to clean; solder complete around joint.
- D. For grooved pipe jointing systems use mechanical pipe couplings and fittings.
- E. For no-hub cast iron soil pipe use double screw joint neoprene coupler.

2.10 UNIONS

- A. Furnish and install unions for each valve or piece of equipment to permit easy installation and removal of equipment.

2.11 VALVES

- A. Water shutoff valves shall be the gate or ball type as designated on the drawings, except on fixture supply piping where globe style valves shall be used.
- B. Hose Bibs shall be provided where indicated on the Drawings. The hose nipple shall be a female iron pipe thread inlet with hose thread outlet. Hose bibs shall be 3/4-inch size unless noted otherwise on the Drawings.
- C. Gate and ball valves shall be in accordance with Section 33 12 00 – Mechanical Appurtenances.

2.12 FLOOR DRAINS IN CONCRETE FLOORS

- A. Floor drains in concrete floors shall be constructed of cast iron of the size indicated on the Drawings and provided with sediment buckets.
- B. Each floor drain located on an upper floor shall have a clamping collar with 4 pound sheet lead flashing 12 inches minimum all around. Where flashing does not comply with local code use epoxy waterproofing membrane.
- C. Floor drains shall be **Z520-Y by Zurn Industries, 32100-AE-81 by Josam Company, Figure 2350 by Jay R Smith Mfg. Co.**, or approved equal.

2.13 FLOOR CLEANOUTS

- A. Cleanouts in concrete floors shall be heavy plugs with tapered shoulders against heavy brass plugs.
- B. Cleanout shall have a minimum diameter of 3-inches.
- C. Floor cleanouts shall be fabricated from cast iron with gas and watertight ABS tapered thread plug.
- D. Floor cleanout shall be **Z1400 by Zurn Industries, 55000 Series by Josam Company, 4237 Series by Jay R Smith Mfg. Co.**, or approved equal.

2.14 NON-FREEZE HYDRANTS

- A. Hydrants in exposed locations subject to freezing shall be the non-freeze type. Hydrant shall have a brass pipe outer casing, brass operating rod, and brass male hose nozzle. Hydrants shall be **Model Iowa Y1 by Woodford Manufacturing Co.**, or approved equal.

PART 3 EXECUTION

3.1 PREPARATION

- A. Prior to installation of piping, verify that it will not interfere with clearances required for the erection and finish of structural members, architectural members, electrical, sprinkler, or mechanical items.
- B. Hang or support piping materials from roof support system whenever possible.
- C. Do not cut any structural members for installation of piping.

3.2 INSERTS

- A. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
- B. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 3 inches in diameter.
- C. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
- D. Where inserts are omitted, drill through concrete slab from below and provide rod with recessed squared steel plate and nut above slab.

3.3 SLEEVES

- A. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
- B. Extend sleeves through potentially wet floors 1 inch above finished floor level. Caulk sleeves full depth and provide floor plate.
- C. Where piping passes through floor, ceiling, or wall, close-off space between pipe and construction with noncombustible insulation. Provide tight-fitting metal caps on both sides and caulk.

3.4 PIPE HANGERS AND SUPPORTS

- A. Support all piping and make adequate provisions for expansion, contraction, slope and anchorage.
- B. The use of pipe hooks, chains, or perforated metal for pipe support will not be permitted.
- C. Suspend all piping in the building as indicated.

- D. Install hangers to provide minimum 1/2-inch clear space between finished covering and adjacent work.
- E. Place a hanger within 1 foot of each horizontal elbow.
- F. Use hangers which are vertically adjustable 1-1/2 inch minimum after piping is erected.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Where practical, support riser piping independently of connected horizontal piping.

3.5 PIPING INSTALLATION

- A. Cut piping accurately for fabrication to measurements established at the construction site and work into place without springing or forcing.
- B. Remove burrs and cutting slag from pipe by reaming or other approved cleaning methods.
- C. Make changes in direction with proper fittings.
- D. Arrange piping so as not to interfere with the removal of other equipment, ducts, or devices. Do not block doors, windows, or access openings. Provide unions in the piping at connections to all equipment. Unions must be accessible.
- E. Cap or plug open ends of pipes and equipment with PVC caps or expanding neoprene plugs to keep dirt and other foreign materials out of the system. Plugs of rags, wool, cotton, waste, or similar materials are not acceptable.
- F. Install all piping systems so they can easily be drained. Provide anti-siphon hose bibbs at low points on water lines.
- G. Slope all soil and waste lines within the building at 1/4 inch per foot fall in the direction of flow unless indicated otherwise.

3.6 PRIMING AND COATING

- A. Prime coat exposed steel hangers and supports and hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces in accordance with Section 09 90 00 – Painting and Finishes.

3.7 PIPE LABELING

- A. Exposed pipe shall be labeled in accordance with Utah State Regulation R309-525-8, Section 33 05 26 – Utility Identification, and the IPC.
 - 1. Labeling shall include direction arrows for flow.

3.8 DISINFECTION AND TESTING

- A. The CONTRACTOR shall perform such tests as are required by local ordinances and codes in the presence of the local governing authority inspector to show that piping is tight, leak free, and otherwise satisfactory, and shall perform such tests as the ENGINEER may direct to ensure that fixtures and equipment operate properly.
- B. Disinfect potable water piping in accordance with Section 33 13 00 - Pipeline Testing and Disinfection.
- C. Test all potable water piping.
- D. Repair defects which develop under tests promptly and repeat tests. No caulking or screwed joints, cracks, or holes will be permitted. Replace pipe or fitting or both with new material when repairing leaks in screwed joints.
- E. Repair leaks in copper tubing by melting out joint, thoroughly cleaning both tubing and fitting, and resoldering.

- END OF SECTION -

SECTION 22 45 00
EMERGENCY PLUMBING FIXTURES

PART 1 GENERAL

1.1 SUMMARY

- A. CONTRACTOR shall furnish and install combination emergency shower and eyewash equipment with all valves, water-tempering equipment, and appurtenances, complete and operable in accordance with the Specifications.

1.2 RELATED WORK

- A. Related work specified in other sections:
 - 1. Section 01 33 00 Submittals

1.3 REFERENCES

- A. The latest edition of the following publications form a part of these specifications to the extent referenced. The publications are referred to in the text to by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - 1. Z 358.1 American National Standard for Emergency Eyewash and Shower Equipment

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittals.
- B. Submit catalog cut sheets including power, signal and control wiring diagrams.

PART 2 PRODUCTS

2.1 COMBINATION EMERGENCY EYEWASH AND SHOWER

- A. Standard, plumbed emergency eyewash and shower combination unit conforming to ANSI Z 358.1, self-draining, with separate supply and waster piping. Provide factory-assembled and tested units with standard compliant identification sign and inspection tag.
 - 1. Eyewash: 5.1 gpm flow rate, impact resistant ABS plastic sprayhead.
 - 2. Showerhead: 22 gpm flow rate, Type 304 stainless steel head with yellow impact-resistant plastic shroud.
 - 3. Ball Valves: Shower valve and eyewash valve Type 316 stainless steel stay-open valve.
 - 4. Valve Operation: Hand-activated push handle Type 316 stainless steel and Type 316 stainless steel foot pedal.
 - 5. Pipe and Fittings: Type 304 stainless steel

6. Bowl: Type 304 stainless steel with integral strainer.
 7. Dust Cover: Eyewash cover, yellow transparent plastic.
 8. Water-Tempering Equipment: Thermostatic mixing valve assembly
 9. Scald Protection Equipment: Anti-scald valve
 10. Flow Alarm Switch: Class I, Division II Groups B, C, and D explosion proof, 120 VAC, 0.5A
- B. Manufacturer or approved equal: **Bradley Pedestal-Mount Halo Eyewash S19314 Series.**

PART 3 EXECUTION

3.1 INSTALLATION

- A. Assemble fixtures and associated fittings and trim in accordance with manufacturer's instructions.
- B. Install fixtures level, plumb, and firmly in place in accordance with manufacturer's rough-in drawings.
- C. Install water supply piping and provide stop on each supply in readily-serviced location. Fasten supply piping to supports or substrate.
- D. Seal joints between fixtures and walls and floors with milder-resistant silicone sealant.

3.2 CLEANING AND PROTECTION

- A. Repair or replace defective work, including damaged fixtures and components.
- B. Clean unit surfaces, text fixtures, and leave in ready-to-use condition.

3.3 TESTING AND ADJUSTING

- A. Set field-adjustable temperature set points of temperature-actuated water mixing valves. Adjust set point within allowable temperature range.
- B. Test and adjust installation.
- C. Remove and replace malfunctioning thermostatic mixing valves and retest.

- END OF SECTION -

SECTION 26 05 00
ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

- A. It is the intent of this part of the Contract Documents to cover all work and materials necessary for erecting complete, ready for continuous use, a tested and working electrical system, substantially as indicated on the Plans and as hereinafter specified.

1.2 GENERAL PROVISIONS

- A. Minimum sizes of equipment, electric devices, etc., are indicated but it is not intended to show every offset and fitting, nor every structural or mechanical difficulty that will be encountered during the installation of the work.
- B. All work indicated on the Plans is approximately to scale, but actual dimensions and detailed drawings should be followed as closely as field conditions permit. Field verification of scale dimensions on Plans is directed since actual locations, distances, levels, etc. will be governed by field conditions.
- C. Discrepancies indicated on different Plans, between Plans and actual field conditions, or between Plans and Contract Documents shall be promptly brought to the attention of ENGINEER for a decision.
- D. The alignment of equipment and conduit shall be varied due to architectural changes, or to avoid work of other trades, without extra expense to OWNER.
- E. CONTRACTOR shall furnish and install all parts and pieces necessary to the installation of equipment in accordance with the best practice of the trade and in conformance with the requirements of these Contract Documents.
- F. All items not specifically mentioned in these Contract Documents or noted on the Plans or accepted shop drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.
- G. CONTRACTOR shall lay out and install electrical work prior to placing floors and walls. He shall furnish and install all sleeves and openings through floors and walls required for passage of all conduits. Sleeves shall be rigidly supported and suitably packed or sealed to prevent ingress of wet concrete.
- H. CONTRACTOR shall furnish and install all inserts and hangers required to support conduits and other electrical equipment. If the inserts, hangers, sleeves, etc. are improperly placed or installed, CONTRACTOR shall do all necessary work, at his own expense, to rectify the errors.
- I. All electrical equipment shall be capable of operating successfully at full-rated

load, without failure, at an ambient air temperature of 40 degrees C, and specifically rated for an altitude of 4500 feet.

- J. CONTRACTOR shall submit shop drawings, data and details to ENGINEER on all controls, fixtures, wiring, electrical equipment, conduit, etc. for review and acceptance prior to use of any components in the work.
- K. All materials, equipment, and parts comprising any unit or part thereof specified or indicated on the Plans shall be new and unused, of current manufacture, and of highest grade consistent to the state of the art. Damaged materials, equipment and parts are not considered to be new and unused and will not be accepted.

1.3 REGULATIONS AND CODES

- A. Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations of each of the following as well as all State and local codes.
 - 1. NATIONAL ELECTRICAL CODE (NEC)
 - 2. NATIONAL ELECTRICAL SAFETY CODE (NESC)
 - 3. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)
 - 4. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - 5. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 6. INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
 - 7. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
 - 8. NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)
 - 9. FEDERAL OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)
 - 10. UNDERWRITERS' LABORATORIES, INC. (UL).

1.4 COORDINATION OF THE ELECTRICAL SYSTEM

- A. CONTRACTOR shall verify all actual equipment and motor full-load and locked-rotor current ratings. The necessary minimum equipment, wire, and conduit sizes are indicated on the Plans. If CONTRACTOR furnishes equipment of different ratings, CONTRACTOR shall coordinate the actual current rating of equipment furnished with the branch circuit conductor size, the overcurrent protection, the controller size, the motor starter, and the branch circuit overcurrent protection. The branch circuit conductors shall have a carrying capacity of not less than 125 percent of the actual full-load current rating. The size of the branch circuit conductors shall be such that the voltage drop from the overcurrent protection devices up to the equipment shall not be greater than 2 percent when the equipment is running at full-load and rated voltage.

1.5 TEST

- A. The electrical work shall be free from improper grounds and from short circuits. The correctness of the wiring shall be verified first by visual comparison of the

conductor connections with connection diagrams. Individual circuit continuity checks shall next be made by using electrical circuit testers. Last, the correctness of the wiring shall be verified by the actual electrical operation of the electrical and mechanical devices. Any deviation from the wiring indicated on the Plans or accepted drawings shall be corrected and indicated on the Plans.

1.6 CONFORMS TO RECORD DOCUMENTS DRAWINGS

- A. Prior to completion of the Contract, CONTRACTOR shall furnish ENGINEER with a set of electrical plans marked with any changes, deviations or additions to any part of the electrical work.
- B. Each conductor shall be identified as required by the Contract Documents. This identification shall be indicated on the record documents drawings to enable rapid and accurate circuit tracing by maintenance personnel.

1.7 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00, CONTRACTOR SUBMITTALS.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Where indicated on the Plans and where required by applicable codes, CONTRACTOR shall furnish and install nameplates which shall be black lamicaid with white letters. The nameplates shall be fastened to the various devices with round head brass screws. Each disconnect means for service, feeder, branch, or equipment conductors shall have nameplates indicating its purpose. All nameplates shall have 3/8-inch high lettering.

2.2 AUTOMATIC EQUIPMENT WARNING SIGNS

- A. Permanent warning signs shall be mounted at all mechanical equipment which may be started automatically or from remote locations. Signs shall be in accordance with OSHA regulations and shall be suitable for exterior use. The warning signs shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to ENGINEER.
- B. Warning signs shall be 7 inches high by 10 inches wide, colored yellow and black, on not less than 18 gauge vitreous enameling stock. Sign shall read:

CAUTION
THIS EQUIPMENT STARTS
AUTOMATICALLY
BY REMOTE CONTROL

PART 3 EXECUTION - Not Used

- END OF SECTION -

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SECTION 26 05 05
ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section includes general electrical equipment used to complete the electrical system.

1.2 RELATED SECTIONS

- A. Related work specified in other sections includes but is not limited to:
1. Section 01 33 00 - Contractor Submittals
 2. Section 01 60 00 - Product Requirements
 3. Section 26 05 00 - Electrical General Requirements
 4. Section 26 05 13 - Conductors and Cables
 5. Section 26 05 33 - Conduit and Raceways
 6. Section 26 05 34 - Electrical Boxes and Fittings

1.3 SUBMITTALS

- A. Submittals will be required for all electrical equipment and shall be made in accordance with Section 01 33 00, Contractor Submittals.

PART 2 MATERIALS

2.1 LIGHTING SWITCHES

- A. Manufacturers:
1. Hubbell 1221I
 2. P&S 20AC1-I
 3. Or approved equal
- B. Specification Grade: Snap switches shall have the number of poles as indicated on the drawings, ivory, rated at 20 ampere.
- C. Device Cover Plates:
1. Indoor Industrial Areas: Stainless steel cover plates shall be utilized.
 2. Outdoor: Weatherproof cover plates.

2.2 RECEPTACLES

- A. Manufacturers:
1. Hubbell No. 5352I

2. P&S No. 5362-I
 3. Leviton No. 8300-I
 4. Or approved equal
 5. Specification Grade: Outlets shall be duplex ivory receptacles and shall be 2-pole, 3-wire grounded, 125 volts, industrial, rated at 20 amperes.
- B. Special receptacles, covers, etc. shall be as specified herein or as indicated on the Plans.
- C. Device Cover Plates:
1. Indoor Industrial Areas: Stainless steel cover plates shall be utilized.
 2. Outdoor: Weatherproof cover plates which also protect outlet when in use.
- D. Ground Fault Interrupter Receptacles (GFI): GFI outlets shall be duplex ivory GFI receptacles, 2-pole, 3-wire grounded, 125 volts AC, rated at 20 amperes.
1. Manufacturers:
 - a. Hubbell No. GF5262I
 - b. General Electric
 - c. P&S 2091-I
 - d. Leviton 5362-IGI
 - e. Or approved equal.

2.3 TRANSFORMERS - DRY TYPE

- A. Manufacturers:
1. Acme Electric Corp.
 2. Federal Pacific Transformer Corp.
 3. Hevi-Duty Electric
 4. General Electric Co.
 5. Square D Co.
 6. Or approved equal.
- B. Transformers shall be of the premium high efficiency quiet type and shall be installed where indicated on the Plans. The primary winding of the transformers shall have two 2-1/2 percent taps above and below normal.
- C. The transformers shall have a BIL of 10 kV with a temperature class of 185 degrees C for transformers up to 25 kVA and a temperature class of 220 degrees C for transformers rated at 30 kVA and larger.
- D. The sound level shall not exceed 44 dBA measured at 5 feet from the transformers after installation. Core and coil assemblies 30 kVA and larger shall be mounted on rubber vibration isolators designed specifically to reduce 120 HZ sound and multiple harmonics.

2.4 ENCLOSURES

- A. Manufacturers:
 - 1. Hammond Manufacturing, Inc.
 - 2. Nvent Hoffman
 - 3. Rittal Systems, Ltd.
 - 4. Saginaw Control and Engineering.
 - 5. Or approved equal.
- B. This specification includes enclosures to house electrical controls, instruments, terminal blocks, etc. If not indicated otherwise they shall be NEMA 12 for indoor and NEMA 3R for outdoor installations.
- C. A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket.
- D. Enclosures shall be from 14 gauge steel with seams that are continuously welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin. They shall be as manufactured by Hoffman, Fischer & Porter, or equal.
- E. Finish - Steel: Finish shall be white enamel interior, light grey enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Plans should be checked for special conditions.

2.5 DISCONNECT SWITCHES (INDIVIDUAL)

- A. Manufacturers:
 - 1. Cutler-Hammer Co.
 - 2. General Electric Co.
 - 3. Siemens
 - 4. Square D Co.
 - 5. Or approved equal.
- B. Disconnect switches shall be heavy-duty safety switches with a quick-make, quick-break operating mechanism, full cover interlock and indicator handle. The disconnect switches shall be furnished with fuses of the size indicated on the Plans. One set of spare fuses shall be furnished for each fused disconnect switch.

2.6 CIRCUIT BREAKERS - LOW VOLTAGE (INDIVIDUAL)

- A. Manufacturers:
 - 1. Cutler-Hammer

2. General Electric
3. Siemens
4. Square D Company
5. Or approved equal

B. All circuit breaker frame and trip ratings shall be as indicated on the Plans, except that they shall be coordinated with the ratings of the equipment actually furnished and shall be modified where necessary to suit this equipment. Circuit breakers to be used in motor control centers shall be as indicated on the Plans. When no indication of type is given on the Plans, the following shall govern:

1. Circuit breakers protecting motors rated 7.5 horsepower or less shall be motor circuit protectors, all other circuit breakers shall be molded case circuit breakers.

2.7 FULL-VOLTAGE, NON-REVERSING MOTOR CONTROLLERS

A. GENERAL

1. Provide each motor with a suitable controller and devices that will function as specified for the respective motors and meeting NEMA ICS 2, the NEC, and UL.
2. Provide each motor controller with thermal overload protection in all ungrounded phases. Use protection consisting of thermal overload relays meeting NEMA ICS 2 which are sensitive to motor current and mounted within the motor controller, or a combination of thermal protectors embedded within the motor windings and controller-mounted overload relays, as indicated. Use overload protection devices of the inverse-time-limit type.
3. Provide controller-mounted overload relays of the manual-reset type with externally operated reset button when used without motor thermal protectors; when used in conjunction with thermal protectors, provide the automatic reset type. Select and install overload relay heaters after the actual nameplate full-load current rating of the motor has been determined.
4. Install and connect any required thermal protector monitoring relay provided by motor manufacturer in motor-control circuit and provide manual reset function. Fuse thermal-protector circuits according to the manufacturer's recommendations.
5. The Booster Pump controller shall be provided with two sets of thermal overload devices, rated for the full load current of the existing motors. The controller shall have a selection switch on the front selecting which thermal overload will be in service.

B. FULL VOLTAGE MAGNETIC STARTERS

1. Provide starters meeting NEMA ICA 2, Class A, with the rating and enclosure shown.
2. Supply individual control power transformers where indicated. The

transformers shall have sufficient capacity to serve the connected load and limit voltage regulation to 10-percent during contact or pickup. Fuse one side of the secondary winding and ground the other side. Provide primary, current limiting fuses on all control power transformers.

3. Provide a panel type voltmeter, nominal 4-1/2 inch model with 3-phase, OFF four position selector switch.
4. Provide a panel type ammeter, nominal 4-1/2 inch model with 3-phase, OFF four position selector switch, C.T.'s with proper ratio.
5. For nonhazardous, indoor, dry locations, provide heavy-duty, indicating lights, selector switches, and stations. Utilize General Electric Type CR 104P, or equivalent by Square D, Cutler-Hammer, or other acceptable manufacturer. Acceptable manufacturer. The use of other manufacturer's names referenced to materials herein, shall indicate the quality of material to be provided.

2.8 FUSES, 0-600 VOLTS

- A. Provide a complete set of current-limiting fuses wherever fuses are indicated. Supply a set of six spare fuses of each type and each current rating installed. Utilize fuses that fit mountings specified with switches and which provide features rejecting Class H fuses. Provide the following types:
 1. For 0- to 600-volt motor and transformer circuits, 0- to 600 amps, UL Class RK-1 with time delay, Bussmann Type LPS-RK, Shawmut Type A6D, or equal.
 2. For 0- to 250-volt motor and transformer circuits, 0- to 600 amps, UL Class RK-1 with time delay, Bussmann Type LPN-RK, Shawmut Type A2D-R, or equal.
 3. For 0- to 600-volt feeder and service circuits, 0 to 600 amps, UL Class RK-1, Bussmann Type KTS-R Shawmut Type A6K-R, or equal.
 4. For 0- to 250-volt feeder and service circuits, 0 to 600 amps, UL Class RK-1, Bussmann Type KTN-R, Shawmut Type A2K-R, or equal.

2.9 MODULAR OVERLOAD RELAYS

- A. Where called for on the Plans, modular overload relays shall be provided with the motor starters. The modular overload relays shall be 3-pole solid state devices set by one plug-in heater and shall protect all 3 phase of the motor in ambient temperatures ranging from -20 degrees to +70 degrees C.
- B. The jam modules shall plug in the modular overload relays and shall provide for instantaneous trip of the overload relay should the current exceed a preset value at any time after the motor has accelerated. The modules shall be adjustable to any value between the 150 percent and 400 percent of the motor full-load current.
- C. The underload modules shall plug in the MOR and shall provide for overload relay trip whenever the current falls below a set value after the motor has accelerated. The modules shall be adjustable between 50 percent and 90 percent of the full load value of the motor full load current.

2.10 LIGHTING

- A. Lighting fixtures shall be as described below and as indicated on the Plans.
- B. Fixtures shall include lamps, ballasts, poles, mounting hardware, etc. to provide complete operating units.
- C. Fluorescent fixtures shall be rapid start type.
- D. Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens shall be submitted to the ENGINEER for review and acceptance for all fixtures before fixtures are manufactured. Substitutions will be permitted only if acceptable to the ENGINEER.
- E. Light Emitting Diode(LED) Lighting
 - 1. The LED Fixture shall consist of a LED Luminaire Assembly, LED Driver and mounting hardware.
 - 2. LED Fixture requirements are as described below:
 - a. The input to the LED Lighting Fixture shall be 120 to 277VAC ($\pm 10\%$), 60HZ or as indicated in the Contract Document.
 - b. Correlated Color Temperature (CCT) shall be minimum 4000K or as indicated in the Contract Document.
 - c. Color Rendering Index (CRI) shall be 70.
 - d. A minimum of 50,000 operating hours before reaching the L70 lumen output degradations point without catastrophic failure, or as indicated in the Contract Document.
 - e. Conform with UL 8750.
 - f. Compliance to FCC CFR Section 15.
 - 3. LED Luminaire Assembly
 - a. Definition: Luminaire Assembly is the LED assembly without LED driver.
 - b. Input voltage shall be 24VDC, 36VDC or as indicated in the Contract Document.
 - c. CCT, CRI, Minimum life and UL conformity requirements are as defined in above article LED Lighting Fixture.
 - 4. LED Driver
 - a. Must operate input voltage between 120VAC to 277VAC ($\pm 10\%$).
 - b. Operating frequency must be 60Hz.
 - c. Must be rated to operate between -40°C to $+50^{\circ}\text{C}$.
 - d. Must have a minimum efficiency of 85%.
 - e. Self protected including short circuit protection.
 - f. Compliance to FCC CFR Section 15.
 - g. Driver must have a Power Factor (PF) of 0.90.
- F. Types and ratings: As shown on "Lighting Fixture Schedule" on Drawings.

2.11 LIGHTING AND POWER DISTRIBUTION PANELBOARDS

- A. Circuit Breaker Lighting Panelboards, 240 Volt Maximum
1. Manufacturers:
 - a. Cutler-Hammer Co.
 - b. General Electric Co.
 - c. Siemens
 - d. Square D Company, NQ
 - e. Or approved equal.
- B. Circuit Breaker Lighting Panelboards, 480Y/277 Volt Maximum
1. Manufacturers:
 - a. Cutler-Hammer Co.
 - b. General Electric Co.
 - c. Siemens
 - d. Square D Company, NF
 - e. Or approved equal.
- C. General: Provide circuit breaker panelboards meeting standards established by UL, NEMA PB 1, and the NEC. Where used as service entrance equipment, provide panels UL labeled for that use. Furnish panels with fully rated short circuit current equipment rating. Series connected equipment ratings are not acceptable. Provide panels rated for connection to an electric system having an available amperes rms symmetrical short current as shown on the drawings. Provide panelboards and circuit breakers suitable for use with 75 degrees C wire at full NEC 75 degrees C ampacity.
- D. Cabinets: Furnish boxes large enough to provide a minimum wiring gutter space on both sides and top and bottom of 4-inches by 4-inches minimum. Provide flush or surface mounted boxes as indicated manufactured with reinforced steel frame and code-gauge, hot-dip galvanized sheet steel. Utilize front trim the same size as the box for surface mounted panelboards and 3/4-inch larger all around than the box for flush mounted panelboards. Provide sheet steel fronts finished with prime coat of rust inhibitor and the manufacturer's standard baked enamel or lacquer finish and utilizing adjustable clamps as the means for fastening the front to the boxes. Utilize fronts having doors with concealed hinges and flush type lock and catch device. Provide multipoint locking devices for all doors over 30 inches in height. Key all locks alike, and furnish two milled type keys with each lock. Furnish on door interior a metal directory frame with transparent plastic face and enclosed directory card. Furnish an engraved, laminate plastic nameplate screwed (no adhesives) to the cabinet exterior face indicating the panelboard designation, service voltage, and phases. Nameplates are described in this section.
- E. Interiors:
1. Utilize panelboard interiors that are factory assembled complete with circuit breakers as indicated. Furnish circuit breakers in positions where diagram or schedule indicates SPARE. Furnish only complete provisions

for future circuit breakers where diagram indicates SPACE, and cover the resulting opening in the cabinet front with an easily removable metal cover. Utilize panelboards with interiors designed so that circuit breakers can be replaced without removing the main bus.

2. Provide bus bars of copper and full sized throughout their length. Make complete provisions for mounting future circuit breakers throughout the full length of the bus provided regardless of the number of units and spaces called for. Provide all machining, drilling, or tapping required to add or change circuit breakers in the future. Bolt together and rigidly support bus bars and connection straps on molded insulators.
3. Furnish an insulated neutral bus bar rated the same as the phase bus bars and having at least one terminal screw for each branch circuit. Furnish a copper ground bus bar installed on the panelboard frame, bonded to the box, and containing at least one terminal screw for each circuit. Provide solderless main lugs for main, neutral, and ground bus bars. Provide lugs and connection point on phase, neutral, and ground busses suitable for either copper or aluminum conductors.

F. CIRCUIT BREAKERS

1. Furnish indicating type molded circuit breakers providing ON/OFF and TRIPPED positions of the operating handle. Furnish thermal magnetic, quick-make, quick-break circuit breakers which are noninterchangeable in accordance with the NEC. Do not use tandem or dual circuit breakers in normal single-pole spaces. Do not use single-pole circuit breakers with handle ties where multiple circuit breakers are indicated. Utilize multipole circuit breakers designed so that on overload on one pole automatically causes all poles to open. Provide circuit breakers meeting requirements of NEMA AB 1. Install bolt-on circuit breakers in all panelboards.

2.12 CONTROL PANELS

A. ENCLOSURES

1. Manufacturers:
 - a. Hammond Manufacturing
 - b. Hoffman
 - c. Rittal
 - d. Or approved equal.
2. This specification includes enclosures to house electrical controls, instruments, terminal blocks, etc. If not indicated otherwise they shall be NEMA 12 for indoor and NEMA 3R for outdoor installations.
3. A rolled lip shall be provided around three sides of the door and around all sides of the enclosure opening. The gasket shall be attached with oil-resistant adhesive and held in place with steel retaining strips. Exterior hardware, such as clamps, screws, and hinge pins, shall be of stainless steel for outdoor installations. A hasp and staple shall be provided for padlocking. Each enclosure shall have a print pocket.
4. Enclosures shall be from 14 gauge steel with seams that are continuously

welded. Doors shall have full length piano hinges with the door removable by pulling the hinge pin. They shall be as manufactured by Hoffman, Fischer & Porter, or equal.

5. Finish - Steel: Finish shall be white enamel interior, light grey enamel, ANSI 61 exterior, over phosphatized surfaces. Special finishes and colors shall be furnished for wet locations. Plans should be checked for special conditions.

B. CP-1:

1. CP-1 will be built and supplied by APCO, the City's SCADA contractor. This will include the PLC, PLC programming and the HMI programming.

C. RTU:

1. The RTU will be supplied by APCO and installed by the Contractor. All components will be included in APCO's scope.

D. PILOT DEVICES:

1. Manufacturers:
 - a. Allen-Bradley, Bulletin 800T, 30 mm
 - b. Cutler-Hammer
 - c. Square D, Type K, 30 mm - Class 9001
 - d. Or equal.
2. Indicating lights, pushbuttons and selector switches shall be miniature oiltight units. Contact blocks in control circuits shall be NEMA ICS, B150, rated 5 amperes inductive at 120 volts AC. Contact blocks for signal circuits shall be rated 0.06 amperes at 30 volts AC or DC and shall be hermetically sealed and reed switches. Pilot lights for 120 volt AC circuits shall be LED type. Where group lamp test circuits are not specified, individual pilot light assemblies shall be "push-to-test" type. Pilot lights shall be capable of being changed from the front of the panel without special tools.

E. TERMINAL BLOCKS:

1. Manufacturers:
 - a. Entrelec (ABB) M4/6
 - b. Square D Co.,
 - c. Buchanan,
 - d. Allen-Bradley,
 - e. Or equal
2. Terminal blocks shall be of the size required for conductors therein and a minimum of 50 percent spares shall be provided in each terminal box.

F. FUSE BLOCKS:

1. Manufacturers:
 - a. Entrelec (ABB), M10/13.SF2

- b. Or approved equal.
2. DIN rail mounted.
3. Terminals shall accommodate 22-10 AWG solid or stranded wires.
4. Provide terminals rated for 600 VAC/VDC and 15 amperes.
5. Device shall be UL listed.

G. CONTROL RELAYS:

1. Manufacturer:
 - a. Idec RH series.
 - b. Allen-Bradley
 - c. Or equal.
2. Control relays shall be general purpose "midget" relays, 10 ampere contact rating, with 1, 2, 3 or 4 Form C contacts as shown on the drawings.
3. Relay shall be provided with blade style terminals.
4. Provide LED indicator light with relay.
5. Provide a standard DIN rail mount relay socket.
6. Relay life expectancy shall be in excess of 500,000 operations at 120 VAC.
7. Device shall be UL listed.

2.13 INSTRUMENTATION

A. PRESSURE TRANSMITTER

1. Manufacturer/Model:
 - a. Endress-Hauser cerebar T PMC 131
 - b. Or approved equal
2. Electronic pressure measurement device tailored to the installation as shown on the drawings and suitable for the planned application shall be installed. The transducer shall include a integral ceramic diaphragm such that a change in pressure is measured by a change in capacitance. The pressure transmitter shall operate on 24 VDC.
3. The unit shall measure system pressure and have a 4-20 mA DC signal output.
4. Process connection: 304 SS, 1/2-inch MNPT with 1/4" FNPT or PT 1/2" male thread.
5. Range:
 - a. PT-1: 0-150 PSIG (System pressure)
 - b. PT-2: 0-150 PSIG (Well Discharge Pressure)

B. WELL LEVEL MEASUREMENT SYSTEM:

1. Manufacturer:
 - a. Druck Series PTX 1830
 - b. Approved equal.
2. Well level measurement shall consist of a downwell submersible level sensor with transmitter.
3. Level sensor shall be enclosed in a 0.68-inch diameter titanium bodytube

welded to the sensor to provide high stability and integrity for the sensing elements and to encapsulate the electronics.

4. A cable shall be molded directly to the sensor to give NEMA 6 rating for permanent immersion. Cable shall consist of electrical conductors, vent tube, and Kelvar strain relieving cord within a thick walled polyurethane sheath. Cable length shall be as shown on the drawings.
5. Sensor shall provide a 4-20 mA output proportional to displayed value.
6. Cable from sensor shall terminate in a sensor termination enclosure with desiccant.
7. Application:
 - a. LT-1: 0-150 psi, with sufficient cable to reach from transducer to control panel.

2.14 PROCESS SWITCHES

A. LEVEL SWITCH - FLOAT

1. Manufacturer/Model:
 - a. IMO Industries, Inc. Gems Sensors Division, 1702.
 - b. Or approved equal.
2. Stem: 316 Stainless steel
3. Float: Buna N
4. Operating Temperature:
 - a. Water: to 180-degrees F.
5. Minimum Liquid Specific Gravity: .65
6. Pressure (MAX): 150 PSI
7. Switch Rating: 20 VA
8. Electrical Termination: No. 22 AWG, 24-inches long, Polymeric Lead Wires.
9. Selectable Normally Open (NO) or Normally Closed (NC) by inverting float on unit stem.

B. PRESSURE SWITCH

1. Manufacturer:
 - a. Mercoid: Model DA-31-3-7
 - b. Approved equal.
2. Brass bourdon tube material
3. Pressure: 5-150 psig
4. Minimum Deadband (psig): 6.
5. Switch: SPDT, closes on increase pressure, 10A120 VAC, Adjustable Deadband.
6. Application:
 - a. PSH-1: Well Pump High Discharge Pressure.

2.15 MISCELLANEOUS

A. HATCH POSITION SWITCH

1. Manufacturer:

- a. Square D Company
- b. Or approved equal.
2. Heavy duty turret head lever arm type switch. Provide a offset type lever arm with sufficient length to contact hatch lid.
3. Rated NEMA 6P
4. Rated: 120 VAC, 6 amps.
5. Application:
 - a. Well Roof Hatch

B. MAGNETIC DOOR SWITCH (MAN-DOOR)

1. Manufacturer
 - a. General Electric 2505A
 - b. Substitutions: Refer to Section 01 60 00 - Product Requirements
2. Provide a gray Normally Open (NO) magnetic door switch, where the switch closes when the magnet engages. Provide appropriate hardware to install on door.

C. TEMPERATURE TRANSMITTER

1. Manufacturer/Model:
 - a. Pribusin, Inc/TWTS-5
 - b. Or approved equal
2. Loop powered two-wire temperature sensor/transmitter that mounts on a single-gang outlet box. Provide 4-20 mA DC output.
3. Range: 0 to +150 deg F., Accuracy: +/- 1 Deg, C or +/- 2 Deg F.

D. MOTION SENSOR (FUTURE)

1. Manufacturer:
 - a. RAB, SMS500
 - b. Or approved equal.
2. Description: Motion sensor with built-in LED indicator, UL listed for wet locations, 120 VAC, 60 Hz, time, ambient light & sensitivity adjustability. Rated for 5 amps, and switching up to 240 watts.
3. Color: Bronze.
4. Application:
 - a. Building (6 ea) and Generator Sound wall (1 ea) locations.

PART 3 INSTALLATION

- A. Installation shall be as per manufacturers specifications.

- END OF SECTION -

SECTION 26 05 13
CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of wires or cables required for power distribution, service, feeders, and branch circuits.
- B. Related work includes but is not limited to,
 - 1. Section 26 05 33 - Raceway
 - 2. Section 26 05 34 - Electrical Boxes and Fittings
 - 3. Section 31 23 16 - Excavation and Backfill for Buried Pipelines.

1.2 REFERENCES

- A. NFPA 70: National Electrical Code.
- B. UL: Underwriters' Laboratories, Inc.

1.3 SUBMITTALS

- A. Field Test Data: Submit megohmmeter test data for circuits under 600 volts.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Building Conductors: Copper, 600 Volt insulation, THW.
- B. Branch Circuit Conductors and All Conductors #3 AWG and Smaller: Copper conductor, with TW, THHN, or THWN insulation #10 AWG and smaller, and THW larger than #10 AWG, where ambient temperature conditions exceed 140 deg. F.
 - 1. Size all conductors per NFPA 70.
 - 2. Minimum size to be #12 AWG.
 - 3. Stranded conductors for #8 AWG and larger.
 - 4. For outlets to fixtures, and in fixture channels (in dry areas); THHN insulated conductor.
 - 5. In damp locations, under slabs, on exterior provide THWN.
- C. Fire Alarm System Conductors: Cross-linked thermosettingpolyethylene (RW90 X-link) type insulating.
- D. Provide permanent plastic name-tag indicating load feed.
- E. Use type XHHW conductors for water pumping and regulator stations.

- F. Cable Supports: OZ cable supports for vertical risers, type as required by application.

2.2 INSTRUMENTATION

- A. Instrumentation cable shall have the number of twisted pairs indicated on the Plans and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be No. 18 AWG minimum.
- B. The jacket shall be flame retardant Flamenal or Okoseal, 90 degrees C temperature rating. The cable shield shall be minimum of 2.3 mil aluminum or copper tape overlapped to provide 100 percent coverage and a tinned copper drain wire.
- C. The conductors shall be bare soft annealed copper, Class B, 7 strand minimum concentric lay with Okoseal or Vulkene, 15 mils nominal thickness, nylon jacket, 4 mil nominal thickness, 90 degrees C temperature rating. One conductor within each pair shall be numerically identified.

2.3 COLOR AND CODING OF CONDUCTORS

- A. 120/240 volt.
 - 1. A-Phase - Black
 - 2. B-Phase - Red
 - 3. Neutral - White
 - 4. Ground - Green
- B. 480Y/277 volt.
 - 1. A-Phase - Brown
 - 2. B-Phase - Orange
 - 3. C- Phase - Yellow
 - 4. Neutral - White
 - 5. Ground - Green

2.4 MODBUS RS485 CABLE

- A. Manufacturers/Model
 - 1. Belden 9841
 - 2. Or approved equal
- B. Provide low-capacitance computer cable for EIA RS-485 signal transmission. Cable shall be AWG#24 stranded (7x32), with polyethylene insulation, twisted-pairs with overall shield (100% coverage) and #24 AWG drain wire.

2.5 VFD CONDUCTORS

- A. Manufacturers:
 - 1. Belden 29534 (350 KCMIL)
 - 2. Approved Equal
- B. Provide 3 conductor plus (3) symmetrical bare copper circuit conductors plus (2) spiral copper tape shields (100% coverage) with PVC insulation, XLPE insulation. Provide a 100% foil plus dual copper tape shield. Cable shall be sun and oil resistant.
- C. Cable shall be suitable for Variable Frequency Drives.
- D. Cable shall be suitable for indoor installation.

2.6 ETHERNET CABLE

- A. Ethernet, Cat 6
 - 1. Manufacturer:
 - a. Belden 7953A
 - b. Or Approved Equal.
- B. 4 pair Category 6 shielded twisted pair cable. Constructed with #23 AWG solid bare copper conductors polyethylene or polypropylene insulation, and a black sunlight resistant PVC jacket with ripcord under the jacket for use in general communications applications.
- C. Characteristics:
 - 1. Jacket Diameter: 0.258-inches.
 - 2. Jacket Material: PP (Polypropylene)
 - 3. Cable Weight: 44 lbs/1000ft.
 - 4. Temperature Rating: -40 to 75-deg C
 - 5. Conductor Color Code:
 - a. Pair 1 - Blue & White/Blue
 - b. Pair 2 - Orange & White/Orange
 - c. Pair 3 - Green & White/Green
 - d. Pair 4 - Brown & White/Brown

PART 3 EXECUTION

3.1 INSTALLATION

- A. Make conductor length for parallel feeders identical.
- B. Lace or clip groups of feeder conductors at distribution center, pull-boxes, and wireway. Neatly arrange wiring within cabinets, junction boxes, fixtures, etc.
- C. Provide copper grounding conductors and straps.
- D. Install wire and cable in code conforming raceway.

- E. Use non-detrimental wire pulling lubricant for pulling No. 4 AWG and larger wire.
- F. Install wire in conduit runs after concrete and masonry work is complete and after moisture is swabbed from conduits.
- G. Color code conductors to designate neutral conductor and phase.
- H. Furnish necessary reels, reel jacks, and other pulling aids required to prevent damage to wires and cable.
- I. Splicing:
 - 1. Install wires and cables continuous without splices from sources of supply to distribution equipment and from source of supply to motor, lighting, or power outlet.
 - 2. Do not use pull boxes for making splices.
 - 3. Do not install splices in conduits.
- J. Install all wiring per NFPA 70.
- K. Use of cable with more conductors than specified; CONTRACTOR's option. When done, tape off and labeled extra conductors as spares.

3.2 CONDUCTOR CONNECTIONS

- A. Use approved pressure type solderless connectors and lugs for service entrance, feeder, equipment connections and terminal posts.
- B. Use connectors of a type compatible to conductors, locations, and load.
- C. Make neutral connection and taps individually in order to prevent the possibility of an "open-neutral".
- D. Make branch circuit connections with UL approved solderless connectors. Do not depend solely upon a single insulating material to secure connection as well as to insulate it.
- E. After first either silverplating the bars or applying suitable nonoxidizing agents, bolt buss bar connections with adequate nonferrous bolts, washers, and lockwashers.
- F. Insulate joints and taps with patented or molded plastic insulators. Use tapes compatible with conductor jackets, temperature, and other conditions.

3.3 SPECIAL WIRING

- A. Special Systems: Furnish and install equipment, materials, labor, services, and accessories required for completion of any special systems of an electrical nature, but not classified otherwise herein, that may be indicated. Applicable portions of NFPA 70 also apply.

3.4 AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW

- A. Prior to energization, test cable and wire for continuity of circuit for short circuits. Megger all circuit of 100 amp and greater rating.
- B. Correct malfunctions.
- C. Submit record of megaohmmeter readings to ENGINEER.

3.5 IDENTIFICATION OF FEEDERS

- A. Affix a marker stamped or embossed on each cable at each entry to and exit for each manhole, pullhole, pullbox, cable tray switchgear and switch, identifying circuit; i.e. "MCCI", "PANEL L" "NO 1" etc.
- B. Identification letters to be 1/8 inch size minimum.
- C. Markers to be rigid, noncorrosive, attached to feeder cables with feeder identification.
- D. Nylon straps to be used to tie the markers.

- END OF SECTION -

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SECTION 26 05 33
RACEWAY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible or rigid conduits, couplings, supports, and nonmetallic ducts.
- B. Related work includes but is not limited to,
 - 1. Section 33 05 20 - Trench backfill.
 - 2. Section 32 92 00 or Section 32 93 13 - Landscape restoration.
 - 3. Section 33 05 25 - Pavement restoration.

1.2 REFERENCES

- A. ANSI C80.1: Rigid Steel Conduit - Zinc-Coated.
- B. ANSI C80.3: Electrical Metallic Tubing - Zinc-Coated.
- C. FS W-F-406: Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible.
- D. FS WW-C-566: Conduit, Metal, Flexible.
- E. NEMA TC6: PVC and ABS Plastic Utilities Duct for Underground Installation.
- F. NEMA TC9: Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.
- G. NFPA 70: National Electric Code.
- H. UL: Underwriters' Laboratories, Inc.

PART 2 PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4 inch.
- B. Rigid Metal Conduit (RMC): ANSI C80.1.
- C. Intermediate Metal Conduit (IMC): ANSI C80.1.
- D. Rigid and Intermediate Steel Conduit Fittings: Provide fully threaded malleable steel couplings; raintight and concrete tight where required by application. Provide double locknuts and metal bushings at conduit termination, use OZ type B bushings on

conduits 1-1/4 inch and larger.

- E. Electrical Metallic Tubing (EMT): ANSI C80. 3.
- F. EMT Fittings: Provide insulated throat non-indenter type malleable steel fittings; concrete tight where required by application. Install OZ type B bushings on conduits 1-1/4 inches and larger.
- G. Flexible Metal Conduit (FMC): FS WW-C-566, Zinc-coated steel.
- H. Flexible Metal Conduit Fittings: FS W-F-406, Type 1, Class 1, Style A.
- I. Liquid Tight Flexible Metal Conduit: Provide liquid-tight, flexible metal conduit; constructed of single strip, flexible continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC).
- J. Liquid-Tight Flexible Metal Conduit Fittings: FS W-F-406, Type1, Class 3, Style G.
- K. Expansion Fittings: OZ Type AX, or equivalent to suit application.

2.2 NON-METALLIC CONDUIT AND DUCTS

- A. General: Minimum trade size: 3/4 inch.
- B. Underground PVC Plastic Utilities Duct: NEMA TC6, Type I for encased burial in concrete, Type II for direct burial.
- C. Duct Fittings: NEMA TC9, match to duct type and material.

2.3 CONDUIT, TUBING, AND DUCT ACCESSORIES

- A. Provide conduit, tubing and duct accessories of types and sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing. Provide manufactured spacers in all duct bank runs.

2.4 LOCKNUTS, BUSHINGS, CONNECTORS, COUPLINGS, AND SUPPORTS

- A. General: Provide malleable bushings, except that plastic bushings may be used in lieu of phenolic-lined malleable bushings where "insulating bushings" are required.
- B. Provide "double-locknut" system (2 locknuts) throughout, each being tightened wrench tight as to effectively bond outlet box or cabinet to conduit.
- C. Sealing Bushing: OZ Type FSK, WSK, or CSMI as required by application. Provide OZ type CSB internal sealing bushings.
- D. Provide insulated-through type ground bushing of the malleable type.
- E. Provide connectors or couplings that are proper for the conduit they are used with.

Make watertight when required.

- F. Provide cadmium plated or galvanized fittings.
- G. Provide fittings with die-cut threads unless approved otherwise.
- H. EMT connectors used with #4 and larger cable shall have throat liners of suitable plastic insulation.

2.5 CONDUIT OUTLET BOXES

- A. Refer to Section 26 05 34.

2.6 SCHEDULE OF LOCATIONS

- A. Chlorine Room: All exposed conduit shall be PVC coated Rigid Galvanized Steel.
- B. Galvanized steel conduit in concrete and exposed in the well room.
- C. Electrical metallic tubing above the ceiling for lighting circuits only, or where concealed in walls.
- D. For underground conduit use rigid, threaded, galvanized steel conduit, or solvent welded PVC conduit
- E. Make connections to motors and equipment with PVC jacketed flexible conduit and liquid tight connectors. Provide 1/2 inch minimum size for motor connections.
- F. Provide flexible conduit for fixture and control wiring with sufficient length of flexible conduit to avoid transmission of vibration.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate utility locations per Section 01 31 13.
- B. Excavate; Section 31 23 16.

3.2 INSTALLATION

- A. Install conduit concealed in all areas, excluding mechanical and electrical rooms, connections to motors, and connections to surface cabinets.
- B. For exposed runs attach surface-mounted conduit with clamps.
- C. Coordinate installation of conduit in masonry work.
- D. Unless indicated otherwise, do not install conduit larger than 2-1/2 inches in concrete

- slabs. Provide a minimum concrete cover around conduits of 2-inches.
- E. Install conduit free from dents and bruises. Plug ends to prevent entry of dirt and moisture.
 - F. Clean out conduit before installation of conductor.
 - G. Alter conduit routing to avoid structural obstructions, minimizing crossovers.
 - H. Fill end of conduit with fiberglass where conduits leave heated area and enters unheated area.
 - I. Provide flashing and pitchpockets, making watertight joints where conduits pass through roof or waterproofing membranes.
 - J. Install UL approved expansion fittings complete with grounding jumpers where conduits cross building expansion joints. Provide bends or offsets in conduit adjacent to building expansion joints where conduit is installed above suspended buildings.
 - K. Route all exposed conduits parallel or perpendicular to building lines.
 - L. Make interconnections between difference types of raceways with manufactured fittings approved by UL.
 - M. Size raceways per NFPA 70 tables. Do not reduce from any sized indicated.
 - N. Do not exceed sizes permitted in slabs or walls.
 - O. Do not exceed number of bends allowed in conduit by NFPA 70.
 - P. Make joints wrench tight or otherwise with minimum resistance to the flow of fault currents.
 - Q. Use furred spaces and chases to an advantage in concealing conduits.
 - R. Make field bends only where needed and then carefully to minimize wire pulling tensions and for best appearance in exposed runs.
 - S. Test conduit runs with lignum vitale ball (mandrel) of 85-percent of conduit diameter.
 - T. Cut conduit with hacksaw or other approved pipe cutting tool and ream ends to clean out all burrs before connecting.
 - U. Keep conduits at least 6-inches away from steam or hot water pipes, breaching, and boilers, but in no case permit conductors to reach higher than rated temperatures. Avoid traps in runs and slope conduit to drain.
 - V. Fasten raceways securely in place. Firmly fasten conduit within 3-feet of each outlet, junction box, cabinet, or fitting. Support metallic conduit, rigid (heavy wall) and EMT at least every 10-feet. Support rigid nonmetallic conduit in strict accordance with

NFPA70. Use raceway fasteners designed for the purpose.

3.3 SPECIAL CONDUIT FITTINGS

- A. Use special conduit fittings as required or indicated. Use UL approved fittings suitable for location and usage made.
- B. At expansion joints use special fittings if cast in concrete slabs.
- C. Building Expansion Joints: Where surface conduits, raceways, panels, or light fixtures, span building expansion joints, make satisfactory arrangements to provide the movement provided for in building structure plus or minus nominal joint width.

3.4 PULL BOXES, WIREWAYS, AND GUTTERS

- A. Furnish as indicated, plus any such items required to assemble conduits and other raceways. Provide Section 16135 pull boxes as dictated by wire pulling requirements. Unless indicated otherwise face into secondary or unfinished rooms.
- B. Construction: Code gage galvanized sheet steel and sized strictly in conformance with NFPA 70 requirements.
- C. Finish: Free of burrs, sharp edges, unreamed holes, and sharp-pointed screw or bolts. Paint both inside and out.
- D. Coating: When mounted direct to concrete or masonry walls that are below grade or where there will be sweating or other moisture present on wall surface, coat backs of boxes with a heavy coat of black asphalt paint before mounting.
- E. Protection: Adequate provisions for preventing damage to conductors either during pulling in or from weights and tensions when in place.
- F. Weatherproof, rain-tight, or special type when indicated or when required by NFPA 70.

3.5 ANCHORS, FASTENERS, AND MISCELLANEOUS SUPPORTS

- A. Use compatible anchors in roof or ceiling slabs of concrete from which a load is suspended and anchors used to fasten heavy equipment without lead in their construction.
- B. Make exposed conduit fastenings with one-piece, malleable conduit clamps. Two hole, galvanized sheet metal pipe straps may be used on all concealed installations.
- C. Use companion bases or backs with conduit clamps when conduit is exposed to weather or continuous moisture.
- D. Use ring type hangers on individual runs of conduit 3-inches and larger if suspended, complete with threaded rods. Use adjustable turnbuckles when specified or otherwise as an option.

- E. Support multiple runs of suspended conduits from trapeze style hangers suspended with rigid threaded steel rods and with suitable conduit clamps or straps of the same make as cross channels used.
- F. Mount multiple runs of conduit on ceiling or wall surfaces.
- G. Do not hang or support electrical equipment and materials from roof decks.

- END OF SECTION -

SECTION 26 05 34
ELECTRICAL BOXES AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Types of electrical boxes and electrical fitting work.

1.2 REFERENCES

- A. NEMA OS 1: Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- B. NEMA OS 2: Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. NFPA 70: National Electric Code.
- D. UL: Underwriters' Laboratories, Inc.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70 as applicable for installation of electrical boxes and fittings.
- B. Comply with NEMA OS 1 and NEMA OS 2 as applicable for outlet boxes, device boxes, covers and box supports.
- C. Provide electrical boxes and fittings which have been UL-listed and labeled.

PART 2 PRODUCTS

2.1 INTERIOR OUTLET BOXES

- A. One piece, galvanized cast iron or cast aluminum outlet wiring boxes, of types shapes and sizes, including box depths, to suit each respective location and installation. If of aluminum, essentially "copper free". Do not use on conduits of dissimilar metals, except with written permission.
- B. Construct with threaded screw holes with corrosion-resistant screws for securing box and covers and wiring devices.
- C. Minimum depth 1-1/4 inches or 2-1/8 inch depth for boxes with 3 or more conduit entries.
- D. Use in combination with factory or field bends when indicated or advised. Complete outlet bodies with mounting brackets, hangers, extension rings, fixture studs, cable clamps, metal straps, gaskets, cover, hubs, reducers, and other accessories.

2.2 WEATHERPROOF OUTLET BOX

- A. Corrosion-resistant cast-metal of types, shapes and sizes (including depth) required.
- B. Threaded conduit ends, cast-metal face plates with spring hinged waterproof caps suitably configured for each application, with faceplate gaskets and corrosion-resistant fasteners.

2.3 JUNCTION AND PULL BOXES

- A. Building Structure Type: Code-gage sheet steel with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with galvanized steel nuts, bolts, screws and washers.
- B. Buried Type: Plastic body and cover, or pre-cast concrete with screw-on traffic rated cast iron covers; of types, shapes and sizes to suit each respective location and installation; equipped with stainless steel.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
- B. Provide knockout closures to cap unused knockout holes where blanks have been removed.

3.2 INSTALLATION

- A. A. Install where indicated, complying with manufacturer's written instruction, applicable requirements of NFPA 70 and NEMA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Install coverplates for all boxes; weatherproof outlets for interior and exterior locations exposed to weather or moisture.
- C. Install boxes and fittings to ensure ready accessibility of electrical wiring. Install recessed boxes with face of box or ring flush with adjacent surface.
- D. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10-inches of conduit between them.

- END OF SECTION -

SECTION 26 29 23
VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes enclosed variable frequency controllers.

1.2 RELATED WORK

- A. Related Work specified in other Sections:
1. Section 01 33 00 Submittal Procedures
 2. Section 01 75 50 Project Closeout
 3. Section 26 06 05 Electrical Equipment
 4. Section 26 05 13 Conductors and Cables

1.3 REFERENCES

- A. IEEE C62.41 (Institute of Electrical and Electronics ENGINEER's) - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. NEMA FU 1 (National Electrical Manufacturers Association) - Fuses.
- C. NEMA ICS 3.1 (National Electrical Manufacturers Association) - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.
- D. NEMA ICS 7 (National Electrical Manufacturers Association) - Industrial Control and Systems:
1. Speed Drives.
- E. NEMA 250 (National Electrical Manufacturers Association) - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NETA ATS (International Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- B. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings dimensions, and enclosure details.

- C. Test Reports: Indicate field test and inspection procedures and test results.
- D. Manufacturers Field Reports: Indicate start-up inspection findings.
- E. Five copies, plus the number of copies the CONTRACTOR wishes returned, shall be submitted to the ENGINEER for approval.
- F. Manufacturer's warranty.

1.5 SUBMITTED AT SHIPMENT

- A. Include system manuals, complete with wiring diagrams, schematics, operating, and maintenance instructions, shall be provided with the VFD and VFD systems at the time of shipment, on both hard and digital copies.

1.6 CLOSEOUT SUB MITTALS

- A. Section 01 78 50 - Project Closeout.
- B. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 3.1. Include procedures for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions. Include routing preventive maintenance schedule.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience and service facilities within 100 miles of the project.

1.8 STANDARDS

- A. The VFD shall be UL listed and not require external fuses except where input power is supplied from multiple transformer secondaries.
- B. All VFD and VFD systems shall be designed in accordance with applicable portions of NEMA standards, and panel build ups manufactured by a UL508 listed manufacturer.
- C. The VFD shall be compatible with the installation requirements of interpretive codes such as National Electric Code (NEC) and Occupational Safety & Health Act (OSHA).
- D. The VFD shall be capable of operating in compliance with IEEE 519-1992.
- E. The VFD shall meet IEC 612 00-2 for vibration levels.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 26 05 00 - Electrical General Requirements.
- B. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.

1.11 WARRANTY

- A. Equipment furnished under this Section shall be guaranteed against defective parts and workmanship for 1 year from date of Final Acceptance of the system and shall include labor and travel time for necessary repairs at the job site.
- B. The manufacturer shall provide the service of a factory-trained service representative to verify the correctness of the CONTRACTOR's completed installation; to check all electronic circuitry and mechanical components to assure their proper function; and to make all necessary measurements in and around the unit to ensure proper operation. A minimum of 1-day startup service shall be provided. The manufacturer shall provide through the CONTRACTOR to OWNER a written certification that the installation is complete, correct and properly calibrated.

1.12 MAINTENANCE SERVICE

- A. Provide service and maintenance of variable frequency controller for one year from Date of Final Acceptance.

1.13 MAINTENANCE MATERIALS

- A. Supply two of each air filter.
- B. Provide three of each fuse size and type.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY CONTROLLER

- A. Manufacturers:
 - 1. ABB
 - 2. Allen-Bradley
 - 3. Eaton

4. Mitsubishi
 5. Square D, Altivar Process 630 Drive
 6. Approved Equals
- B. Product Description: NEMA ICS 7, enclosed 6 pulse variable frequency controller suitable for operating the indicated loads. Select unspecified features and options in accordance with NEMA ICS 3.1.

2.2 RATINGS

- A. Rated Input Voltage: 480 Volts, three phase, 60 Hertz. The VFD shall be able to withstand voltage variations of -15% to +10% without tripping or affecting VFD performance.
- B. Motor Nameplate Voltage: 460 Volts, three phase 60 Hertz.
- C. Motor Nameplate Horse power: 200 horsepower design B.
- D. Displacement Power Factor: Between 1.0 and 0.95 lagging over entire range of operating speed and load.
- E. Operating Ambient: 0 degrees C to 50 degrees C.
- F. Relative Humidity: 5 to 95 percent non-condensing.
- G. Minimum Efficiency at Full Load: 96 percent.
- H. Elevation: The VFD shall be suitable for operations up to 4,500 feet.

2.3 DESIGN FEATURES

- A. Employ microprocessor-based inverter logic isolated from power circuits.
- B. Employ pulse-width-modulated inverter system.
- C. Design for ability to operate controller with motor disconnected from output.
- D. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.
- E. The VFD shall be capable of 4 different acceleration and different deceleration rates, each rate independently adjustable from 0.01 to 3600 seconds. Selectable accel/decel patterns to include linear, S-curve, and non-linear for variable torque loads.
- F. The VFD shall have the capability of determining motor characteristics to optimize its operation with the use of pre-programmed motor data information or self-tuning operation. Self-tuning is to be available with or without the motor coupled to the load. Tuning shall also include an online mode that automatically and dynamically compensates the VFD regulator for changes in motor

temperature.

2.4 INDICATORS AND MANUAL CONTROLS

- A. Input Signal: 4 - 20 mA DC.
- B. Display:
 - 1. Provide integral LCD display to indicate output voltage, output frequency, output current, fault codes and drive status.
 - 2. Upon a fault condition, the LCD shall display VFD output current, voltage, frequency, torque, DC link voltage, operating hours, I/O terminal status, and temperature at the time of fault. The last four (4) faults will be stored in memory and selectively be displayed on the LCD.
- C. Indicator Lights:
 - 1. Provide an indicator light to indicate VFD failure.
- D. The drive shall have a built-in keypad that is installed on the outside cover and shall include Forward/Reverse/Stop/Jog keys, Drive reset key and Reference increment/decrement keys.
- E. Volts Per Hertz Adjustment: Plus or minus 10 percent.
- F. Current Limit Adjustment: 60 - 110 percent of rated.
- G. Acceleration Rate Adjustment: 0.5 - 30 seconds.
- H. Deceleration Rate Adjustment: 1 - 30 seconds.
- I. HAND-OFF -AUTOMATIC selector switch and manual speed control.
- J. Control Power Source: Integral control transformer.

2.5 SAFETIES AND INTERLOCKS

- A. Includes undervoltage release.
- B. Door Interlocks: Mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.
- C. Safety Interlocks: Terminals for remote contact to inhibit starting under both manual and automatic mode.
- D. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.
- E. The VFD shall be able to automatically reset up to ten (10) times after

over-current, over-voltage, overheating, and overload faults. Reset attempts and reset intervals must be programmable.

- F. Disconnecting Means: Integral circuit breaker on the line side of each controller.

2.6 VFD INPUT/OUTPUT PARAMETERS

- A. The VFD shall accept and follow a selectable external frequency reference of either analog 0-5 VDC, 0-10 VDC, 4-20m A with signal inversion.
- B. The VFD shall maintain the output frequency to within 0.2% of reference when the reference is analog, and to within .01% of reference when the reference is digital (Speed level inputs from keypad, contact closure, digital interface, or serial communication).
- C. The VFD shall have a reference filter to reduce noise in the analog signals and a low noise control power supply system.
- D. The VFD shall accept inputs from external dry contacts for the following functions:
 - 1. Run forward command
 - 2. Run reverse command
 - 3. Multi-step frequency selection
 - 4. Acceleration/Deceleration time selection
 - 5. Stop command
 - 6. Coast to stop command
 - 7. Alarm reset
 - 8. Trip command (external fault)
 - 9. Jogging operation
 - 10. Frequency reference selection (2)
 - 11. DC brake command
 - 12. Torque limits (2)
 - 13. Switching operation between line and inverter (50 and 60 Hz)
 - 14. Speed Increase command
 - 15. Speed Decrease command
 - 16. Write enable for keypad
 - 17. PID control cancel
 - 18. Inverse mode changeover
 - 19. Interlock signal
 - 20. Serial communications enable
 - 21. Universal DI
 - 22. Pick up start mode
 - 23. Forced stop command
 - 24. Forced stop command with Deceleration time
- E. The frequency reference shall be from, selectively, an external speed potentiometer, external analog signals (0-5 VDC, 0-10 VDC, 4 to 20mA with signal inversion), from the built in keypad, or from serial communication.
 - 1. The VFD shall provide five selectable digital outputs indicating the following:

- a. Inverter running
- b. Frequency equivalence signal
- c. Frequency level detection
- d. Torque polarity
- e. Torque limiting
- f. Auto-restarting
- g. Overload early warning
- h. Keypad operation mode
- i. Inverter stopping
- j. Ready input
- k. Line/Inverter changeover
- l. Motor 2 / Motor 1
- m. Auxiliary terminal
- n. Time-up signal
- o. Cycle completion time
- p. Stage No Indication (1, 2, and 4)
- q. Alarm Indication (1, 2, 4, and 8)
- r. Fan operation signal
- s. Auto resetting
- t. Universal DO
- u. Overheat early warning
- v. Second frequency level detection
- w. Second overload early warning
- x. Terminal C1 off signal

2.7 PROTECTIVE AND DIAGNOSTIC FEATURES

- A. When a fault occurs, the VFD shall have a controlled shut down sequence. A Form C relay fault output shall be available. The reason for the fault condition shall be enunciated on the LED display, and the LCD graphic screen shall display the current, temperature, frequency, and voltage at the time of the fault as well as potential reasons for the condition. The VFD shall monitor, sense, and display the following fault conditions:
 - 1. Over-current during acceleration
 - 2. Over-current during deceleration
 - 3. Over-current during constant speed operation
 - 4. Ground fault
 - 5. Input phase loss
 - 6. Fuse blown
 - 7. Over-voltage during acceleration
 - 8. Over-voltage during deceleration
 - 9. Over-voltage during constant speed operation
 - 10. Under-voltage
 - 11. Overheating of heatsink
 - 12. External thermal relay
 - 13. Over-temperature of internal air
 - 14. Overheating at Dynamic Braking circuit
 - 15. Motor 1 overload
 - 16. Motor 2 overload
 - 17. Inverter unit overload

18. Over-speed
 19. Memory Error
 20. Keypad panel communication error
 21. CPU error
 22. Option error
 23. Operational procedure error
 24. Output wiring error / Impedance imbalance
 25. Modbus-RTU error
- B. The VFD shall have a selectable Torque Limiting function for both motoring and braking that will sense an overload condition and will reduce frequency and current temporarily until the load reaches acceptable levels. If the overload condition is not settled in the proper amount of time, the Drive will trip on overload. The Torque Limiting shall be programmable from 20-150% of Drive rated motor torque (30 HP and below) and from 20-150% of Drive rated motor torque (40 HP and above), with 1% resolution.
 - C. The VFD shall have a selectable electronic inverse time thermal overload function as required by NEC and UL Standard 991 for an AC Induction Motor (Refer to applicable codes for specific installation requirements). The overload shall be programmable from 20 - 135% of Drive rated current.
 - D. The VFD shall have an over-voltage protection function that operates if supply voltage rises above rated value or by motor's regeneration.
 - E. The VFD shall treat short circuits in either the output load or the output module as an over-current.
 - F. If the VFD heat sink temperature exceeds approximately 100-degrees C, the Drive will shut down on over temperature fault.
 - G. The VFD shall provide output ground fault protection.
 - H. The VFD shall provide LED indication of DC bus voltage, which, when lit, will signify to maintenance people the presence of potentially dangerous voltage.

2.8 VFD CONSTRUCTION

- A. The VFD shall be a sinusoidal PWM type Drive with sensor-less vector control capability. The VFD Supplier shall provide open chassis, IP20, NEMA 1 enclosures at all ratings as required for the application. Drive shall be of modular construction for ease of access to control and power wiring, and maintenance. It shall consist of the following general components:
 1. Full wave diode AC/DC rectifier, to eliminate line voltage notching of the three phase source and maintain an input displacement power factor of 0.95 or greater, regardless of speed or load. SCR front ends with gate firing electronics are unacceptable.
 2. DC link capacitors standard, DC link reactor available at all ratings, standard on systems 100HP+.

3. Input surge protection performed by internal MOV'S (metal oxide varistors) or devices providing equal protection.
4. Insulated Gate Bipolar Transistor (IGBT) power section. The power section control shall use vector dispersal pulse width modulated (PWM) control and fourth generation soft switching IGBTs to reduce noise and allow longer cable length from VFD to motor without the need for output filters.
5. The VFD shall be microprocessor based and fully transistorized with a 32 bit MCU and 33 MIPS processing speed.
6. Separate control and power terminal boards, with option plug shall be provided by the VFD to allow for remote operation.
7. The VFD shall have an RS485 serial communications port as a standard with options for communicating with recognized industry standard device level networks such as Ethernet.
8. The VFD shall have a Keypad capable of copying, uploading and downloading Drive function codes.

2.9 INPUT FILTER

- A. Harmonic Filter: Provide a Matrix Harmonic Filter to reduce the harmonic currents going back into the utility power grid and power system. The total harmonic voltage distortion factor (DF) at the main 480 volt bus for voltage shall be less than 5 percent.
- B. The filter shall include a capacitor contactor that will be controlled from CP-1 and shall de-energize the capacitors when the drive is less than 30% output.

2.10 POWER MONITOR

- A. Manufacturer/Model:
 1. Crompton/Integra 1530.
 2. No Equal.
- B. The VFD enclosure shall be supplied with a power monitor/meter. The meter shall be UL listed and CE marked. Meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems.
 1. Meter shall support 3-Element Wye, systems.
 2. Surge withstand shall conform to IEEE C37.90.1 and ANSI C62.41 (6 kV)
 3. The meter shall be user programmable for voltage range to any CT or PT ratio.
 4. Meter shall have a burden of not more than 0.36VA per phase, Max at 600V, 0.014VA at 120 Volts.
 5. Meter shall have a burden of not more than 0 .005VA per phase, Max at 11 Amps.
 6. The meter shall accept a voltage input range from 57.5 to 277V L-N, 100-480V L-L.
 7. Meter shall accept a current reading of up to 120% nominal. Start-up current for a 5 Amp input shall be no greater than 0.005 Amps

- C. Power meter shall use a dual input method for current inputs. Method one shall allow the CT to pass directly through the meter without any physical termination on the meter, ensuring the meter cannot be a point of failure on the CT circuit. The second method shall provide additional termination pass-through bars, allowing the CT leads to be terminated on the meter. The meter must support both termination methods.
1. Fault Current Withstand shall be 100 Amps for 10 seconds, 300 Amps for 3 seconds, and 500 Amps for 1 second.
 2. Pass through wire gauge dimension of 0.177ö / 4.5 mm shall be available.
 3. All inputs and outputs shall be galvanically isolated to 2500 Volts AC.
 4. The meter shall accept current inputs of class 10: (0 to 10) A, 5 Amp Nominal, and class 2 (0 to 2) A, 1A Nominal Secondary.
- D. The meter shall have an accuracy of +/- 0.1% or better for volts and amps, and 0.2% for power and energy functions. The meter shall meet the accuracy requirements of IEC687 (Class 0.2%) and ANSI C12.20 (Class 0.2%)
1. The meter shall provide true RMS measurements of voltage, - phase to neutral and phase-to-phase; and current, per phase and neutral.
 2. The meter shall calculate RMS readings, sampling at over 400 samples per cycle on all channels measured readings.
 3. The meter shall utilize 24 bit Analog to Digital conversion.
 4. The meter shall provide %THD (% of total Harmonic Distortion). Harmonic magnitude recording to the 40th order shall be available for voltage and current harmonics.
- E. The meter shall include a three-line, bright red, .56" L ED display.
1. The meter shall fit in both DIN 92mm and ANSI C3 9.1 round cut-outs.
 2. The meter must display a % of Load Bar on the front panel to provide an analog feel. The % Load bar shall have not less than 10 segment.
- F. The power meter shall include the following measurements:
1. kW
 2. kVAR
 3. PF
 4. kVA
 5. Freq.
 6. kWh
 7. kVAh
 8. kVARh
 9. Power Quality Harmonics
- G. The meter shall be provided with a RS485 Modbus RTU communications.

- H. Ethernet communication card with 10 BaseT Ethernet functionality and allow auto transmit/receive detection for straight or null RJ45 cables. Software for remote programming and integration shall also be provided.
- I. The meter shall have a standard 4 -year warranty.
- J. Power meter shall be able to be stored in (-20 to +70) degrees C.
- K. Operating temperature shall be (-20 to +70) degrees C.

2.11 RS485 TO ETHERNET CONVERTER

- A. Manufacturer/Model
 - 1. Gridconnect Net485
 - 2. Or Equal.
- B. Supply a RS485 to Ethernet converter for the power monitor. Unit shall be configurable for multiple Baud Rates and shall provide 10/100 ethernet and Serial 7 pole terminal for power and data lines. Unit shall be provided with configurable software as required.
- C. Power Supply: 8-24 V DC (1 watt power). Unit shall provide Modbus RTU propocol.

2.12 SURGE PROTECTIVE DEVICE

- A. This Section describes the materials and installation requirements for an integrated Transient Voltage Surge Suppressor (TVSS), also referred to as Surge Protective Device (SPD), inside VFD enclosure. These devices are used to protect AC electrical circuits from the effect of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and or capacitive load switching.
- B. References
 - 1. UL 1449 Second Edition 2005 - Transient Voltage Surge Suppressors
 - 2. UL 1283 - Electromagnetic Interference Filters
 - 3. ANSI/IEEE C62.41.1-2002 - IEEE Guide on the Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits; C62.41.2-2002 - IEEE Recommended Practice on Characterization of Surge Voltages in Low Voltage AC Power Circuits; and C62.45-2002 - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
 - 4. NEC 2017 Article 285
- C. Internal TVSS
 - 1. TVSS shall be Listed in accordance with UL 1449 Second Edition 2005 and UL 1283, Electromagnetic Interference Filters.
 - 2. Integrated surge protective devices (SPD) shall be Component Recognized in accordance with UL 1449 Second Edition, Revision

2/9/2005 Section 37.3 and 37.4 at the standard's highest short-circuit current rating (SCCR) of 200 kA, including intermediate level of fault current testing that will be effective 2/9/2007.

3. TVSS shall be tested with the ANSI/IE EE Category C High exposure waveform (20kV -1.2/50s, 10kA-8/20s).
 4. TVSS shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems.
 5. Recommended TVSS ratings:
 - a. Minimum surge current rating shall be 80 kA per phase (80 kA per mode) for service entrance and 40 k A per phase (40 kA per mode) for distribution applications.
 - b. UL 14 49 clamping voltage must not exceed the following:
480Y/277
 - c. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IE EE Category C High transients without failure or degradation of clamping voltage by more than 10%.
 6. TVSS shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
 7. TVSS shall be constructed of one self-contained suppression module per phase.
 8. Visible indication of proper TVSS connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each TVSS module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.
 9. TVSS shall be equipped with an audible alarm which shall activate when any one of the surge current modules has reached an end-of-life condition. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.
 10. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate an end-of-life condition for the complete TVSS or module.
 11. Terminals shall be provided for necessary power and ground connections.
 12. The TVSS shall be equipped the following optional items:
 - a. A transient voltage surge counter shall be located on the diagnostic panel on the front cover of the enclosure. The counter shall be equipped with a manual reset and battery backup to retain memory upon loss of AC power.
- D. TVSS shall have a warranty for a period of ten (10) years from date of Final Acceptance. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by the irrespective field service division.
- E. TVSS Manufacturer:

1. Eaton
2. Square D
3. Raycap
4. Or Approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that building environment can be maintained within the service conditions required by the manufacturer.

3.2 INSTALLATION

- A. Install in accordance with NEMA ICS 3.1.
- B. Tighten accessible connections and mechanical fasteners after placing controller.
- C. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- D. Provide engraved plastic nameplates.
- E. Motor Data: Neatly type label inside controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
- F. Ground and bond controller under the provisions of Section 26 05 26.

3.3 QUALITY ASSURANCE

- A. All VFD's shall be 100 % factory tested to ensure proper performance upon delivery.
- B. VFD's installed in panels shall be 100% factory tested as a system by the VFD supplier.

3.4 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 3.1.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Prepare and startup variable frequency controller.
- B. VFD operational and maintenance training and startup service shall be provided by the VFD supplier. The VFD vendor shall have factory trained personnel at field

locations convenient to the installation site, available for trouble shooting and/or startup assistance 24/7.

- C. Coordinate factory startup with the VFD, motor and Motor Protector factory representatives.
- D. Coordinate VFD settings and the Backup Power Generator so that the facility operates as intended on both utility power and on backup generator power.

3.6 DEMONSTRATION AND TRAINING

- A. Provide 4 hours of instruction each for 6 persons, to be conducted at Project Site with manufacturer's representative.

3.7 WARRANTY

- A. The VFD vendor shall provide a warranty for material and workmanship, for a period of twenty-four months after Final Completion.
- B. Warranty and non-warranty service shall be available in house and in the field. There shall be authorized service centers locally available within 4 hours.

3.8 SPARE PARTS

- A. Provide a list of all spare parts to the OWNER at Substantial Completion.

- END OF SECTION -

SECTION 26 32 13.13
DIESEL-ENGINE GENERATOR SETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Engine-generator set.
2. Provide engine generator set including but not necessarily limited to the following:
 - a. Engine.
 - b. Cooling system.
 - c. Exhaust system.
 - d. Mounting.
 - e. Starting system.
 - f. Generator.
 - g. Control equipment and accessories.
 - h. Housing.
 - i. Output circuit breaker.
3. Concrete/steel fuel storage tank.

B. Related Sections include but are not necessarily limited to:

1. Division 01 00 00 - General Requirements.
2. Division 26 05 00 - Electrical.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. National Electrical Manufacturer's Association (NEMA).
2. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 110, Underwriter's Laboratories, Inc. (UL).

B. Testing:

1. Prototype Test: The manufacturer shall have successfully tested a prototype of each engine/generator set series offered. The tests performed shall include the following:
 - a. Maximum power test.
 - b. Maximum motor starting kVA.
 - c. Transient response, steady state governing, and voltage regulation.
 - d. Single step load pick-up per NFPA 110.
 - e. Three-phase short circuit test for mechanical and electrical strength.
 - f. Fuel consumption.
 - g. Cooling system test.

- h. Endurance run test.
 - i. Torsiograph analysis and test.
 - j. Temperature rise test.
2. Factory Tests: Prior to shipment, each unit shall be factory performance tested under load. Test results shall be certified and documented on a strip chart recorder. The tests shall be performed in accordance with the Manufacturer's standards and NFPA Standard 110. The following tests shall be performed:
- a. Stepped load test at 1/2, 3/4, and full load for 5 minutes each step.
 - b. Three-quarter block load.
 - c. Full single step block load.
 - d. Results documented shall include steady-state voltage and frequency analysis, transient response, maximum power analysis, and fuel consumption.
3. Field Tests: Each complete installation shall be tested for compliance with the plans and specifications following completion of all site work. Testing shall be conducted by a representative of the supplier. The Contractor shall supply fuel, load bank, and other equipment required for the test. The Owner and Engineer shall be notified in advance and shall have the option to witness the tests. The tests shall be repeated until the equipment performs as specified. The tests to be conducted on site shall be as follows:
- a. Cold Start Test: Perform a cold start test on the generator using the generator's actual load as a test load. A power failure shall be simulated by opening the normal power disconnect and the following information shall be recorded:
 - (1) Time delay on start.
 - (2) Cranking on time.
 - (3) Time required to come up to speed.
 - (4) Voltage and frequency overshoot.
 - (5) Time to achieve steady state.
 - (6) Voltage, frequency, and amps at standby state.
 - (7) Oil pressure, water temperature, and battery charge rate at 5-minute intervals for the first 15 minutes and at 15-minute intervals thereafter for 2 hours.
 - (8) Time delay on retransfer after return of normal power.
 - (9) Cool-down time delay.
 - b. Full Load Test: Immediately after cooling time from cold start test, perform a one step full load test using a load bank. Record the same data as in the cold start test except for time delays on transfer and retransfer.
 - c. Crank Cycle Test: Disable the generator from starting by a method approved by the Manufacturer and test the crank cycle by switching the generator to run.
 - d. Safety Shutdowns: Test all the generator safety shutdowns.

1.3 SUBMITTALS

- A. See Section 01 33 00 and 26 05 00.
- B. Verify dimensions, coordination and applicability of equipment furnished.
- C. Full detail for performing of engine testing required. Upon completion of engine

testing prepare and submit final results along with all new data.

- D. Upon satisfactory completion of startup, secure a written statement from manufacturer that each engine generator is installed in accordance with manufacturer's recommendations, properly started up and is ready for operation by the Owner's personnel. Also certify that required operation and maintenance training has been fully satisfied.
- E. Wiring diagrams for each engine-generator set. Indicate clearly factory versus field wiring connections.
- F. Generator fault current at full rpm and main circuit breaker trip curves and fault interrupting rating.
- G. Operation and Maintenance Manuals: See Section 01700.

1.4 WARRANTY

- A. Comply with General Conditions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. MTU
 - 2. Owner approved equal.
- B. Assure engine, generator and accessories are provided by the engine manufacturer and its authorized dealer.
- C. Assure local availability of service and replacement parts.

2.2 PERFORMANCE AND OPERATING REQUIREMENTS

- A. Operating Conditions: Provide complete generator sets, controls and accessories rated for the following conditions:
 - 1. Location: Salt Lake City, Utah
 - 2. Altitude: 4,500 FT AMSL.
 - 3. Fuel: #2 diesel.
 - 4. Enclosure rating: Level 3 sound attenuated.
- B. Performance: Establish net rating of each generator set under operating conditions specified when equipped and fully loaded with all necessary operating accessories. Substantiate ratings with manufacturer's standard published curves and data.

1. Minimum ratings:
 - a. Standby rating:
 - (1) 230 kW at 0.8 PF.
 - b. Frequency: 60 HZ.
 - c. Voltage and phase: 480/3.
 - d. Engine speed, max: 1800 rpm.
 - e. Maximum voltage dip: 35 percent.
2. Fuel: Engines requiring special or premium fuel will not be acceptable.

2.3 ENGINE

- A. Engine Construction: Provide diesel-type engine of heavy-duty construction, full compression ignition diesel, radiator and fan cooled, "V" type multi-cylinder, four stroke, four cycle.
 1. Engines solid-state designed for cold quick start, capable of delivering full load output in 10 seconds.
 2. Engine must meet scheduled performance without turbo-charging or after-cooling.
 3. Engines shall have replaceable cylinder liners of wet sleeve-type and replaceable valve seat inserts.
 4. Design combustion chambers of open type.
 5. Cross tie bolt main bearing caps to crankcase for rigidity. Design connecting rods of forged steel, angle split line for precise cap alignments.
 6. Design crankshaft of forged steel.
 7. Provide exhaust manifolds.
- B. Lubrication:
 1. Provide pressure-type lubrication system with gear-type oil pump and fullflow filters fitted to engines. Provide pressure-regulating valve. Provide level indicator or dipstick.
 2. Locate filter for convenient servicing. Equip filters with spring loaded bypass to ensure oil circulation if filters are clogged.
 3. Oil drain piped to edge of skid with valve or cap.
- C. Air Cleaner:
 1. Provide one or more dry-type replaceable element air cleaners suitable for high dust load operation.
 2. Equip each air cleaner with service indicator.
- D. Governor:
 1. Provide a fully enclosed electronic governor.
 2. Frequency at any constant load shall not deviate more than plus or minus 0.5 percent of rated frequency.
 3. The governor to provide adjustable frequency regulation from isochronous to 5 percent droop.
 4. Equal to Woodward 2301 single controller with an EGLOP Woodward actuator.

- E. Fuel System: Dual replaceable element filter, engine supply and return line, solenoid shut off valve, and engine driven fuel pump.

2.4 GENERATOR

- A. Construction: Provide brushless, revolving field type, synchronous generator coupled directly to engine flywheel through a flexible driving disc for positive alignment.
 - 1. Bolt generator housing directly to engine flywheel housing.
 - 2. Provide (a single) double ball-bearing support for the rotor in the generator housing. Dynamically balance rotor for up to 25 percent overspeed.
 - 3. Provide Class H insulation operating on Class F temperature rise on the stator and rotor, and protect with 100 percent epoxy impregnation and an overcoat of resilient insulating material to reduce possible fungus and abrasion deterioration. Equip field with full amortisseur winding.
 - 4. Perform generator field excitation with static-type rotating exciter mounted on the generator rotor shaft through a brushless rotating diode system.
 - 5. Provide volts-per-hertz type voltage regulator of solid-state 3-phase sensing, construction matching characteristics of each unit. Provide no load to full load regulation within ± 0.5 percent at rated voltage during steady state conditions.
 - 6. Provide permanent magnet generator to provide excitation power to the automatic voltage regulator. Provide shock-resistant mounting of regulators.

2.5 COOLING SYSTEM

- A. Provide unit-mounted radiator cooling system with sufficient capacity for cooling generator set at full rated load and operating conditions specified.
 - 1. Equip engine with engine-driven centrifugal-type water circulating pumps and thermostatic valve to maintain coolant temperature below 200 Deg F.
- B. Coolant:
 - 1. Flush and drain cooling system.
 - 2. Fill with minimum 50 percent ethylene glycol and water solution.
 - 3. Assure radiator, engine block and related items protected to minus 50 Deg F.
 - 4. Coolant drain piped to edge of skid with valve or cap.
- C. Jacket Water Heaters: Furnish one or more engine mounted thermal circulation type water heaters to maintain engine jacket water at 70 Deg F at minimum ambient temperature specified.
 - 1. Include integral thermostatic controls to maintain desired temperatures.
 - 2. Rate heater for 240 V, 1 PH, 60 HZ.

2.6 EXHAUST SYSTEM

- A. Exhaust Silencer. Provide a Critical-grade silencer and related hardware to include side inlet, standard 125-150 LB flange connections, companion-flanges, cleanouts,

Type E support arrangement, and stainless steel bellows type flexible exhaust connectors at least 24 IN long.

1. Ensure silencers and related hardware are properly sized and installed according to the manufacturer's recommendation.
2. The silencer shall be mounted horizontally such that its weight is NOT supported by the engine. Silencer shall be mounted inside enclosure.
3. Furnish and install exhaust pipe constructed of schedule 40 steel pipe with standard 125-150 LB flange connections as shown on the Drawings. Exhaust pipe size shall be sufficient to ensure that measured exhaust back pressure does not exceed 20-inches of water.

B. Install insulation so that it does not interfere with the functioning of the flexible exhaust fitting.

2.7 STARTING SYSTEMS

A. Starting Motors: Provide 120 or 24 V DC starting system with solenoid operated positive engagement drive.

B. Batteries: Furnish lead acid batteries with each engine generator with sufficient capacity to crank engines for three 20-second cranking periods with a 30-second rest period between cranks without recharging.

1. Provide battery rack appropriately sized for the batteries furnished, painted with alkaline-resistant paint.
2. Provide constant voltage, current limiting, full wave rectifier type battery chargers using silicon-controlled rectifiers as the power controlling elements.
3. Provide float and equalize charge rates. Rate charger for 120 V, 1 PH, 60 HZ with output current rating to recharge the battery from a 70 percent discharged condition to 95 percent charged condition in 12 HRS.
4. Provide malfunction alarm contacts for actuation of alarm in the event of malfunction in the battery charging system.
5. Provide DC voltmeter and ammeter, ac input and dc output circuit breakers.
6. Provide cables, clamps and all other necessary connections.
7. Size main cables to exhibit total circuit resistant of 0.005 ohm or less.
8. Batteries and charger located in generator enclosure.
9. Starting shall be initiated by a normally open, dry contact closure.

2.8 CONTROLS

A. Control Panel:

1. Provide NEMA 1 enclosed control panel mounted on each generator terminal box with vibration isolators.
2. Construct dead front panel with 14 GA steel.
3. Include the following devices in panel:
 - a. Engine coolant temperature gage.
 - b. Engine lube oil pressure gage.
 - c. Engine lube oil temperature gage.

- d. Engine running hour meter.
 - e. Battery charging indicators.
 - f. Voltmeter.
 - g. Ammeter with true RMS output, supplied by 3 CT's at generator output leads.
 - h. Ammeter and voltmeter phase selector switch or switches.
 - i. Frequency meter.
 - j. Manual and automatic starting controls.
 - k. Panel illumination lights and switch.
 - l. Voltage level adjustment rheostat.
 - m. Fault indicators including low oil pressure, high water temperature, overspeed and overcrank. Provide dry contacts for common annunciation of fault conditions.
4. Provide minimum 3-1/2 IN DIA, dial type meters. Accuracy shall be within ± 2 percent.
- B. Main Line Circuit Breaker: Provide main circuit breaker for each generator set, sized as indicated on Contract Drawings.
- 1. Breakers are to operate both manually for normal switching function and automatically during overload and short circuit conditions.
 - 2. The trip unit for each pole of each breaker is to have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection.
 - 3. Provide breakers to interrupt bolted 3 PH fault from generator at full rpm at load terminals.
 - 4. Provide a NEMA 1 enclosure for circuit breakers and mount on generator using suitable vibration isolators.

2.9 AUTOMATIC TRANSFER SWITCH

A. GENERAL

- 1. The automatic transfer switch shall be furnished by the manufacturer of the engine-generator set so as to maintain system compatibility and local service responsibility for the complete emergency power system. Representative production samples of the transfer switch supplied shall have demonstrated through tests the ability to withstand at least 10,000 mechanical operation cycles. One operation cycle is the electrically operated transfer from normal to emergency and back to normal. Wiring must comply with NEC table 312.6. The manufacturer shall furnish schematic and wiring diagrams for the particular automatic transfer switch and a typical wiring diagram for the entire system.

B. RATINGS & PERFORMANCE

- 1. The automatic transfer switch shall be a 3 pole design rated for 400 amps continuous operation in ambient temperatures of -20 degrees Fahrenheit (-30 degrees Celsius) to +140 degrees Fahrenheit (+60 degrees Celsius). Main power switch contacts shall be rated for 600 V AC minimum. The transfer switch supplied shall have a minimum withstand and closing rating of 35,000

amperes. Where the line side overcurrent protection is provided by circuit breakers, the short circuit withstand and closing ratings shall be 35,000 amperes RMS. These RMS symmetrical fault current ratings shall be the rating listed in the UL listing or component recognition procedures for the transfer switch. All withstand tests shall be performed with the overcurrent protective devices located external to the transfer switch.

C. CONSTRUCTION

1. The transfer switch shall be double throw construction, positively electrically and mechanically interlocked to prevent simultaneous closing and mechanically held in both normal and emergency positions. Independent break before make action shall be used to positively prevent dangerous source to source connections. When switching the neutral, this action prevents the objectionable ground currents and nuisance ground fault tripping that can result from overlapping designs. The transfer switch shall be approved for manual operation under no load conditions. The electrical operating means shall be by electric solenoid. Every portion of the contactor is to be positively mechanically connected. No clutch or friction drive mechanism is allowed, and parts are to be kept to a minimum. This transfer switch shall not contain integral overcurrent devices in the main power circuit, including molded case circuit breakers or fuses.
2. The transfer switch electrical actuator shall have an independent disconnect means to disable the electrical operation during manual switching. Maximum electrical transfer time in either direction shall be 160 milliseconds, exclusive of time delays. Main switch contacts shall be high pressure silver alloy with arc chutes to resist burning and pitting for long life operation.

D. CONTROLS

1. All control equipment shall be mounted on the inside of the cabinet door in a metal lockable enclosure with transparent safety shield to protect all solid state circuit boards. This will allow for ease of service access when main cabinet lockable door is open, but to prevent access by unauthorized personnel. Control boards shall have installed cover plates to avoid shock hazard while making control adjustments. The solid state voltage sensors and time delay modules shall be plug-in circuit boards with silver or gold contacts for ease of service.
2. A solid state undervoltage sensor shall monitor all phases of the normal source and provide adjustable ranges for field adjustments for specific application needs. Pick-up and drop-out settings shall be adjustable from a minimum of 70% to a maximum of 95% of nominal voltage. A utility sensing interface shall be used, stepping down system voltage of 480Y/277 vac 3 phase to 24VAC, helping to protect the printed circuit board from voltage spikes and increasing personnel safety when troubleshooting.
3. A solid state undervoltage sensor shall monitor all phases of the normal source and provide adjustable ranges for field adjustments for specific application needs. Pick-up and drop-out settings shall be adjustable from a minimum of 70% to a maximum of 95% of nominal voltage. A utility sensing interface shall

be used, stepping down system voltage of 480Y/277 vac 3 phase to 24VAC, helping to protect the printed circuit board from voltage spikes and increasing personnel safety when troubleshooting.

4. Signal the engine-generator set to start in the event of a power interruption. A set of contacts shall close to start the engine and open for engine shutdown. A solid state time delay start, adjustable, 0.1 to 10 seconds, shall delay this signal to avoid nuisance start-ups on momentary voltage dips or power outages.
5. Transfer the load to the engine-generator set after it reached proper voltage, adjustable from 70-90% of system voltage, and frequency, adjustable from 80-90% of system frequency. A solid state time delay, adjustable from 5 seconds to 3 minutes, shall delay this transfer to allow the engine-generator to warm-up before application of load. There shall be a switch to bypass this warm-up timer when immediate transfer is required.
6. Retransfer the load to the line after normal power restoration. A return to utility timer, adjustable from 1-30 minutes, shall delay this transfer to avoid short term normal power restoration.
7. The operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred. Controls shall provide an automatic retransfer of the load from emergency to normal if the emergency source fails with the normal source available.
8. Signal the engine-generator to stop after the load retransfers to normal. A solid state engine cool down timer, adjustable from 1-30 minutes, shall permit the engine to run unloaded to cool down before shutdown. Should the utility power fail during this time, the switch will immediately transfer back to the generator.
9. Provide an engine minimum run timer, adjustable from 5-30 minutes, to ensure an adequate engine run period.
10. The transfer switch shall have a time delay neutral feature to provide a time delay, adjustable from 0.1-10 seconds, during the transfer in either direction, during which time the load is isolated from both power sources. This allows residual voltage components of motors or other inductive loads (such as transformers) to decay before completing the switching cycle. A switch will be provided to bypass all transition features when immediate transfer is required.
11. The transfer switch shall have an in phase monitor which allows the switch to transfer between live sources if their voltage waveforms become synchronous within 20 electrical degrees within 10 seconds of transfer initiation signal. A switch must be provided to bypass this feature if not required.
12. If the in phase monitor will not allow such a transfer, the control must default to time delay neutral operation. Switches with in phase monitors which do not default to time delay neutral operation are not acceptable.
13. Front mounted controls shall include a selector switch to provide for a NORMAL TEST mode with full use of time delays, FAST TEST mode which bypasses all time delays to allow for testing the entire system in less than one minute, or AUTOMATIC mode to set the system for normal operation.
14. Provide bright lamps to indicate the transfer switch position in either UTILITY (white) or EMERGENCY (red). A third lamp is needed to indicate STANDBY OPERATING (amber). These lights must be energized from utility or the engine-generator set.
15. Provide manual operating handle to allow for manual transfer. This handle

must be mounted inside the lockable enclosure so accessible only by authorized personnel.

16. Provide a maintenance disconnect switch to prevent load transfer and automatic engine start while performing maintenance. This switch will also be used for manual transfer switch operation.
17. Provide LED status lights to give a visual readout of the operating sequence. This shall include utility on, engine warm-up, standby ready, transfer to standby, in phase monitor, time delay neutral, return to utility, engine cool down and engine minimum run. A "signal before transfer" lamp shall be supplied to operate from optional circuitry.

E. MISCELLANEOUS TRANSFER SWITCH EQUIPMENT

1. The transfer switch mechanism and controls are to be mounted in a NEMA 1 or better enclosure.

2.10 EXTERNAL FUEL STORAGE

- A. The unit shall be supplied with an above ground external steel reinforced, concrete lined insulated steel fuel storage tank, complete with appropriate fuel/return lines and grounding lug. Provide 2,000 gallon minimum.
- B. Manufacturer/Model:
 1. Oldcastle Convault Model 2000-CVLT
- C. Unit shall comply with the following:
 1. UL - 142, Standard for Aboveground Tanks for Flammable and Combustible Liquids.
 2. UL - 2085, Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids.
- D. Features shall include:
 1. Single structure design.
 2. Multiple layer containment.
 3. Monolithic concrete enclosure.
 4. Secondary polyethylene layer.
 5. Primary steel tank.
- E. Unit shall be supplied with the following:
 1. 2" diameter tank leak detection tube.
 2. 1" diameter communication port.
 3. 4" diameter nipple.
 4. 6" diameter emergency vent nipple.

2.11 SPARE PARTS

- A. Furnish Owner the following extra parts and supplies for each generator set:

1. One complete set of belts.
 2. Two sets of filters, i.e., fuel, oil, and air.
 3. Oil for one complete oil change.
 4. One complete set of control panel indicating lights.
 5. Complete replacement set of all fuses.
- B. Spare parts shall be suitably packaged with labels indicating contents of each package.

PART 3 - EXECUTION

3.1 MOUNTING, FUEL TANK AND ENCLOSURE

- A. Base: Mount engine, generator and cooling system on a common structural steel base capable of maintaining unit alignment suitable for mounting unit on a concrete pad. Equip base with vibration isolators.
- B. Fuel Tank: Provide separate concrete encased steel UL listed base tank assembly designed and supplied by the generator manufacturer.
1. Size tank for minimum 24 HRS of continuous engine operation at full load.
 2. Provide mounting and anchoring means suitable for installation on concrete pad.
- C. Flexible Connections: Provide stainless steel flexible fittings on all engine piping and electrical conduits.
1. Engine control conduit.
 2. Fuel connection: Braided metallic.
 3. Exhaust connector bellows: Stainless steel.
 4. Coolant water pipes: Braided metallic.
- D. Enclosure:
1. Provide the generator and engine in a sound attenuated, Level 3 lockable enclosure. Generator will be installed indoors.
- E. Provide a complete exhaust system including an exhaust silencer inside the enclosure. Provide all appropriate insulating materials, mounting hardware, supports, for a complete installation.

3.2 FIELD QUALITY CONTROL

- A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by these Specifications.
 2. Supervise any adjustments and installation checks.
 3. Conduct initial start up of equipment and perform operational checks at jobsite.

3.3 TESTING

- A. Provide services of authorized manufacturer's technician to start, test, and adjust system for proper operation.
- B. Provide services of factory trained and authorized technician to give Owner a 4 hour class in proper operation and maintenance.
- C. Site Acceptance Test:
 - 1. Prior to performing any on-site testing of the generator or associated systems, the generator vendor must demonstrate to the Owner that all generator shut-downs and alarms are working. This includes all remote annunciators included with the emergency generator system. The system must be operational and working before proceeding. Any item that fails must be repaired before proceeding with the testing.
 - 2. The complete standby generator set shall be tested under the supervision of capable service engineers provided by the diesel engine-generator manufacturer. (Submit a detailed chronological test plan with the Shop Drawings.) Prior to any testing, verify that the set is complete and ready for testing and that all instrumentation required is connected and ready for Start-up and test. Tests shall be witnessed by the Owner's representatives. Provide necessary lube oil, fuel oil, and testing equipment to obtain full load conditions, including any required additional resistive load banks, for the system test.
 - 3. The on-Site test program shall cover the following as a minimum:
 - a. Verify that all components are correctly installed and interconnected. Exercise each circuit breaker, and each automatic transfer switch, including its draw out mechanisms.
 - b. Individually test each engine protective device and verify the accuracy of instrumentation set points. Provide coordination study for each overcurrent and ground fault device and calibrate same at the Project Site by means of primary injection testing before any tests are performed. Coordination study shall be submitted with Shop Drawings.
 - c. The diesel generator set shall operate under full load conditions for a minimum of four (4) hours. The generator set shall maintain rated voltage and rated frequency per Specifications for the duration of the full load test. Voltage, amperage and frequency measurements, as well as engine gauge and monitor points, shall be recorded at 15 minute intervals. All doors of the weatherproof housing shall remain closed during testing.
 - d. Operate the diesel engine-generator from 0 to 100 percent load, starting at no-load and increasing in increments of 25 percent. Hold at each incremental load for 15 minutes and check at each load point for stable operation, fuel consumption, engine performance, and generator performance. The generator shall be capable of returning to its rated voltage and frequency per Specifications when incremental loads are added.
 - e. Verify acoustical performance, if the enclosure is so rated, with the diesel engine generators operating at full load.

4. Provide all labor and materials required for on-Site testing with 100 percent load at unity power factor, including but not limited to, the following:
 - a. The required resistive portable temporary dummy load banks to achieve 100 percent of generator rated output conditions.
 - b. Temporary connections from generator output breaker fuse to dummy load, including grounding conductor.
 - c. Overcurrent and short-circuit protection devices, contactors, relays, etc., for temporary cables, as required.
 - d. All instrumentation and connections required to measure and record test data. Provide accurate voltage, current, frequency, and kW meters to accomplish this. For each transient or load change, provide oscillograph trace recordings of voltage frequency and current, showing the entire restabilization period for each. Record and log all test data and submit to Owner in a comprehensive test report.
 - e. Disconnection and removal of all temporary power and control wiring and equipment.
 - f. Seven (7) sets of certified test reports, submitted within fourteen (14) calendar days.
 - g. Provide all fuel required for the test. After the test and prior to final acceptance the Contractor shall fill the fuel tanks to full level.
5. A final system test (pull-the-plug) to demonstrate the system as a whole, including safeties, etc., shall be conducted to the satisfaction of the Owner/Engineer. This test shall not be conducted as an extension of the Site acceptance test, but rather as a separate test after Substantial Completion and acceptance of all other Work associated with this Project. Submit a detailed chronological test plan with the Shop Drawings.
6. Any item documented as being failed or not working will be submitted to the vendor for repair. The vendor has five (5) working days to either fix the item or respond in writing why the item is not being repaired. If the item is not repaired or no response is received in five (5) working days, the Owner will make repairs and deduct the cost of repairs from the final payment of the generator.

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SECTION 31 05 19
GEOSYNTHETICS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section covers the manufacturing and installation of geosynthetics.

1.2 RELATED WORK

- A. Related work specified in other sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 31 22 00 Site Grading
3. Section 31 23 15 Excavation and Backfill for Buried Pipelines
4. Section 33 46 16 Sub-Drainage System
5. Section 33 16 00 Underground Water Storage Reservoir

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text to by basic designation only.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- | | |
|---------------------|---|
| 1. B16.1/ASTM D 751 | Standard Test Methods for Coated Fabrics |
| 2. ASTM D 1777 | Standard Test Method for Thickness of Textile Materials |
| 3. ASTM D 3786 | Standard Test Method for Bursting Strength of Textile Fabrics - Diaphragm Bursting Strength Tester Method |
| 4. ASTM D 4533 | Standard Test Method for Trapezoid Tearing Strength of Geotextiles |
| 5. ASTM D 4632 | Standard Test Method for Grab Breaking Load and Elongation of Geotextiles |
| 6. ASTM D 4751 | Standard Test Method for Determining Apparent Opening Size of a Geotextile |
| 7. ASTM D 4833 | Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products |
| 8. ASTM D 5034 | Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test) |
| 9. ASTM D 5035 | Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method) |
| 10. ASTM D 5261 | Standard Test Method for Measuring Mass per Unit Area of Geotextiles |

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Quality Control Certificates shall be provided at a minimum frequency of one (1) per every hundred thousand (100,000) square feet of geosynthetics produced consecutively, and which is supplied to the project. These certificates shall be supplied only for the individual

rolls of geosynthetics sampled and tested by the Manufacturer or his representative. An individual Quality Control Certificate shall be provided for each roll of geosynthetics provided to the project, which was not produced consecutively within the hundred thousand (100,000) square foot lot. Quality Control Certificates shall be submitted two (2) weeks prior to installation of geosynthetics and shall state that the geosynthetics meets the requirements of these specifications for:

1. Mass per Unit Area
 2. Grab Tensile Strength
 3. Mullen Burst Strength
 4. Equivalent Opening Size
- C. Geosynthetics shall not be accepted and/or incorporated into the project without the approved quality control documentation.
- D. Certification stating that all geosynthetics is furnished by one manufacturer shall be submitted two (2) weeks prior to installation.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage and handling of the geosynthetics shall be the responsibility of CONTRACTOR.
- B. During shipment, handling and storage, the geosynthetics shall be protected from ultraviolet light exposure, precipitation, or other inundation, mud, dirt, dust, puncture, cutting or any other damage or deleterious conditions. To that effect, geosynthetics rolls shall be shipped and stored in relatively opaque and watertight wrappings. An opaque tarp shall be placed over all rolls where the outer wraps are removed or damaged and where the geotextile is exposed. CONTRACTOR shall be responsible for the replacement of damaged or unacceptable materials at no cost to OWNER.
- C. Storage of Materials: A storage area shall be provided on site by OWNER. The storage of geosynthetic materials shall be the responsibility of CONTRACTOR until the completed installation is accepted by ENGINEER.
- D. Damaged Geosynthetics: Damaged geosynthetic materials shall be repaired, if possible, in accordance with these specifications, or shall be replaced at no additional cost to OWNER.

1.6 MEASUREMENT AND PAYMENT

- A. Geosynthetics shall not be measured or paid as a separate item, but shall be included as part of the various items to which it relates.

PART 2 PRODUCTS

2.1 GEOSYNTHETICS (FILTER FABRIC)

- A. The geosynthetics shall be 10-ounce (or heavier) non-woven filter fabric.
- B. Geosynthetics shall be provided in rolls.
- C. Each roll of geosynthetics shall be externally labeled or tagged to provide product identification sufficient for field determination as well as inventory and quality control

purposes. Each roll shall be labeled with the name of manufacturer, roll number, physical dimensions (length and width) and the material type. Any roll of geosynthetics from which the labeling has been removed or has become illegible, shall not be used, but shall be removed from the site and replaced at the expense of CONTRACTOR.

- D. The geosynthetics shall be sampled, tested, and certified by the manufacturer for the following properties:

MATERIAL PROPERTIES FOR NON-WOVEN GEOTEXTILE FILTER FABRIC		
Property	Specification	ASTM Test Method
Mass per Unit Area (min)	10.0 oz./S.Y.	D-5261
Grab Tensile Strength (min)	250 lbs.	D-4632
Elongation at Break	50 %	D-4632
Tear Strength (min)	100 lbs	D-4533
Apparent Opening Size (maximum U.S. Sieve size)	100 mesh	D-4751

- E. Filter Fabric shall be **Mirafi 1100N by TenCate, 250NW by U.S. Fabrics**, or approved equal.

2.2 GEOSYNTHETIC (DRAINAGE COMPOSITE)

- A. Geosynthetic drainage composite materials shall be provided in rolls. The system shall have a polypropylene dimpled core bonded to a non-woven filter fabric.
- B. Each roll of geosynthetic material shall be externally labeled or tagged to provide product identification sufficient for field determination as well as inventory and quality control purposes. Each roll shall be labeled with the name of manufacturer, roll number, physical dimensions (length and width) and the material type. Any roll of geosynthetic material from which the labeling has been removed or has become illegible, shall not be used, but shall be removed from the site and replaced at the expense of CONTRACTOR.
- C. The geosynthetic materials shall be sampled, tested, and certified by the manufacturer for the following properties:

MATERIAL PROPERTIES PREFABRICATED DRAINAGE COMPOSITE		
Property	Specification	ASTM Test Method
Mass per Unit Area (min)	15.8 oz./S.Y.	D-5261
Grab Tensile Strength of Geotextile (min)	100 lbs.	D-4632
Puncture of Geotextile	30 lbs	D-4833
AOS of Geotextile (min)	70	D-4751
Thickness	0.40 inch	D-1777
Compressive Strength of Core	15,000 psf	D-1621
Flow (gal/min/ft)	17.5	D-4716 @ 4000 psf and i=1

- D. Prefabricated Drainage Composite shall be **J-DRain 420 by JDR Enterprises, Inc., Delta-Drain 6000 by Cosella-Dorken**, or approved equal.

PART 3 EXECUTION

3.1 DEPLOYMENT

- A. Prior to deployment, CONTRACTOR shall inspect each roll of geosynthetics to verify that the roll has a valid Quality Control Certificate and that has been previously approved by ENGINEER.
- B. Adjacent rolls shall be joined by overlapping the edges a minimum of twelve (12) inches.
- C. The overlap shall be glued, sewn or otherwise fastened or secured at intervals no greater than two feet along a line through the midpoint of the overlap. Additional fasteners shall be installed as necessary to prevent slippage of the geosynthetics regardless of location.
- D. CONTRACTOR shall visually inspect the geosynthetics during deployment for holes, tears or improperly formed geosynthetics. Defective areas shall be repaired or removed and replaced by CONTRACTOR at no additional cost to OWNER.
- E. Smoking shall not be permitted on the geosynthetics.
- F. CONTRACTOR shall be responsible to provide adequate loading (e.g., sand bags or similar items that will not damage the underlying geosynthetic) to prevent movement of the geosynthetics. Any damage to the geosynthetics shall be repaired at CONTRACTOR's expense.
- G. The geosynthetics shall not be exposed to the sun and elements for more than 72 hours unless the filter fabric has ultraviolet inhibitors. Fabric with ultraviolet inhibitors shall not be exposed for a period in excess of the manufacturer's recommendations, in which case manufacturer shall provide prior to product delivery.

- H. Any damage to the geosynthetics during installation or any fabric that has been exposed to the sun or elements for longer than the 72 hours, or as specified by the manufacturer, shall be replaced by CONTRACTOR at no additional cost to OWNER.
- I. CONTRACTOR shall be responsible to observe placement of geosynthetics. CONTRACTOR shall provide a daily inventory of all geosynthetics deployed to ENGINEER.

3.2 REPAIRS

- A. Any holes, tears or defective areas in the geosynthetics shall be repaired by patching with same type of geosynthetics. The patch shall extend a minimum of twelve (12) inches in all directions beyond the area to be repaired. The patch shall be secured in place by gluing, sewing, or securing the fabric as per these specifications.

- END OF SECTION -

SECTION 31 11 00
CLEARING, GRUBBING, AND STRIPPING

PART 1 GENERAL

1.1 SUMMARY

- A. This Work shall consist of removing and disposing of all trees; shrubs; brush; stumps; windfalls; roots; and other vegetation, including dead and decayed matter; and debris that exist within the designated construction limits, borrow areas, and soil stockpile areas and which are not specifically designated to remain.

1.2 DEFINITIONS

- A. Clearing: Clearing operations shall consist of cutting, removing and disposing of trees, shrubs, bushes, windfalls and other vegetation within the construction limits, borrow areas, and soil stockpile areas. All brush shall be cut off within six inches of the ground surface.
- B. Grubbing: Grubbing operations shall consist of removing and disposing of stumps, roots, debris deleterious materials, and other remains (such as organic and metallic materials) which if left in place would interfere with proper performance or completion of the contemplated work, would impair its subsequent use or form obstructions therein. Organic material from clearing or grubbing operations shall not be incorporated in fill or backfill.
- C. Stripping: Stripping operations shall consist of removing all soil material containing sod, grass, or other vegetation and topsoil to a minimum depth of six (6) inches from all areas that will receive fill or over all trenches in field or yard areas.

1.3 MEASUREMENT AND PAYMENT

- A. Measurement and payment for clearing, grubbing and stripping shall not be paid as a unit item, but considered as included in the contract unit or lump sum prices for the various items of the contract to which it relates.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 CLEARING

- A. All trees, stumps, shrubs, bushes, windfalls and other vegetation (except such trees and vegetation as may be indicated or directed by ENGINEER to be left standing) shall be cut off to within six inches of the ground surface and shall be removed from the construction limits. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by such means as the circumstances require.

3.2 GRUBBING

- A. All stumps, roots, debris, deleterious and other organic or metallic materials not suitable for foundations shall be removed completely from the construction limits, borrow areas and soil stockpile areas. Unless otherwise permitted by ENGINEER, stumps shall be removed completely. If any stumps are permitted to remain, they shall be cut off not more

than six inches above the ground.

3.3 STRIPPING

- A. Soil material containing sod, grass, or other vegetation and topsoil shall be removed to a minimum depth of six (6) inches from all areas to receive fill from the area within lines 5 feet outside all foundation walls, over all trenches, and from beneath pavement and curb and gutter areas. The stripped material shall be deposited in such locations as are acceptable to ENGINEER. Topsoil shall be placed over designated areas to be landscaped, and over all trench areas (outside of paved areas).
- B. All areas to be sodded shall have a minimum thickness of 3 inches (or thicker if required elsewhere in these documents or on the drawings) of topsoil.

3.4 DISPOSAL

- A. No open burning of combustible materials will be allowed.
- B. All trees, timber, stumps, roots, debris, shrubs, bushes, and other vegetation removed during the clearing and grubbing operations shall be removed from the project site and disposed of by CONTRACTOR subject to specific regulations imposed by laws and ordinances and in a manner that will not create a public nuisance nor result in unsightly conditions. CONTRACTOR shall assume full responsibility for acceptable disposition of the material as well as for any damages resulting from his disposal operations.

- END OF SECTION -

SECTION 31 22 00
SITE GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. This Work consists of site grading and related activities

1.2 RELATED WORK

- A. Related work specified in other sections:
 - 1. Section 01 45 00 - Quality Control and Materials Testing
 - 2. Section 01 50 00 - Temporary Construction Utilities & Environmental Controls
 - 3. Section 31 23 15 - Excavation and Backfill for Buried Pipelines
 - 4. Section 31 23 23 - Excavation and Backfill for Structures
 - 5. Section 32 11 23 - Untreated Base Course

1.3 REFERENCES

- A. The latest edition of the following publications form a part of these Specifications to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)
 - 2. ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

1.4 MEASUREMENT AND PAYMENT

- A. Site grading shall not be paid as a separate item but shall be paid as part of the items to which it relates.

PART 2 PRODUCTS

2.1 EMBANKMENT MATERIAL

- A. Embankment materials are defined as those complying with ASTM D2487, the Unified Soil Classification System (USCS) of CL, ML, SM, SC, SP or combinations of these materials.
- B. Embankment material shall be free from frozen lumps, rocks larger than 6 inches in the larger dimension, roots, trash, lumber or organic material. Suitability of material for embankment in accordance with these criteria will be as determined by ENGINEER.
- C. It is not anticipated that CONTRACTOR will be required to furnish additional quantities of embankment fill material from off-site sources to supplement material available from on-site excavations. However, if required, CONTRACTOR shall not borrow materials from adjacent private or public lands without providing to OWNER written verification of such

approval from the appropriate land owner or agency. CONTRACTOR shall be responsible for all costs associated with providing additional quantities of embankment fill as may be required to complete the work described herein and as shown on the drawings.

PART 3 EXECUTION

3.1 GENERAL

- A. Grading shall produce uniform grades or slopes between spot elevations or contours shown.
- B. Areas of construction activity shall be left in condition of uniform grade, blending into pre-existing contours and concealing, as much as possible, evidence of construction activity by back dragging or raking to conceal tire marks. Revegetation shall not be performed until the subgrade is acceptable to OWNER.
- C. Unless otherwise directed by OWNER, all excess excavated materials shall be removed from the site and disposed of by CONTRACTOR. CONTRACTOR shall restore stockpile area to pre-existing condition.

3.2 SITE PREPARATION

- A. Prior to placement of embankment fill, loose or disturbed soil shall be removed and replaced with compacted structural fill, or disturbed soil shall be properly compacted.
- B. Prior to placement of embankment fill, the top 6-inches, or as noted on the drawings, of the subgrade shall be scarified and compacted to 95% minimum Modified Proctor density as determined by ASTM D1557.
- C. Embankment shall include the placement of materials to raise the existing grade to the established elevations indicated and the construction of driving surfaces.
- D. Embankment material shall be placed in no more than 8-inch loose lifts for heavy equipment, and 4-inch loose lifts for hand operated equipment.
- E. All embankment fill material shall be placed and compacted to 96% minimum Modified Proctor Density as determined by ASTM D1557. Embankment under roadways, to a minimum depth of four feet, shall be compacted to 96% minimum as determined by ASTM D1557.
- F. Where the moisture content is not suitable and/or sufficient compaction has not been obtained, the fill shall be reconditioned to an approved moisture content and recompacted to the minimum required compaction, unless recommended otherwise by the Soils Testing Agency, prior to placing any additional fill material.
- G. Unless otherwise specified, CONTRACTOR shall be responsible for arranging for the placing and compacting of approved fill material in accordance with these Specifications. If the Soils Testing Agency should determine that CONTRACTOR is failing to meet the minimum requirements, CONTRACTOR shall stop operations and make adjustments as necessary to produce a satisfactorily compacted fill at no additional cost to OWNER.

3.3 GRADING

- A. The final grade of all completed areas shall be between plus and minus one-tenth (± 0.1) of a foot from the grade designated on the drawings.

- END OF SECTION -

SECTION 31 22 16

FINE GRADING

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Perform fine grading work required to prepare site for landscape finish grading and soil preparation as described in Contract Documents.
 - 2. Furnishing of conditioner to imported topsoil.
- B. Related Sections:
 - 1. Section 32 91 13: Finish grading and soil preparation for landscaping.

1.2 REFERENCES

- A. American Society For Testing And Materials:
 - 1. ASTM D 1557-02, 'Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.'

1.3 QUALITY ASSURANCE

- A. Pre-Installation Conference: Participate in pre-installation conference.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not commence work of this Section until site grading tolerances are met.

3.2 PREPARATION

- A. Protection: Protect utilities and site elements from damage.
- B. Surface Preparation:
 - 1. Before placing topsoil, dig out weeds from planting areas by their roots and remove from site. Remove rocks larger than 1 inch in size and foreign matter such as building rubble, wire, cans, sticks, concrete, etc.
 - 2. Remove imported paving base material present in planting areas down to natural sub-grade or other material acceptable to Architect.

3. Limit use of heavy equipment to areas no closer than 6 feet from tank or other permanent structures.

3.3 PERFORMANCE

- A. Interface with Other Work: Do not commence work of this Section until site grading tolerances are met.
- B. Site Tolerances:
 1. Maximum variation from required grades shall be 1/10 of one foot.
 2. To allow for final finish grades of planting areas, sub-grade elevations in landscape areas, before placing topsoil are:
 - a. Rock Mulched Shrub & Tree Areas: 15 inches below top of walk or curb.
- C. Do not expose or damage existing shrub or tree roots designated to remain.
- D. Distribute approved imported topsoil as required. Remove organic material, rocks and clods greater than 1 inch in any dimension, and other objectionable materials.
- E. Slope grade away from structure for 12 feet minimum from walls at slope of 1/2 inch in 12 inches minimum unless otherwise noted. Direct surface drainage in manner indicated on Drawings by molding surface to facilitate natural run-off of water. Fill low spots and pockets with specified fill material and grade to drain properly.

END OF SECTION

SECTION 31 23 15
EXCAVATION AND BACKFILL FOR BURIED PIPELINES

PART 1 GENERAL

1.1 SUMMARY

- A. This item shall consist of excavating all pipeline trenches to the lines and grades indicated on the Contract Drawings or as directed by ENGINEER in the field, and the backfilling of all pipeline trenches. Excavation shall include the removal of all materials of whatever nature encountered to the depths shown on the Contract Drawings, or as modified in the Field by ENGINEER.

1.2 RELATED SECTIONS

- A. Related work specified in other Sections:
1. Section 01 33 00 Submittal Procedures
 2. Section 01 45 00 Quality Control & Materials Testing
 3. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
 4. Section 31 23 19 Dewatering
 5. Section 33 05 01 ABS Pipe
 6. Section 33 05 02 Reinforced Concrete Pipe
 7. Section 33 05 05 Ductile Iron Pipe
 8. Section 33 05 07 Polyvinyl Chloride Pipe
 9. Section 33 92 10 Steel Pipe, Specials, and Fittings

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referred. The publications are referred to in the text by basic designation only.
- B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
1. M 145 Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
 2. T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
 3. T 88 Standard Method of Test for Particle Size Analysis of Soils
 4. T 96 Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 5. T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
 6. T 191 Standard Method of Test for Density of Soil In Place by the Sand Cone Method
 7. T 205 Density of Soil In-Place by the Rubber-Balloon Method
 8. T 238 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
 9. T 239 Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
 10. T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. C 131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
2. C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
3. D 422 Standard Test Method for Particle Size Analysis of Soils
4. D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³)
5. D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
6. D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft³)
7. D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity -Flow Applications
8. D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
9. D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.4 DEFINITIONS

- A. Degree of Compaction: Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.
- B. Pipe Zone: That zone in an Excavation which supports, surrounds, and extends to 12 inches above the top of the pipe barrel. Specifically, 6 inches below the bottom (4 inches below the bottom where rock, hard pan, boulders, etc. are encountered), 12 inches above the top of the pipe, and 1 foot laterally beyond both sides of the pipe, unless noted otherwise on the Drawings.
- C. Trench Zone Backfill: That zone in an Excavation which begins 12 inches above the top of the pipe barrel and extends to the natural surface level or the finished grade indicated on the Plans.
- D. Unyielding Material: Unyielding material shall consist of rock and gravelly soils with stones greater than 12 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.
- E. Unstable Material: Unstable material shall consist of materials too wet to allow backfill compaction or to properly support the utility pipe, conduit, or appurtenant structures.
- F. Rock: Solid mineral material which cannot be removed with equipment reasonably expected to be used in the Work without cutting, drilling or blasting. Minimum equipment size, in good running order, shall be similar to a Komatsu 300, Caterpillar 320 or 330, or equal.

1.5 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

1. Copies of Field Density Test reports shall be submitted to ENGINEER or RPR at the beginning of each work day for the previous day's testing of subgrades, embankments and backfill Materials.
2. Copies of all Laboratory Test Reports shall be submitted to ENGINEER or RPR within 24 hours of the completion of the test.
3. Submit gradations and proctors for Pipe Zone Material and Trench Zone Backfill.
4. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

1.6 SITE CONDITIONS

- A. Unsuitable Weather Limitations: CONTRACTOR shall not place, spread, or roll any fill material during unsuitable weather conditions. CONTRACTOR shall not resume operations until moisture content of material is satisfactory.
- B. Weather Softened Subgrade: CONTRACTOR shall remove and replace at no additional cost to OWNER soft subgrade materials resulting from adverse weather conditions.
- C. Protection of Graded Areas: CONTRACTOR shall protect all graded areas from traffic and erosion and shall keep these areas free of trash and debris. Work required to repair and reestablish grades in settled, eroded, and rutted areas shall be completed to specified tolerances at CONTRACTOR's expense.
- D. Reconditioning Compacted Areas: All areas compacted to required specifications that become disturbed by subsequent construction operations or weather conditions shall be scarified, moisture conditioned, and re-compacted to the required density prior to further construction.
- E. Grading: the final compacted surface of base course shall not vary more than 1/4 inch above or below design grade.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Stabilization Material: Stabilization material shall consist of hard, durable particles of stone or gravel, screened or crushed to the required size and gradation. The material shall be free from vegetation matter, lumps or balls of clay, or other deleterious matter and shall conform to the following gradation when tested in accordance with AASHTO T 27 or ASTM C 136.
 1. Coarse material shall be crushed or washed and fine material shall be wasted to meet the grading requirements set forth below. Note that if stabilization material is required, an 8 oz. non-woven filter fabric shall be placed between the stabilization material and the pipe zone material.

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

Sieve Size (Square Opening)	Percent By Weight Passing Screen
2-inch	100
1-1/2 inch	10 - 50
3/4-inch	0 - 25
No. 4	0 - 10
No. 200	0 - 3

- B. Select Pipe Zone Material: Select material shall consist of 1-inch minus, well-graded native or import material, shall be free from vegetative matter, or other deleterious matter, and shall meet manufacturer's recommendations for the type of pipe installed. Select Pipe Zone Material shall be capable of meeting the compaction requirements.
- C. Pipe Zone Material: All material in the pipe zone shall be clean and free from alkali, salt, petroleum products, vegetative matter or other deleterious matter, slag, cinders, ashes and rubbish or other material that in the opinion of the ENGINEER may be objectionable or deleterious. "Squeegee" or any other flowable material shall not be permitted. Pipe zone material shall conform to the following:

1. Storm Drain – Gravel, 100 percent crushed mineral aggregate per the following gradation:

U.S. Standard Sieve Size (Square Opening)	Percent By Weight Passing Screen
1 1/2 - inch	100
1 - inch	95-100
1/2 - inch	25-60
No. 4	0-10
No. 200	0-5

2. Waterline – Sand per the following gradation:

U.S. Standard Sieve Size (Square Opening)	Percent By Weight Passing Screen
3/8 - inch	100
No. 4	80-100
No. 8	30-50
No. 40	10-30
No. 200	7-15

- 3. Waterline – Controlled Low-Strength Material (Flowable Fill):
 - a. Flowable Fill shall be per APWA Section 03 31 05 – Controlled Low Strength Material.
- D. Select Trench Backfill: Select backfill shall consist of native or imported materials (soils or bedrock which can be broken down to a compactible size). Maximum particle size for backfill shall be no greater than 4-inches. Select backfill shall be capable of meeting the compaction requirements.
- E. Native Trench Backfill: Trench backfill may consist of native fill material meeting soils classifications A-1, A-2 or A-3 (A-1-a for Granular Borrow material) of AASHTO M 145, with a maximum particle size no greater than 4-inches in any dimension and shall be capable of meeting the compaction requirements. Trench backfill shall be non-plastic. Trench backfill shall be free from alkali, salt, petroleum products, vegetative matter or other deleterious matter, slag, cinders, ashes and rubbish or other material that in the opinion of the ENGINEER may be objectionable or deleterious. “Squeegee” or any other flowable material shall not be permitted.
- F. Imported Granular Trench Backfill: At the direction of the OWNER where native materials are unable to achieve satisfactory compaction or meet the required soils classification, imported granular trench backfill shall be used and shall consist of imported materials meeting soils classifications A-1, A-2 or A-3 (A-1-a for Granular Borrow material) of AASHTO M 145 and shall be non-plastic. Maximum particle size for backfill shall be no greater than 6 inches. Imported granular trench backfill shall be capable of meeting the compaction requirements.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavation shall be performed to the lines and grades indicated. All excavated materials not intended for reuse shall be removed from the site and disposed of by the Contractor.
- B. Rock Removal
 - 1. CONTRACTOR shall cut away Rock at excavation bottom to form level bearing.
 - 2. All shale layers shall be removed to provide sound and unshattered base for foundations.
 - 3. CONTRACTOR shall remove and legally dispose of excess excavated material and debris off-site unless indicated otherwise.
 - 4. CONTRACTOR shall correct unauthorized Rock removal at no additional cost to OWNER.

3.2 SAFETY

- A. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the latest requirements of OSHA Safety and Health Standards for Construction (29 CFR 1926). CONTRACTOR is responsible for assessing safety needs to meet such requirements, arranging for proper equipment and/or

construction methods, and maintaining such equipment, methods and construction practices so as to fully comply with all safety requirements.

- B. CONTRACTOR is responsible for assessing needs related to confined space entry, as defined by OSHA. CONTRACTOR shall meet all such requirements, arranging for proper equipment and/or construction methods, and maintaining such equipment, methods and construction practices so as to fully comply with all confined space safety requirements.

3.3 DEWATERING

- A. Water removal shall be in accordance with Section 31 23 19 - Dewatering.

3.4 TRENCH WIDTH

- A. The bottom of the trench shall have a minimum width equal to the outside diameter of the pipe plus 24-inches or as detailed on the drawings.
- B. The width of the trench shall be ample to permit the pipe to be laid and jointed properly, and the backfill to be placed and compacted as specified. Trenches shall be of such extra width, when required, as will permit the convenient placing of timber supports, sheeting, and bracing, and the handling of special units as necessary.

3.5 TRENCH PREPARATION

- A. Each trench shall be excavated so that the pipe can be laid to the alignment and grade as required. The trench wall shall be so braced that the workmen may work safely and efficiently. All trenches shall be drained so the pipe laying may take place in dewatered conditions.
- B. Bottom Preparation
 - 1. Where rock, hard pan, boulders or other material which might damage the pipe are encountered, the bottom of the trench shall be over excavated 4 inches below the required grade and replaced with Stabilization Material. Otherwise, the bottom of the trench shall be over excavated 6 inches or 1/12 the outside diameter of the pipe, whichever is greater, below the required grade and replaced with Pipe Zone Backfill.
 - 2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 1-inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.
- C. Removal of Unstable Material
 - 1. Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed by ENGINEER and replaced to the proper grade with Stabilization Material. When removal of unstable material is required due to the fault or neglect of CONTRACTOR in his performance of the work, the resulting material shall be excavated and replaced by CONTRACTOR without additional cost to OWNER.

- D. The trench bottom (at the level of the base of the pipe) shall be given a final trim using a string line, laser, or another method approved by ENGINEER for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Bell holes shall be provided at each joint to permit the jointing to be made properly. The trench grade shall permit the pipe spigot to be accurately centered in the preceding laid pipe joint, without lifting the pipe above the grade, and without exceeding the permissible joint deflection.

3.6 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.7 LAYING AND JOINING PIPE

- A. Laying pipe: Provide proper facilities for lowering pipe sections into place. Dropping pipe will not be permitted. Place each section true to line and gradient in close and true contact with adjacent sections.
- B. Joining pipe:
 - 1. Use methods of joining conduit sections insuring ends are fully entered and inner surfaces are flush and even. The equipment used to force the joints together must be adequate to overcome the gasket pressure involved. Pipe shall be installed in accordance with these specifications and the manufacturers written specifications.
 - 2. Just prior to joining the pipes, both spigot and bell ends shall be thoroughly cleaned to remove all foreign substances which may have adhered to the bell and spigot surfaces. All dust and dirt shall be removed with a clean rag. An approved lubricant (recommended by the manufacturer), that is not injurious to the gasket, shall be applied in accordance with the manufacturer's recommendations.
 - 3. In the event any foreign material becomes embedded in the lubricant, or the lubricant becomes contaminated by water or other substances before the joint is started, the area affected shall be re-cleaned and new lubricant applied.
 - 4. The pipe being joined shall be carefully moved into position, line and grade checked, and, as the spigot end is started into the bell of the section previously laid, the gasket shall be checked to insure uniform entry into the bell at all points. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Apply firm steady pressure either by hand or by bar and block assembly, until the spigot easily slips through the gasket. Care must be taken to insure that the spigot is not over-inserted and that previously assembled pipe joints are not disturbed.

3.8 PIPELINE TRENCH BACKFILLING AND COMPACTION

A. Pipe Zone:

1. Pipe Zone Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise approved or specified. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Each layer shall be compacted to at least 95 percent of the maximum Modified Proctor density (ASTM D-1557), unless otherwise specified.
2. Replacement of Unyielding Material: Unyielding material removed from the bottom of the trench shall be replaced with Stabilization Material placed in layers not exceeding 6 inches loose thickness.
3. Replacement of Unstable Material: Unstable material removed from the bottom of the trench or excavation shall be replaced with Stabilization Material placed in layers not exceeding 6 inches loose thickness.
4. Where the pipe grade exceeds 30%, cohesive material shall be used in lieu of pipe bedding. The cohesive material shall be moistened to within 2% of optimum moisture and compacted as noted.
5. The relative density of the compacted cohesionless material shall not be less than 60% as determined by the Bureau of Reclamation Relative Density of Cohesionless Soil Test (Designation E-12) of the "Earth Manual."

B. Trench Backfill: Trenches shall be backfilled to the grade shown with Trench Backfill material as specified.

1. Trench backfill in asphalted road shall consist of backfilling the trench from above the pipe zone up to underneath the noted recommended depth for untreated base course and asphalt or concrete of finished grade with Trench Backfill material compacted to 95 percent of maximum density (ASTM D-1557). Backfill shall be placed in layers not exceeding 6-inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise approved or specified.
2. Trench backfill in unimproved or landscaped areas shall consist of backfilling the trench from above the pipe zone to 8-inches below finished grade with Trench Backfill material compacted to 95 percent of maximum density (ASTM D-1557). Backfill from 8-inches below finished grade to finished grade shall consist of topsoil replacement in addition to replacement of all landscaped materials. Trench backfill shall be placed in layers not exceeding 8 inches loose thickness.
3. It shall be the responsibility of CONTRACTOR to be assured that the Trench Backfill material is capable of being compacted to the degree specified. It shall be CONTRACTOR's responsibility to remove and dispose of all excess excavated material.

C. Final Backfill:

1. Unimproved and Landscaped Areas: The top 8-inches of the trench shall be filled with topsoil. Topsoil may be native material stripped prior to excavation of the trench. Backfill shall be deposited in layers of a maximum of 12-inch loose thickness, and compacted to a minimum of 85 percent maximum density (ASTM D-1557).

Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

2. Roadways shall be completed with the type and thickness of materials (i.e. Untreated Road Base and Asphalt) as indicated or shown on the drawings

3.9 SPECIAL REQUIREMENTS

- A. Special requirements for both excavation and backfill relating to the specific utilities from above the pipe zone to the natural surface level or the finished grade indicated on the Plans shall be placed and compacted as follows:
 1. Where existing underground pipes or conduits larger than 3 inches in diameter and all sizes of sewer lines or sewer laterals cross the trench above the new work, the backfill from the bottom of the trench to 1 foot above the top of the intersecting pipe or conduit shall be pipe zone material compacted to 95 percent of maximum density (ASTM D-1557). The pipe zone material shall extend 2 feet on either side of the intersecting pipe or conduit to insure that the material will remain in place while other backfill is placed.
- B. The maximum trench length open at any given time shall not exceed 200 feet unless approved by the ENGINEER, and must be backfilled in a timely manner.

3.10 MAINTENANCE OF BACKFILL

- A. All backfill shall be maintained in satisfactory condition, and all places showing signs of settlement shall be filled and maintained during the life of the Contract and for a period of one year following the day of final acceptance of all work performed under the Contract. When CONTRACTOR is notified by ENGINEER or OWNER that any backfill is hazardous, CONTRACTOR shall correct such hazardous condition at once. Any utility, road and/or parking surfacing damaged by such settlement shall be repaired by CONTRACTOR to the satisfaction of OWNER and ENGINEER. In addition, CONTRACTOR shall be responsible for the cost to OWNER of all claims for damage filed with the Court, actions brought against the said OWNER for, and on account of, such damage.

3.11 FINISH GRADING AND CLEANUP

- A. CONTRACTOR shall grade the trench line to a smooth grade to affect a neat and workmanlike appearance of the trench line.
- B. All tools, equipment and temporary structures shall be removed. All excess dirt and rubbish shall be removed from the site by CONTRACTOR.
- C. CONTRACTOR shall restore the site to at least as good as original condition, including but not limited to final trench grade and restoration of affected public and private facilities whether in the public right-of-way or on private property. Any exception to this requirement must be in writing from ENGINEER for the job specific conditions.

3.12 COMPACTION TESTS

- A. It shall be the responsibility of CONTRACTOR to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of CONTRACTOR to control his operations by performing any additional tests necessary to verify and confirm that

CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

1. Testing of Backfill Materials

- a. Characteristics of backfill materials shall be determined in accordance with the requirements of Section 01 45 00 - Quality Control & Materials Testing.
- b. The CONTRACTOR shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:
 - i) 50 linear feet of trench backfill.
- c. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
- d. After satisfactory conclusion of the initial compaction demonstration and at any time during construction, earthwork which does not comply with the specified degree of compaction shall not exceed the previously specified quantities.
- e. Compliance tests may be made by ENGINEER to verify that compaction is meeting the requirements previously specified at no cost to CONTRACTOR.
- f. ENGINEER may require retesting of backfill that has settled from water penetration in the trench. CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall backfill and recompact the excavation after the test is complete at no additional cost to the OWNER.
- g. If compaction fails to meet the specified requirements, CONTRACTOR shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to ENGINEER. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by CONTRACTOR. CONTRACTOR's confirmation tests shall be performed in a manner acceptable to ENGINEER

2. Field Density Tests

- a. Field density tests shall be made in accordance with ASTM D 1557.

- END OF SECTION -

SECTION 31 23 19
DEWATERING

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section provides specifications for dewatering systems and appurtenances to be used during construction as required to remove water and continuously maintain groundwater at a level at least 1-foot below the bottom of the excavation.
- B. Contractor shall obtain all necessary permits for disposal of water removed from the excavation.

1.2 RELATED WORK

- A. Related work specified in other sections:
 - 1. Section 01 33 00 Submittal Procedures

1.3 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Before dewatering is commenced, Contractor shall provide information to Engineer outlining the method, installation and details of the proposed dewatering system. CONTRACTOR shall provide ENGINEER with plans setting forth details of the proposed dewatering systems. The dewatering system plans shall be of sufficient detail to indicate sizes of pumps, piping, appurtenances, the ultimate disposal point for water, and to indicate the overall completeness and effectiveness of the proposed system.
- C. CONTRACTOR shall certify to OWNER that the design and implementation of the proposed dewatering system is sufficient to complete the Work.
- D. Submit a plan to monitor settlement of adjacent structures.

1.4 QUALITY CONTROL

- A. Contractor shall be responsible to control the rate and effect of dewatering to avoid all settlement and subsidence.
- B. Where critical structures exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at frequent intervals to detect any settlement which may develop. Contractor is responsible for protecting adjacent structures from settlement. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of Contractor.

PART 2 PRODUCTS

2.1 MATERIALS

- A. CONTRACTOR shall be responsible for selection of dewatering means, methods and materials.

- B. Standby pumping equipment shall be maintained on the Site.

PART 3 EXECUTION

3.1 DESIGN AND IMPLEMENTATION

- A. CONTRACTOR shall be responsible for complete design and implementation of the dewatering system.
- B. CONTRACTOR shall be responsible for the design and implementation of any modifications that may be required to the initial design of the dewatering system (at no additional cost to OWNER) to provide a dewatering system that operates adequately to complete the Work.
- C. CONTRACTOR shall furnish, install, operate and maintain all machinery, appliances, and equipment to maintain all excavations free from water during construction.
- D. CONTRACTOR shall dispose of water so as to not cause damage to public or private property, or to cause a nuisance or menace to the public or violate the law.
- E. CONTRACTOR shall be responsible to obtain groundwater discharge permits, if required.
- F. CONTRACTOR shall install and operate the dewatering system so as to not cause damage or endanger adjacent structures or property.
- G. The control of groundwater shall be such that softening of the bottom of excavations, or formation of "quick" conditions or "boils," does not occur. Dewatering systems shall be designed and operated so as to prevent removal and migration of the natural soils.
- H. CONTRACTOR shall have sufficient stand-by equipment at the project site at all times to continuously maintain the dewatering program until Work necessitating dewatering is complete.
- I. CONTRACTOR shall have on hand equipment and machinery in good working condition for emergencies and shall have personnel available for operation of such equipment and machinery.
- J. CONTRACTOR shall control surface water to prevent entry into excavations.

- END OF SECTION -

SECTION 31 23 23
EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers excavating, backfilling, and compacting of disturbed areas for structures and roadways as directed by ENGINEER.

1.2 RELATED WORK

- A. Related work specified in other sections:
1. Section 01 33 00 Submittal Procedures
 2. Section 01 45 00 Quality Control and Materials Testing
 3. Section 01 45 23 Testing Agency Services
 4. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
 5. Section 31 11 00 Clearing, Grubbing and Stripping
 6. Section 31 23 15 Excavation and Backfill for Buried Pipelines
 7. Section 31 23 19 Dewatering

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referred. The publications are referred to in the text by basic designation only.
- B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
1. M 145 Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
 2. T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
 3. T 88 Standard Method of Test for Particle Size Analysis of Soils
 4. T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
 5. T 191 Standard Method of Test for Density of Soil In Place by the Sand Cone Method
 6. T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. D 422 Standard Test Method for Particle Size Analysis of Soils
 2. D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³)
 3. D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
 4. D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft³)
 5. D 2487 Standard Practice for Classification of Soils for Engineering Purposes

- (Unified Soil Classification System)
6. D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- D. The latest Edition of the Utah Department of Transportation Standard Specification for Road and Bridge Construction.
- E. The latest Edition of the American Public Works Association (APWA) and Associated General Contractors of America Standard Plans and Standard Specifications.

1.4 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00 Submittal Procedures:
1. Submit gradations and proctors for structural fill materials and backfill materials.

PART 2 PRODUCTS

2.1 WALL BACKFILL MATERIAL

- A. Wall backfill material shall consist of native or import fill material meeting soils classifications A-1, A-2 or A-3 of AASHTO M 145, with a maximum particle size no greater than 6 inches in any dimension and shall be capable of meeting the compaction requirements.
1. Wall backfill material shall be free from frozen lumps, rocks larger than 6 inches in the largest dimension, roots, trash, lumber and organic material.

2.2 STRUCTURAL FILL

- A. Structural fill material, if required, shall meet the following requirements.
1. Material shall be non-expansive granular soil with less than 35 percent passing the No. 200 sieve, with a liquid limit less than 30, and free from rocks larger than 4 inches in the largest dimension, frozen lumps, roots, trash, lumber and organic material. The natural soils may be used as structural fill where it meets the above stated criteria.

2.3 FLOOR SLAB FILL (Upper 4 inches)

- A. Material shall be non-expansive granular soil with less than 5 percent passing the No. 200 sieve, and free from rocks larger than 2 inches in the largest dimension, frozen lumps, roots, trash, lumber and organic material. The natural soils may be used as fill for the first 4 inches directly under the slab where it meets the above stated criteria.

2.4 FLOOR SLAB

- A. Material shall be non-expansive granular soil with less than 50 percent passing the No. 200 sieve, with a liquid limit less than 30, and free from rocks larger than 6 inches in the largest dimension, frozen lumps, roots, trash, lumber and organic material. The natural soils may be used as fill below the first 4 inches under the slab where it meets the above stated criteria.

2.5 3/4" WASHED ROCK

- A. 3/4" Washed Rock shall consist of hard, durable particles of stone or gravel, screened or crushed, to the required size and gradation. The material shall be free from vegetation matter, lumps or balls of clay, or other deleterious matter and shall conform to the following gradation when tested in accordance with AASHTO T 27 or ASTM C 136.

Sieve Size (Square Opening)	Percent By Weight Passing Screen
3/4-inch	100
3/8 inch	78-92
No. 4	0 - 50
No. 8	0 - 5
No. 200	0 - 3

PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavation shall be performed to the lines and grades indicated. Excavated material not required or not satisfactory for backfill shall be removed from the site.
- B. Excavations shall be braced and supported as needed to prevent the ground adjacent to the excavation from sliding or settling. Slides shall be promptly removed and corrected by CONTRACTOR.

3.2 PREPARATION

- A. Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with granular fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Scarify subgrade surface to depth of 6 inches.

3.3 DEWATERING

- A. Water removal shall be in accordance with Section 31 23 19 - Dewatering.

3.4 BACKFILL

- A. Backfill material shall not be placed against concrete structures that have not been properly cured. No backfill material shall be placed until concrete has cured for a minimum of 7 days or until the compressible strength is 3,400 psi, whichever is greater.
- B. Backfill material shall be placed in no more than 6-inch loose lifts for compaction by hand operated machine compactors, and 8 inches loose lifts for other than hand operated machines.

- C. Structural fill placed beneath foundations, footings or the floor slab shall be placed and compacted to at least 96% of maximum dry density at a moisture content within 2 percent of optimum moisture content in accordance with ASTM D 1557.
- D. Backfill material shall be placed and compacted to at least 95 percent of maximum dry density at a moisture content within 2 percent of optimum moisture content in accordance with ASTM D-1557.
- E. Where the moisture content is not suitable and/or sufficient compaction has not been obtained, the fill shall be reconditioned to an approved moisture content and re-compacted to the minimum required compaction prior to placing any additional fill material.
- F. CONTRACTOR shall be responsible for arranging for the placing and compacting of approved fill material in accordance with these Specifications. If it is determined that CONTRACTOR is failing to meet the minimum requirements, CONTRACTOR shall stop operations and make adjustments as necessary to produce a satisfactorily compacted fill at no additional cost to OWNER.
- G. Sufficient personnel, equipment, sumps or other means should be provided to maintain the site in an acceptable dry condition for the duration of this contract.
- H. Excavations shall be so braced and supported as needed to prevent the ground, adjacent to the excavation, from sliding or settling. Localized slides or settlements shall be promptly removed and corrected by CONTRACTOR.

3.5 FINISHED GRADE

- A. The finished subgrade and grade of the fill shall not vary more than 0.05 feet from the established grades and cross sections shown on the Drawings.

3.6 COMPACTION TESTS

- A. Compaction testing shall be the provided and paid for in accordance with Section 01 45 00 – Quality Control and Materials Testing.
- B. It shall be the responsibility of CONTRACTOR to accomplish the specified compaction for backfill, structural fill, Untreated Base Course and other earthwork. It shall be the responsibility of CONTRACTOR to control his operations by performing any additional tests necessary to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

1. Testing of Backfill Materials

- a. Characteristics of backfill materials shall be determined in accordance with the requirements of Section 01 45 00.
- b. Contractor shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:

- 1) One (1) test per 1.0 feet of backfill thickness placed per structure.
- c. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
 - d. After satisfactory conclusion of the initial compaction demonstration and at any time during construction, earthwork which does not comply with the specified degree of compaction shall not exceed the previously specified quantities.
 - e. Quality Control tests may be made by Engineer to verify that compaction is meeting the requirements previously specified at no cost to Contractor. If Engineer requires retesting of backfill, CONTRACTOR shall remove the overburden above the level at which Engineer wishes to test and shall backfill and recompact the excavation after the test is complete at no additional cost to OWNER.
 - f. If compaction fails to meet the specified requirements, Contractor shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to Engineer. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid in accordance with Section 01 45 23 – Testing Agency Services. The confirmation tests shall be performed in a manner acceptable to Engineer. Frequency of confirmation tests for remedial work shall be double that amount specified for initial confirmation tests.
2. Field Density Tests
 - a. Tests shall be performed in sufficient numbers to meet the requirements of Section 01 45 00 and to ensure that the specified density is being obtained.
- C. Field density tests shall be made in accordance with ASTM D-1557 and ASTM D-6938.

- END OF SECTION -

SECTION 32 01 01

PLANT MAINTENANCE

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Provide maintenance for new landscaping as described in Contract Documents.
- B. Related Sections:
 - 1. Section 32 90 01: Common Planting Requirements.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 PERFORMANCE

- A. General:
 - 1. Before beginning maintenance period, plants shall be in at least as sound, healthy, vigorous, and in approved condition as when delivered to site, unless accepted by Architect in writing at final landscape inspection
 - 2. Maintain newly installed landscaping from completion of landscape installation to 30 days after Substantial Completion Meeting. Areas landscaped after October 15 will be accepted following spring approximately one month after start of growing season, May 1st or as determined by Architect, if specified conditions have been met.
 - 3. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Architect at end of maintenance period. Make replacements within 10 days of notification.
- B. Trees, Shrubs, And Plants:
 - 1. Maintain by pruning, cultivating, and weeding as required for healthy growth.
 - 2. Restore planting basins.
 - 3. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical positions as required.
 - 4. Spray as required to keep trees and shrubs free of insects and disease.
 - 5. Provide supplemental water by hand as needed in addition to water from sprinkling system.

END OF SECTION

SECTION 32 11 23
ROAD BASE - UNTREATED BASE COURSE

PART 1 GENERAL

1.1 DESCRIPTION

- A. This work consists of the placement of Sub-Base and Untreated Base Course (UBC) material at designated road ways and all driving surfaces as indicated on the Drawings.

1.2 RELATED SECTIONS

- A. Related work specified in other Sections:
1. Section 01 33 00 Submittal Procedures
 2. Section 01 45 00 Quality Control and Materials Testing

1.3 REFERENCES

- A. The latest edition of the following publication forms a part of this specification to the extent referenced. The publication is referred to in the text by basic designation only.
- B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
1. AASHTO T 88 Standard Method of Test for Particle Size Analysis of Soils
 2. AASHTO T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
 3. AASHTO T 191 Standard Method of Test for Density of Soil In-Place by the Sand Cone Method
 4. AASHTO T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods. (Shallow Depth)
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM D 422 Standard Method for Particle Size Analysis of Soils
 2. ASTM D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³)
 3. ASTM D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
 4. ASTM D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)
 5. ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 6. ASTM D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- D. The latest edition of the Utah Department of Transportation Standard Specification for Road and Bridge Construction (UDOT).

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Untreated Base Course (State approved 1 1/2" gradation, APWA Grade 1 or Grade 3/4).

1.5 MEASUREMENT AND PAYMENT

- A. Road Base shall not be measured or paid as a separate item, but shall be included as part of the various items to which it relates.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Untreated Base Course: Untreated Base Course Materials shall meet the APWA Specifications for Grade 1 or Grade 3/4 as shown in Table 1.

TABLE 1

SIEVE SIZE	MASTER GRADING BAND LIMITS (PERCENT PASSING)	GRADE 1 GRADATION (PERCENT PASSING)	GRADE 3/4 GRADATION (PERCENT PASSING)
1 1/2 inch	100	-	-
1 inch	90-100	100	-
3/4 inch	70-85	-	100
1/2 inch	65-80	79 - 91	-
3/8 inch	55-75	-	78 -92
No. 4	40-65	49 - 61	55 - 67
No. 16	25-40	27 - 35	28 - 38
No. 200	7-11	7 - 11	7 - 11

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

- A. Prior to placement of untreated base course materials, the foundation area to receive untreated base course materials shall be scarified to a minimum depth of 8-inches and recompacted to 95% minimum laboratory density as determined by ASTM D-1557.

3.2 UNTREATED BASE COURSE MATERIAL PLACEMENT

- A. No Untreated Base Course material shall be placed on sub-grade materials until the sub-grade has been checked and accepted by ENGINEER.
- B. Road base material placed on driving surfaces shall be compacted to a minimum density of 96% in accordance with ASTM D-1557 to provide a uniform graded smooth surface.

- C. Untreated Base Course material shall be placed to a minimum thickness eight (8) inches or as shown on the drawings.

3.3 FIELD QUALITY CONTROL

- A. CONTRACTOR shall be responsible for directing proper placement of all road base materials. CONTRACTOR shall be responsible for the stability of the road base materials during placement and shall replace any portions which have become displaced due to careless or negligent work on the part of CONTRACTOR, or to damage resulting from natural causes, such as storms.
- B. Whenever the work areas to receive Sub-Base and/or Untreated Base Course material are covered with snow, the snow must be removed prior to placing the road base and/or Untreated Base Course, and deposited outside the immediate construction areas at CONTRACTOR's expense.

- END OF SECTION -

SECTION 32 12 16
HOT-MIX ASPHALT CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. This section addresses the requirements for installing hot-mix asphalt concrete, as outlined in Section 33 05 25 – Pavement Restoration of the APWA Specifications, and as modified herein.

1.2 RELATED SECTIONS

- A. Related work specified in other sections includes but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 01 45 00 Quality Control and Materials Testing
 - 3. Section 01 50 00 Temporary Facilities and Environmental Controls
 - 4. Section 32 11 23 Road Base - Untreated Base Course
 - 5. Section 32 11 24 Pulverized Pavement Base Course (APWA)
 - 6. Section 32 12 05 Bituminous Concrete (APWA)
 - 7. Section 32 12 13.13 Tack Coat (APWA)
 - 8. Section 32 12 16.13 Plant-Mix Bituminous Paving (APWA)
 - 9. Section 32 17 23 Pavement Marking (APWA)
 - 10. Section 33 05 25 Pavement Restoration (APWA)

1.3 REFERENCES

- A. The American Public Works Association General Conditions and Standard Specifications for Construction, latest edition
- B. The latest edition of the following publication forms a part of this specification to the extent referenced. The publication is referred to in the text by basic designation only.
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM D 2041 Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
 - 2. ASTM D 2950 Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Method
 - 3. ASTM D 3665 Standard Practice for Random Sampling of Construction Materials

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Laboratory mix design for proposed hot-mix asphalt concrete paving.
- C. Means and methods for removal, reprocessing, and placement of existing asphalt surfaces as base course material.
- D. Laboratory mix design for proposed tack coat application.

- E. Quality assurance tests for asphalt and aggregate material sources.
- F. Copies of batch delivery tickets shall be submitted during progress of the work, and shall show the following information:
 - 1. Name of production facility
 - 2. Serial number of ticket
 - 3. Date and truck number
 - 4. Name of CONTRACTOR
 - 5. Job name and location
 - 6. Weight of asphalt concrete
 - 7. Loading temperature
 - 8. Signature or initial of plant representative
 - 9. Type and grade of asphalt cement
 - 10. Type and grade of aggregate
 - 11. Applicable mix design method
 - 12. Separate weights of aggregate and asphalt
- G. Submit type and number of rollers required for compacting asphalt concrete

1.5 SITE CONDITIONS

- A. Pave only when air and roadbed temperatures in the shade are greater than 40 deg. F and rising. The temperature restrictions may be waived only upon written authorization from ENGINEER.
- B. Do not pave during rain or unsuitable weather or when surface is wet.

1.6 ACCEPTANCE

- A. Acceptance of hot-mix asphalt concrete paving is based upon minimum density, minimum thickness, smoothness, and surface appearance. Smoothness and surface appearance shall be as defined by Section 32 12 16.13 of the APWA Specifications.

PART 2 PRODUCTS

2.1 BITUMINOUS PAVEMENT

- A. The bituminous material shall be PG64-22, DM-1/2, 50 blow per APWA Section 32 12 05 unless noted otherwise. Maximum allowable reclaimed asphalt pavement (RAP) is 15% and shall be free from detrimental quantities of deleterious materials.
- B. Sampling and testing shall be the responsibility of CONTRACTOR, and shall be performed as required in Section 01 45 00 - Quality Control and Materials Testing.

2.2 TACK COAT

- A. Tack coat material shall be Grade SS-1 and conform to all requirements of Section 32 12 13.13 - Tack Coat (APWA).

PART 3 EXECUTION

3.1 PREPARATION

- A. Preparation shall conform to all requirements of Section 32 12 16.13 and Section 33 05 25 of the APWA specifications.
- B. CONTRACTOR shall map and mark all existing surface utilities within the line of work, and shall lower fixtures if pavement machine is not capable of passing over structure.
- C. All asphalt and concrete surfaces within the line of work are to be removed and disposed of properly by CONTRACTOR. CONTRACTOR may, upon written authorization of OWNER, use processed asphalt materials as base course material. Excess materials shall be removed and disposed by CONTRACTOR.
- D. Existing asphalt pavements and drive approach extensions to be removed shall be cut by a wheel cutter or other device capable of making a neat, reasonably straight and smooth cut without damaging adjacent pavement and/or concrete that is not to be removed. The cutting device operation shall be subject to the approval of ENGINEER.
- E. Any existing base, surfacing, or pavement shall be thoroughly cleaned immediately prior to receiving the plant-mixed surfacing. Where existing pavement is being widened or extended, it shall be cut to a straight vertical face prior to the paving operations and treated with asphalt paint binder.

3.2 BASE COURSE

- A. Base course material shall be placed in accordance with Section 32 11 23 of these specifications.
- B. Base course surfaces shall be maintained in an acceptable condition for both moisture and density, as defined by Section 32 11 23 - Road Base – Untreated Base Course, until the overlying hot-mix asphalt cement materials have been placed, at no additional expense to OWNER.
- C. Processed asphalt materials may be used as base course provided that the resulting gradation for the 1" or 3/4" and -200 sieves comply with the requirements of Section 32 11 23 - Road Base. Processed asphalt materials may also be used if they meet the requirements of APWA Section 32 11 24 – Pulverized Pavement Base Course with the addition of stabilizers and if approved by the OWNER. Processed asphalt which has been contaminated with clay or silt materials will not be accepted.

3.3 PLACEMENT OF TACK COAT

- A. Apply tack coat to all existing asphalt concrete surfaces preparatory to placing asphalt concrete pavement in accordance with Section 32 12 13.13 – Tack Coat of the APWA specifications.

3.4 PLACEMENT OF HOT-MIX ASPHALT CONCRETE

- A. For all excavations within twenty-four (24) inches of any structure, concrete, or edge of existing pavement surface; CONTRACTOR shall remove and replace existing pavement surface to the concrete, structure, or edge of existing pavement surface.

- B. Where a longitudinal trench is partly in pavement, the pavement shall be replaced to the original pavement edge, on a straight line, parallel to the center line of the roadway.
- C. Where no part of a longitudinal trench is in the pavement, surfacing replacement will only be required where existing surfacing materials have been removed.
- D. Spreading shall be as nearly continuous as possible.
- E. Placement shall also allow for line, grade, elevations, and thickness specified herein and as shown on the drawings.
- F. When asphalt concrete is laid against vertical surfaces such as gutters, the face of the vertical surface shall be roughened for proper bonding, cleaned, and then painted with a light coating of asphalt cement or emulsified asphalt.
- G. At terminations of new surface course, the asphalt concrete shall be feathered into the existing surface over such a distance as may be required to produce a smooth riding transition. Base course and single course construction shall be joined by vertical butt joints finished and rolled to a smooth surface.
- H. Asphaltic concrete shall not be placed when frozen materials are present in the base or sub-base.
- I. Asphaltic concrete shall not be placed during adverse conditions, i.e., rain or when a roadway surface is wet.
- J. Asphaltic concrete shall be placed between April 15 and October 15. Asphalt concrete shall not be placed after October 15 and before April 15 of the following year unless roadway surface temperatures are 40° F and rising in the shade. Approval to place the asphalt concrete after October 15 and before April 15 of the following year requires written approval from the OWNER.
- K. Roadways not completed prior to October 15, and not meeting the requirements of this section, shall be repaired by placing a temporary 2-inch thick asphalt (or other ENGINEER approved surface) course over all exposed, earthen surfaces. These temporary surfaces shall be completely removed and repaired in accordance with these specifications at no additional expense to OWNER.
- L. Asphalt rolling shall be in accordance with Section 32 12 16.13 of the APWA specifications. CONTRACTOR shall establish and document a rolling pattern for obtaining densities. The test strip shall be no shorter than 300 feet. Establishment of rolling patterns are for the purpose of establishing minimum rolling patterns, and shall not release CONTRACTOR of meeting all requirements of these specifications and drawings.
- M. The target density for asphalt placement shall be 94 percent of laboratory density plus or minus two (2) percent. If an individual test result falls below 92 percent of maximum density, the material represented by that test will be considered defective, and shall be removed and replaced by CONTRACTOR at no additional cost to OWNER.
- N. The minimum acceptable thickness of asphalt for completed roadways shall be 2 inches, as verified by core samples. Areas found to contain less than the minimum thickness shall be removed and replaced at no additional expense to OWNER.

- O. Allowable tolerance shall be 1/4 inch vertical deviation from design elevation in 10 feet. Match existing adjacent surface slopes.
- P. The completed finish shall be as specified in Section 32 12 16.13 of the APWA specifications.
- Q. CONTRACTOR shall adjust the height of all street fixtures to match final grade. If required, concrete collars shall be placed around all surface street fixtures (i.e. manholes, valve boxes, monuments, etc.).
- R. CONTRACTOR shall complete all concrete collars within 2 weeks of completion of paving each roadway section.
- S. CONTRACTOR shall restripe streets, as required, in accordance with Section 32 17 23 - Pavement Markings of the APWA specifications.

3.5 REPAIR

- A. Remove bumps and depressions exceeding 1/4 inch vertical deviation in 10 feet.
- B. Repair options include mill and inlay, or grinding. Feather edges on bituminous concrete repairs are not allowed. Apply a cationic or anionic tack emulsion to make miller surfaces water resistant.

3.6 SITE SAFETY AND TRAFFIC CONTROL

- A. Site safety and traffic control shall be the responsibility of CONTRACTOR.
- B. CONTRACTOR shall verify full compliance with all applicable local, county, state and/or federal regulations, and shall comply with Section 01 55 26 Traffic Control.

- END OF SECTION -

SECTION 32 31 19
ORNAMENTAL METAL FENCE AND GATES

PART 1 GENERAL

1.1 SUMMARY

- A. This section covers the furnishing of labor, materials and appurtenances necessary for installation of the ornamental metal fence system defined herein. The manufacturer shall provide a total fence system including all components, panels, posts, gates, and hardware required.

1.2 RELATED WORK

- A. Related work specified in other sections:
1. Section 01 33 00 Submittal Procedures
 2. Section 03 30 00 Cast-in-Place Concrete
 3. Section 31 23 23 Excavation and Backfill for Structures

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specifications to the extent referenced. The publications are referred to in the text to by basic designation only.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM B 117 Standard Practice for Operating Salt-Spray (Fog) Apparatus.
3. ASTM D 523 Standard Test Method for Specular Gloss.
4. ASTM D 714 Test Method for Evaluating Degree of Blistering in Paint.
5. ASTM D 822 Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
6. ASTM D 1654 Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
7. ASTM D 2244 Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
8. ASTM D 2794 Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
9. ASTM D 3359 Standard Test Methods for Measuring Adhesion by Tape Test.
10. ASTM F 2408 Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets.

1.4 MEASUREMENT AND PAYMENT

- A. Full compensation for ornamental metal fences and gates shall be considered at the contract unit bid prices for each lineal foot of ornamental metal fences and gates installed and accepted.

1.5 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

- B. Contractor shall submit Manufacturer's product data and installation instructions for approval.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.7 QUALITY ASSURANCE

- A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.8 WARRANTY

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Ameristar Montage Industrial,
- B. Or approved equal

2.2 MATERIALS

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653, with a minimum yield strength of 45,000 psi and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/sq. ft., Coating Designation G-90.
- B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1.75" x 0.105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 1.

Table 1 – Minimum Sizes for Posts			
<u>Fence Posts</u>	<u>Panel Height</u>		
2-1/2" x 12 Ga.	Up to & Including 6' Height		
3" x 12 Ga.	Over 6' Up to & Including 8' Height		
<u>Gate Leaf</u>	<u>Gate Height</u>		
	<u>Up to & Including 4'</u>	<u>Over 4' Up to & Including 6'</u>	<u>Over 6' Up to & Including 8'</u>
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.

4' 1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.
6' 1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8' 1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10' 1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12' 1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14' 1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

2.3 FABRICATION

- A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by welding, thus completing the rigid panel assembly.
- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).

<u>Quality Characteristics</u>	<u>ASTM Test Method</u>	<u>Performance Requirements</u>
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.
- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 11ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6 feet in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.

PART 3 EXECUTION

3.1 PREPARATION

- A. All new installation shall be laid out by the contractor in accordance with the construction plans.

3.2 FENCE INSTALLATION

- A. Fence post shall be spaced according to Table 3, plus or minus 1/2 inch. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36 inches. Section 03 30 00 Cast-in-Place Concrete shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application. Foundation soils shall be excavated as required for footing base/leveling pad dimensions shown on the construction drawings, or as directed by the ENGINEER.

Table 3 – Post Spacing By Bracket Type										
Span	For 8' Nominal (91-1/2" Rail)				For 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount*		Industrial Line 2-1/2" or 3"		Industrial Universal 2.5" or 3"		Industrial Flat Mount		Industrial Swivel*	
Post Settings ± 1/2" O.C.	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"
*Note: When using swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the flat mount bracket for 91-1/2" rail, rail may need to be drilled to accommodate rail to bracket attachment.										

3.3 FENCE INSTALLATION MAINTENANCE

- A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces;
1. Remove all metal shavings from cut area.
 2. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry.
 3. Apply 2 coats of custom finish paint matching fence color.
- B. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Spray cans or paint pens provided by the manufacturer shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-manufacturer parts or components may negate the manufactures' warranty.

3.4 GATE INSTALLATION

- A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware

required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.5 CLEANING

- A. The CONTRACTOR shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

- END OF SECTION -

SECTION 32 31 33
CANTILEVER SLIDE GATE & OPERATORS

PART 1 GENERAL

1.1 SUMMARY

- A. The Work in this section shall include furnishing all labor, materials, equipment and appliances necessary to complete installation of pre-wired, self-contained, slide gate operator(s) and horizontal cantilever sliding gates, including all selected attachments and accessory equipment specified for all Hydraulic Operator System(s) required for this project in strict accordance with this specification.
- B. Install cantilever slide gates, complete with operators, where indicated in the Contract Documents.

1.2 RELATED DOCUMENTS

- A. Section 01 33 13 - Submittal Procedures
- B. Section 01 78 00 - Closeout Submittals
- C. Section 01 79 00 - Demonstration and Training

1.3 RELATED WORK SPECIFIED ELSEWHERE:

- A. Related work specified in other Sections includes, but is not limited to:
 - 1. Section 03 30 00 Cast-in-Place Concrete: Structural portal foundations.

1.4 SYSTEM DESCRIPTION

- A. Modular automated cantilevered vehicular access gate for closure of vehicular access routes and regulation of traffic flow. Unique construction completely eliminates the cross bracing commonly used on cantilever gates, which is both unsightly and compromises security, by providing a foothold to climbers. Always supply a separate pedestrian entrance when foot traffic is anticipated near an automated gate. Section includes the following components:
 - 1. Aluminum and steel cantilever sliding gate
 - 2. Electric gate operator
 - 3. Gate support posts (structural portals) and rolling hardware.
 - 4. Gate operator accessories including safety and reversing devices.
 - Accessed control devices to be included.
 - a. key pad
 - b. 10 remotes
 - c. and push button.

1.5 SUBMITTALS

- A. Product Data

1. Gates and hardware.
2. Gate operator including operating instructions, motor name plate data, ratings, characteristics and mounting arrangement.

B. Shop Drawings:

1. Submit shop drawings in accordance with Section 01 33 13 - Submittal Procedures.
2. Gate Operator:
 - a. Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - b. Submit drawings showing connections to adjacent construction, range of travel, and all electrical and mechanical connections to the operator.
 - c. Drawings shall also show the size and location of the concrete mounting pad.
3. Wiring Diagrams: Power and control wiring [and access controls if applicable].
 - a. Differentiate between manufacturer-installed and field-installed wiring and between components provided by gate and gate operator manufacturer and those provided by others.
 - b. Include underground electrical runs and inductive vehicle obstruction and free exit loop locations, and dimensions.
4. Include complete details of gate construction, gate height, structural support spacing dimensions and unit weights of structural components.
5. Cantilever gates shall be designed to span the distance of the opening and offset back one half the distance of the opening.
6. All joints shall be welded joints and welds shall be ground smooth prior to hot-dip galvanizing.
7. Provide detailed diagrams of all gate components.
8. Gates shall comply with ASTM F 1184 for single and double slide gates.

C. Installation instructions:

1. Submit two copies of manufacturer's written installation instructions.

D. Test reports:

1. Submit affidavits from the manufacturer demonstrating that the gate mechanism has been tested to 200,000 cycles without breakdown.
2. ISO 9001 Compliant manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer: A company specializing in the manufacture of cantilever slide gates and electric gate operators of the type specified, with a minimum of five years experience.
- B. Installer Qualifications: an experienced installer who has completed fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- C. Source Limitations for Gates operators and Gates: obtain each color, grade, finish, type, and variety of components for fences and gates from one source with resources to provide fences and gates of consistent quality in appearance and physical properties.
- D. Electrical Components, Devices, and Accessories: listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. UL Standard: Provide gate operators, tested and listed by a nationally recognized testing laboratory to comply with UL 325 5th edition
- F. Emergency Access Requirements: comply with requirements of local authorities having jurisdiction for automatic gate operators serving as a required means of access.
- G. Installer: A minimum of three years experience installing similar equipment and approved by manufacturer

1.7 WARRANTY

- A. Provide a two-year warranty against all defects in material and workmanship.

PART 2 PRODUCTS

2.1 CANTILEVERED ACCESS GATE

- A. Manufacturers, or equal
 - 1. Ameristar Fence Products (TransPort II Ornamental Cantilever Gate)

2.2 GATE CONTROLS

- A. Gate opener – card reader & pedestal
 - 1. Supplier: Yamas Controls

2.3 MATERIALS

- A. Electrical components: CSA/UL approved.
- B. Power Supply: 208-volt three phase or single phase or 120-volt, 50/60 Hertz, single phase. If gate motor requires 240-volt single phase supplier must provide buck boost transformer to be mounted inside by the panel.

2.4 COMPONENTS: TYPE II CANTILEVER SLIDE

- A. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1184 and Specification 09 90 00 Painting and Coatings for protective coatings.
- B. Frames and Bracing: Fabricate members from galvanized steel or aluminum tubing and structural shapes of sufficient size and strength to support the weight of the gate as well as any live loadings, including but not limited to wind, snow and ice loads, with outside dimension and weight according to ASTM F 1184 and the following minimums:

1. Gate Height: 7 feet.
 2. Gate Opening Width: see drawings for access road width.
 3. Frame Members:
 - a. Tubular Steel or Aluminum: 1.66 inches (or as recommended by manufacturer)
 4. Bracing Members:
 - a. Tubular Steel or Aluminum: 1.90 inches round (or as recommended by manufacturer)
- C. Frame Corner Construction:
1. Welded frame and 5/16-inch diameter, adjustable truss rods for panels 5 feet wide or wider.
- D. Roller Guards: As required per ASTM F 1184 for Type II gates.
- E. Hardware
1. Latches permitting operation from both sides of gate, locking devices, hangers, and stops fabricated from galvanized steel. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate. Latches shall permit operator to catch and align the gate properly when closed.
 2. Rollers: Rollers shall be made of nylon. Placement of the rollers on the offset posts shall be designed to ensure proper alignment of the gate.

2.5 OPERATION

- A. Operation shall be by means of a metal rail passing between a pair of solid metal wheels with polyurethane treads. Operator motors shall be hydraulic, geroller type, and system shall not include belts, gears, pulleys, roller chains or sprockets to transfer power from operator to gate panel. The operator shall generate a minimum horizontal pull of 300 pounds without the drive wheels slipping and without distortion of supporting arms. Gate panel velocity shall not be less than 12 inches per second and shall be stopped gradually to prevent shock loads to the gate and operator assembly. The "soft stop" feature of the gate operator shall be controlled by two adjustable hydraulic brake valves (one for each direction). The "soft start" feature shall allow the pump to start at zero pressure, then progressively increase the pressure, over a period not less than two seconds, to 1,000 PSI.
- B. Standard mechanical components shall include as a minimum:
1. Supporting arms: Cast aluminum channel. Arms shall incorporate a fully bushed, 1-1/2" bronze bearing surface, acting on arm pivot pins. (Item 2 below)
 2. Arm pivot pins: 3/4" diameter, stainless steel, with integral tabs for ease of removal.
 3. Tension spring: 2-1/2" heavy duty, 800 pound capacity.
 4. Tension adjustment: Finger tightened nut, not requiring the use of tools.
 5. Drive release: Must instantly release tension on both drive wheels, and disengage them from contact with drive rail in a single motion, for manual operation.

6. Limit switches: Fully adjustable, toggle types, with plug connection to control panel.
7. Electrical enclosure: Oversized, metal, with hinged lid gasketed for protection from intrusion of foreign objects, and providing ample space for the addition of accessories.
8. Chassis: 1/4" steel base plate and 12 Ga. sides and back welded and ground smooth.
9. Cover: 10GA. sheet steel, hot-dip galvanized, and gasketed. Box shall be powder coated black. All joints welded, filled and ground smooth. Finished corners square and true with no visible joints.
10. Drive wheels: 6" Diameter metal hub with polyurethane tread.
11. Drive rail: Shall be extruded 6061 T6, not less than 1/8" thick. Drive rail shall incorporate alignment pins for ease of replacement or splicing. Pins shall enable a perfect butt splice.
12. Hydraulic hose: Shall be 1/4" synthetic, rated to 2750 PSI.
13. Hydraulic valves: Shall be individually replaceable cartridge type, in an integrated hydraulic manifold.
14. Hose fittings: At manifold shall be quick-disconnect type, others shall be swivel type.
15. Hydraulic fluid: High performance type with a viscosity index greater than 375 and temperature range -40F to 167F degrees (-40C to 75C).
16. A zero to 2000-PSI pressure gauge, mounted on the manifold for diagnostics, shall be a standard component.
17. The hydraulic fluid reservoir shall be formed from a single piece of metal, nonwelded, and shall be powder coated on the inside and the outside, to prevent fluid contamination.

C. Minimum standard electrical components:

1. Pump motor: Shall be a 1 HP, 56C, TEFC, continuous duty motor, with a service factor of 1.15, or greater. Standard voltages available, single or three phase.
2. All components shall have overload protection.
3. Controls: Smart Touch Controller Board with 256K of program memory containing:
 - a. inherent entrapment sensors, redundant, independent system required;
 - b. built in "warn before operate" system;
 - c. built in timer to close;
 - d. liquid crystal display for reporting of functions; system configuration control status;
 - e. 26 programmable output relay options;
 - f. anti-tailgate mode;
 - g. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions;
 - h. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded;
 - i. built-in power surge/lightning strike protection;

- j. adjustable limit switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions;
 - k. menu configuration, event logging and system diagnostics easily accessible with a PC utilizing operator manufacturer's START software;
 - l. RS232 port for connection to laptop or other computer peripheral and RS485 connection of Master/Slave systems or network interface;
 - m. System shall be integrated with other onsite- controls and systems. See Electrical Controls Drawings and Specifications.
4. Transformer: 75 VA, non-jumpered taps, for all common voltages.
 5. Control circuit: 24VDC.
 6. Master/Slave capabilities for dual gates.
- D. Gate edges shall be installed such that the gate is capable of reversing in either direction upon sensing an obstruction.
- E. Control Devices: Card reader, and keypads.
- F. Alert Devices: Configurable audible beacon shall be included as standard.
- G. The following optional devices shall be included:
1. Lock for operator cover.
 2. Drive wheel manual release indicator switch.
 3. Heater with thermostat control for cold or damp climates.
 4. Weather-stripped drive rail slot in chassis, and snow wiper blades for drive rail.
 5. Pneumatic remote gate release devices. Places operator in "manual mode" from remote location (lockable box on public side of gate).
 6. HySecurity factory drive rail.
 7. Fire Box with equipment required to manually operate gate.
- H. Emergency Release Mechanism: Quick-disconnect release of operator drive system of the following type of mechanism, permitting manual operation if operator fails. Design system so control circuit power is disconnected during manual operation.
1. Type: Mechanical device, key, or crank-activated release. See attached cut sheet for Fire and Emergency Access Lock Box.
- I. Vehicle Loop Detector: System including automatic closing timer with adjustable time delay before closing, timer cut-off switch, and loop detector designed to open and close gate, and hold gate open until traffic clears. Provide electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location as recommended in writing by detection system manufacturer for function indicated.

1. Loop: Factory preformed style for saw-cut with epoxy-grouted installation
 2. BD Loops RL 5240, or as recommended by the loop manufacturer
 3. Induction loops shall be compatible and shall work in conjunction with the specified access controllers and gate operators.
 4. Approved equal.
- J. The installing contractor shall be responsible to ensure that appropriate external primary entrapment safety devices be installed for the specific site conditions to protect against all potential entrapment zones. Proper operation of these safety devices shall be verified and training as to the operation and maintenance of these devices for the users and owners shall be documented.
- K. Operator Manufacturers:
1. HySecurity: model SlideDriver 40 (222 E ST) with Smart Touch Controller for single cantilever slide gates.
 2. HySecurity: model SlideDriver 15 (222 SS ST) with Smart Touch Controller for dual cantilever slide gate (NOT USED).
 3. Approved equal.

2.6 ACCESSORIES & OPTIONS

- A. Vehicle obstruction devices
1. Inductive loop vehicle detectors: Micro-processor based, digital type, with sensitivity to detect a wide variety of vehicle sizes. Built in frequency counter and automatic frequency assignment to prevent any possibility of 'cross talk'.
 2. Inductive vehicle Loop: select either 'pre-formed' type or 'saw cut' field constructed type. Size, location and construction type should be shown on drawing.
- B. Safety Devices: (Note: The word "Safety" only applies to devices intended to reduce likelihood of a gate striking or injuring a pedestrian. See 'obstruction devices' for vehicular reversing options).
1. Through- Beam photo cells
 2. Radio transmitting 5' gate contact edge and radio receiver
- C. Notification or instructive Devices:
1. Audible beacon
 2. Strobe or flashing light indicating gate in motion or pending motion.
 3. Traffic indicator lights (8" Green arrow / Red "X" typical)
- D. Access control devices, see section 028000 – electronic security devices including access controls.
- E. Gate panel options

1. Substitute 3 strands of non-barbed wire top

2.7 FINISHES

- A. The manufactured gate components shall be subjected to a thermal stratification coating process (high-temperature, in-line, multi-stage, and multi-layer) including, as a minimum, a six-stage pretreatment/wash and an electrostatic spray application of a polyester finish. The topcoat shall be a “no-mar” TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be Black. The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 1 below.

Table 1 – Coating Performance Requirements		
<u>Quality Characteristics</u>	<u>ASTM Test Method</u>	<u>Performance Requirements</u>
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,000 hours (Scribed per D1654; failure mode is accumulation of 1/8” coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625” ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install structural post (portals) in concrete foundations with a minimum depth of 48-inches.
- B. Posts shall be installed completely level both horizontally and vertically.
- C. Install cantilevered sliding access gate to manufacturer's written instructions.
- D. Test and adjust complete system for proper function and leave in perfect working order.
- E. Install vehicle detection loops and lead-in-wires per manufacturer's instructions.
- F. Supply and install other electrical wiring, conduit junction boxes, transformers, circuit breakers and auxiliary components required for complete installation. Conform to CSA/NEC and local requirements.

3.2 FIELD QUALITY CONTROL

- A. Test gate operators through ten full cycles and adjust for operation without binding or scraping.
- B. Owner or owner's representative, shall complete "punch list" with installing contractor prior to final acceptance of the installation and submit completed warranty documentation to manufacturer

3.3 CLEANING, MAINTENANCE AND DOCUMENTATION

- A. Perform cleaning and maintenance procedures in strict accordance with manufacturer's written instructions.
- B. Train owner's personnel on how to safely shut off electrical power, release and manually operate the gate. Additionally, demonstrate the general maintenance of the gate operator and accessories and provide copy of "Installation and Maintenance Manual" for the owner. Manual will identify parts of the equipment for future procurement.
- C. Maintain logbook of repairs and maintenance.

- END OF SECTION -

SECTION 32 84 23

UNDERGROUND SPRINKLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install planting irrigation system as described in Contract Documents complete with accessories necessary for proper function.
- B. Related Requirements:
 - 1. Division 26: Controller conduit and power to controller.
 - 2. Section 31 22 16: Fine Grading.
 - 3. Section 32 90 01: Common Planting Requirements.
 - a. Pre-installation conference held jointly with other common planting related sections.
 - 4. Section 32 91 13: Finish Grading and Topsoil Preparation.
 - 5. Section 32 91 20: Topsoil Placement and Grading.
 - 6. Section 32 93 00: Plants.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Conference:
 - 1. Participate in mandatory pre-installation conference:
 - a. Irrigation Subcontractor's Representative and Foreman responsible for installation of irrigation system required to be in attendance.
 - b. Schedule pre-installation conference before irrigation system installation begins.
 - c. Review required test and inspections and controller requirements.
- B. Sequencing:
 - 1. Install sleeves before installation of cast-in-place concrete site elements and paving.

1.3 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Manufacturer's cut sheets for each element of system.
 - b. Parts list for operating elements of system.
- B. Informational Submittals:
 - 1. Test And Evaluation Reports:
 - a. Results of main line service pressure test before beginning work on system should be submitted as a report following testing and before burial of mainline.
- C. Manufacturer Instructions:

1. Manufacturer's printed literature on operation and maintenance of operating elements of system.
 2. Instruction Manual:
 - a. Includes complete directions for system operation and maintenance, including winterizing, controller program worksheet and annual service and scheduling calendar based on local site specific conditions.
 3. Complete instructions on how to drain entire backflow preventer to prevent freezing.
- D. Field Quality Control Submittal:
- a. Controller Approved Distributor or Manufacturer:
- E. Qualification Submittals:
1. Irrigation Subcontractor:
 - a. Minimum five (5) years experience in irrigation sprinkler installations.
 - b. Minimum five (5) satisfactorily completed irrigation sprinkler installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
 - c. Produce certifiable list of reputable landscape suppliers from whom it will be purchasing materials to be used on this project.
 - d. Produce evidence that it employs quality employees with specified experience and in a quantity sufficient to perform work of this Section within time limits established by Contractor.
 - e. Produce evidence that all employees have legal documents to be working in the United States and that documents have been verified legitimate by the owner.
 - f. Agree to complete reporting documents, including:
 1. Use only approved Distributors for controller system.
 2. Provide Controller Instructional Training.
 3. Assist Landscape Architect in completing the Watering Schedule.
 2. Irrigation Installer:
 - a. Irrigation sprinklers shall be performed under direction of foreman or supervisor with minimum three (3) years experience in irrigation sprinkler installations similar in size, scope, and complexity.
 - b. Foreman or supervisor required to attend pre-installation conference.
 - c. Use trained personnel familiar with required irrigation sprinkler procedures and with Contract Documents.
- F. Closeout Submittals:
1. Record Drawings:
 - a. As installation occurs, prepare accurate record drawing to be submitted before final inspection, including:
 1. Detail and dimension changes made during construction.
 2. Significant details and dimensions not shown in original Contract Documents.
 3. Field dimensioned locations of valve boxes, manual drains, quick-coupler valves, control wire runs not in mainline ditch, and both ends of sleeves.
 4. Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
 5. Take and record dimensions at time of installation.
 - b. Print copy of record drawing to *11 x 17 inches*, color key circuits, and laminate both sides with 5 mil thick or heavier plastic. Drill two *1/2 inch* holes at top of board and

- hang on hooks in Custodial Room. Provide 2 additional, non-mounted, full size copies: 1-nonlaminated and 1-laminated.
2. Operations And Maintenance Manual Data:
 - a. Include in the Maintenance Manual the following information:
 1. Instruction manual that contains complete directions for system operation and maintenance, including winterizing, controller program worksheet and annual service and scheduling calendar based on local site specific conditions.
 2. Complete instructions on how to drain entire backflow preventer to prevent freezing.
 3. Manufacturer's cut sheets for each element of system.
 4. Parts lists for operating elements of system.
 5. Manufacturer's printed literature on operation and maintenance of operating elements of system.
 3. Warranty Documentation:
 - a. Manufacturer's warranty information for each operating elements of system.
 4. Photographs: Provide photographs prior to burial of key elements including but not limited to:
 - a. Valves.
 - b. Drains.
 5. Final payment for system will not be authorized until Closeout Submittals are received and accepted by Architect and landscape consultant.
- G. Maintenance Material Submittals:
1. Extra Components to Owner:
 - a. Contractor to provide the following materials prior to the final inspection:
 1. 1 bag for each size of emitters specified on plans.
 2. 1 drip valve assembly kit.
 3. 1 control valve of each type and size specified on plans.
 2. Tools:
 - a. Furnish following items before Final Closeout Review:
 1. One heavy-duty key for stop and waste or main shut-off valve.
 2. One quick coupler key with brass hose swivel.
 3. Keys to the controller closets.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
1. Work and materials shall be in accordance with latest rules and regulations, and other applicable state or local laws.
 2. Nothing in Contract Documents is to be construed to permit work not conforming to these codes.
- B. Qualifications: Requirements of Section 01 4301 applies, but not limited to the following:
1. Installer Qualifications:
 - a. General:
 1. Perform installation under direction of foreman or supervisor with five (5) years minimum experience in sprinkling system installations.

- b. Controller:
 - 1. Factory trained certified personnel familiar with required irrigation system and controller installation procedures. Follow requirements as described under Installers in PART 3 EXECUTION.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. During delivery, installation, and storage, protect materials from damage and prolonged exposure to sunlight.

1.6 WARRANTY

- A. Standard one year guarantee stipulated in General Conditions shall include replacement of defective parts and workmanship. Guarantee shall also include the following:
 - 1. Repairing or replacing defective materials or workmanship.
 - 2. Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
 - 3. Adjusting system to supply proper coverage of areas to receive water.
 - 4. Ensuring system can be adequately drained.

PART 2 - PRODUCTS

2.1 SYSTEM

- A. Manufacturers:
 - 1. Manufacturer Contact List (for reference only):
 - a. 3M, Austin, TX www.3m.com/elpd.
 - b. Action Machining Inc, Bountiful, UT www.actionfilters.com.
 - c. Carson Industries LLC, Glendora, CA www.carsonind.com.
 - d. Harrington Corporation (Harco), Lynchburg, VA www.harcofittings.com.
 - e. King Innovation, St Charles, MO www.kinginovation.com.
 - f. IPS Corporation, Compton, CA www.ipscorp.com.
 - g. Leemco, Colton, CA www.leemco.com.
 - h. Netafim, Inc. www.netafimusa.com.
 - i. Nibco Inc, Elkhart, IN www.nibco.com.
 - j. Northstar Industries, LLC, Methuen MA www.northstarind.com.
 - k. Paige Electric, Union, NJ www.paigewire.com.
 - l. Rain Bird Sprinkler Manufacturing Corp, Glendora, CA www.rainbird.com.
 - m. T. Christy Enterprises, Inc. (Christy's), Anaheim, CA www.tchristy.com.
- B. Materials:
 - 1. Pea Gravel:
 - a. For use around drains, valves, and quick couplers.
 - b. $1/2$ inch maximum dimension, washed rock.

2. Sand:
 - a. For use of backfill around ALL PVC lateral and mainline pipe.
 - b. Fine granular material naturally produced by rock disintegration and free from organic material, mica, loam, clay, and other deleterious substances.
3. Native Material: Soil native to project site free of wood and other deleterious materials and rocks over *1 inch*.
4. Topsoil: Approved conditioned, imported material without rocks, roots, sticks, clods, debris, and other foreign matter over *1 inch* longest dimension.
5. Pipe, Pipe Fittings, And Connections:
 - a. Pipe shall be continuously and permanently marked with Manufacturer's name, size, schedule, type, and working pressure.
 - b. Pipe sizes shown on Drawings are minimum. Larger sizes may be substituted if at no additional cost to Owner.
 - c. Pipe:
 1. Pressure Lines: Refer to irrigation schedule.
 2. Lateral Lines: Refer to irrigation schedule.
 3. Backflow Assembly Piping: Refer to Irrigation Details.
 4. Backflow Preventer Piping: Refer to Irrigation Details.
 5. Quick Coupler Piping: Refer to Irrigation Details.
 - d. Fittings: Lateral Line - Same material as pipe, except where detailed otherwise.
 - e. Sleeves:
 1. Under Parking Area And Driveway Paving: Schedule 40 PVC Pipe.
 2. All Other: Class 200 PVC Pipe.
 3. Sleeve diameter shall be two times larger than pipe installed in sleeve.
6. Automatic Irrigation Controller and Control Wiring:
 - a. Controllers:
 1. Category Three National Account Approved Product. See Section 01 6200 for definitions of Categories:
 - (1) Refer to Irrigation Schedule for controller type.
 - (2) All other components required for complete and operational system.
 - b. Control Wiring:
 1. Traditional control wire shall be UF-UL listed, color coded PE insulated copper conductor direct burial size 14. For wire runs exceeding 3,300 feet (1 005.84 meter), use 12 AWG wire. Do not use green color coded wire.
 2. Waterproof Wire Connectors:
 - a) Control wire connections shall consist of properly-sized wire nut inserted in waterproof grease cap:
 - b) Type Two Acceptable Products:
 - (1) DBY or DBR by 3M.
 - (2) 'One Step' 20111SP by King Innovation.
 - (3) Equal as approved by Architect before installation. See Section 01 6200.
 - c. Lightning Arrestor:
 1. Provide grounding and Lightning Arrestor(s) as required by Manufacturer.
 2. Valve Boxes
 - a) Type Two Acceptable Products:
 - (1) Carson Industries: 10 inch (255 mm) Model 0910.
 - (2) Equal as approved by Architect before use. See Section 01 6200.
 - b) Valve Box Supports:
 - (1) Standard size fired clay paving bricks without holes.

7. Valves:
 - a. Manual Drain Valves – Refer to Irrigation Schedule and Details.
 - b. Automatic Valves – Refer to Irrigation Schedule.
 - c. Isolation Valves – Refer to Irrigation Schedule
 - d. Backflow Preventer - Refer to Irrigation Schedule.
 - e. Quick Coupling Valves and Keys – Refer to Irrigation Schedule.
 - f. Pressure Reducing Valve: Make and model shown on Drawings or as required by local code.
8. Valve Accessories:
 - a. Valve manifolds – Refer to Irrigation Details.
 - b. Valve Boxes And Extensions:
 1. Colors:
 - a) Brown: Bare soil and rock areas.
 2. Type Two Acceptable Products:
 - a) Carson Industries: Refer to Details.
 - c. Valve Box Supports: 6 inch x 8 inch x 16 inch CMU. Refer to details.
 - d. Valve ID tags:
 1. Type Two Acceptable Products:
 - a) Christy's: Stamped ID tag.
 - b) Equal as approved by Architect before use. See Section 01 6200.
9. Drip System:
 - a. Drip Valve Assembly – Refer to Irrigation Schedule.
 - b. Distribution Tubing:
 1. a) Refer to Irrigation Schedule and Details.
 - c. Drip Emitters – Refer to Irrigation Schedule and Details.
 - d. Valve Boxes:
 1. Colors:
 - a) Brown: Bare soil and rock areas.
 2. Type Two Acceptable Products:
 - a) Carson Industries - Refer to Details.
 - b) Equal as approved by Architect before use.
10. Solvent Cement:
 - a. Primer:
 1. Meet ASTM F656 standard and applicable sections of latest edition of 'Uniform Plumbing Code'.
 2. Meet NSF/ANSI standard for use on potable water applications.
 3. Low VOC emissions and compliant with LEED.
 4. Product: Weld-On P-70 primer by IPS.
 - b. PVC Solvent Cement:
 1. Heavy bodied, medium setting, high strength:
 - a) Meet ASTM D2564 standard and applicable sections of latest edition of 'Uniform Plumbing Code'.
 - b) Meet NSF/ANSI standard for use on potable water applications.
 - c) Meet CSA standards for use in pressure and non-pressure potable water applications.
 - d) Low VOC emissions and compliant with LEED.
 - e) Product: Weld-On 711 Low VOC PVC Cement by IPS.
11. Other Components:
 - a. Recommended by Manufacturer and subject to Architect's review and acceptance before installation.

- b. Provide components necessary to complete system and make operational.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site Verification of Conditions: Perform pressure test at stub-out on main water line provided for irrigation system, or at near-by fire hydrant. Notify Architect if pressures over 70 *psi* or under 55 *psi* are found to determine if some re-design of system is necessary before beginning work on system.

3.2 PREPARATION

- A. Protection:
 1. Protection Of In-Place Conditions:
 - a. Repair or replace work damaged during course of the Work at no additional cost to Owner. If damaged work is new, installer of original work shall perform repair or replacement.
 - b. Do not cut existing tree roots measuring over 2 inches (50 mm) in diameter in order to install irrigation lines.
- B. Surface Preparation:
 1. Layout of Irrigation Components:
 - a. Location of emitters, valves and piping shown on Drawings is approximate. Actual placement may vary slightly as is required to achieve full, even coverage.
 - b. During layout, consult with Architect to verify proper placement and make recommendations, where revisions are advisable.
 - c. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.
 - d. Make certain changes from Contract Documents are shown on record drawings.

3.3 INSTALLATION

- A. Trenching and Backfilling:
 1. Pulling of pipe is not permitted.
 2. Excavate trenches to specified depth. Remove rocks larger than 1 *inch* in any direction from bottom of trench. Separate out rocks larger than 1 *inch* in any direction uncovered in trenching operation from excavated material and remove from areas to receive landscaping.
 3. Cover pipe both top and sides with 2 *inches* of sand as specified under PART 2 PRODUCTS. Top 12 inches of backfill in shrub beds shall be topsoil as specified in Section 32 91 13.
 4. Do not cover pressure main, irrigation pipe, or fittings until Architect has inspected and approved system.
 5. Contractor to ensure that all pipe is properly bedded and all trenches are properly compacted. Contractor will be responsible for completely repairing settled trenches.

B. Sleeving and Conduits:

1. Sleeve water lines and control wires under walks and paving. Extend sleeves *6 inches* minimum beyond walk or pavement edge. Cover sleeve ends until pipes and wires are installed to keep sleeve clean and free of dirt and debris.
2. Use one water pipe maximum per sleeve. Sleeve control wiring in separate sleeve.
3. Position sleeves with respect to buildings and other obstructions so pipe can be easily removed.
4. Glue all sleeve and conduit joints to keep water out.

C. Grades And Draining:

1. Grade piping so system can be completely drained or blown out with compressed air.
 - a. Slope pipe to a minimum number of low points.
 1. At these low points, install:
 - a) *3/4 inch* brass ball valve for manual drain. Do not use automatic drain valves.
 - b) Install *2 inch* Class 200 PVC pipe over top of drain and cut at finish grade. Refer to details.
 - c) Provide yellow hard plastic valve cap marker.
 - d) Provide *three cu ft* pea gravel sump at outlet of each drain.
 - e) Sumps to be installed no closer than 3 feet from any paved surface.
 - b. Slope pipes under parking areas or driveways to drain outside these areas.
 - c. Provide and install quick-coupling valve or valves in location for easy blowout of entire system.

D. Installation of Pipe:

1. Install pipe in manner to provide for expansion and contraction as recommended by Manufacturer.
2. Install pipe and wires under driveways or parking areas in specified sleeves *18 inches* below finish grade or as shown on Drawings. Install manual drain valves at low point in sleeve.
3. Cut plastic pipe square. Remove burrs at cut ends before installation so unobstructed flow will result.
4. Make solvent weld joints as follows:
 - a. Do not make solvent weld joints if ambient temperature is below *35 deg F*.
 - b. Clean mating pipe and fitting with clean, dry cloth and apply one coat of P-70 primer to each.
 - c. Apply uniform coat of 711 solvent to outside of pipe.
 - d. Apply solvent to fitting in similar manner.
 - e. Give pipe or fitting a quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
 - f. Allow joints to set at least 24 hours before applying pressure to PVC pipe.
5. Tape threaded connections with teflon tape.

E. Control Valves And Controller

1. Install valves in plastic boxes with reinforced heavy duty plastic covers.
2. Place *3 inches* minimum of pea gravel below CMU Blocks supporting valve boxes.
3. Set valve boxes over valve so all parts of valve can be reached for service. Set cover of valve box even with finish grade. Valve box cavity shall be reasonably free from dirt and debris.

4. Wiring:
 - a. For traditional wiring, tape control wire to side of main line every 10 feet. Where control wire leaves main or lateral line, enclose it in gray conduit.
 - b. Use waterproof wire connectors consisting of properly-sized wire nut and grease cap at splices and locate all splices within valve boxes.
 - c. Use white or gray color for common wire and other colors for all other wire. Each common wire may serve only one controller.
 - d. Run one spare control wire from panel continuously from valve to valve throughout system similar to common wire for use as a replacement if a wire fails. Spare wire shall be different color than other wires, except use of green wire is not acceptable. Mark spare control wire in control box as an unconnected wire. Extend spare control wires 24 inches and leave coiled in each valve box.
 5. Install Controllers, control wires, and valves in accordance with Manufacturer's recommendations and according to electrical code.
 6. Extend extra control wires 24 inches and leave coiled in each valve box
- F. Backflow Preventer (refer to irrigation details):
1. Install *24 inches* minimum from structures or hardscaping.
 2. When installed adjacent to any structure, mount test cocks on side away from structure.
 3. After installation, remove handles and turn over to Owner together with extra maintenance materials.
- G. Drip Assembly (refer to irrigation details):
1. Install pipe providing for expansion and contraction as recommended by Manufacturer.
 2. Cut tubing square and remove burrs at cut ends.
 3. Locate drip emitter on uphill side of plant within rootball zone. Where significant slope does not occur, locate emitter on backside or building side of plant.
 4. Set emitter to be visible to maintenance personnel.
 5. Locate distribution tubing on top of soil but under bark or rock mulch and weed barrier.
 6. Assembly Using 'Funny Pipe' Type Joints: Refer to Irrigation Details
- H. Before installation of drip emitters, open control valves and use full head of water to flush out system.
- I. Arrange valve stations to operate in an easy-to-view progressive sequence around building. Tag valves with waterproof labels showing final sequence station assignments.
- J. Note any changes on as-builts.

3.4 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
1. Irrigation System:
 - a. Notify Architect 2 working days minimum before conducting test.
 - b. Before backfilling main line, test pressure at *100 psi* minimum for 2 hours minimum and make certain there are no leaks. Any decrease in pressure signifies that there is a leak. Take pictures of the pressure gauge at the beginning of the 2 hours and at the end. Provide copies of the pictures to the Landscape Architect.

2. Test Report:
 - a. Report of Pressure Test results along with photographs of test results are to be provided to Landscape Architect at completion of testing.
 - b. Pressure test report shall be included in the Operation and Maintenance Manual.
 3. Controller Testing:
 1. Verify controller is installed correctly.
 2. Provide controller report with all information programmed into the controller
 4. Pre-substantial Inspection:
 - a. Landscape Architect will review irrigation system before substantial completion.
 5. Substantial Completion Walkthrough:
 - a. Landscape Architect will inspect site and create list of non-conforming items to be resolved prior to Irrigation Final Acceptance. Date on this list will act as date of Landscape Substantial Completion.
 - b. Installations completed after water source has been turned off for season, as determined by Landscape Architect, will be inspected following spring after system can be checked for proper operation.
 6. Irrigation Final Inspection:
 - a. Irrigation Final Acceptance will be awarded when all non-conforming work is brought into conformance.
- B. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
1. Underground Sprinkler System:
 2. Correct any work found defective or not complying with Contract Document requirements at no additional cost to the Owner.

3.5 ADJUSTING

- A. Watering Time:
1. Adjust watering time of valves to provide proper amounts of water to plants.

3.6 CLOSEOUT ACTIVITIES

- A. Instruction of Owner:
1. After system is installed and approved, instruct Owner's designated personnel in complete operation and maintenance procedures.
 - a. Describe difference between plant establishment schedule and long term maintenance schedule.
 - b. Describe annual and regular filter maintenance.
 2. Controller Training:
 - a. Contractor to instruct Owner's designated personnel in complete operation and maintenance of Controller.
 - b. Manufacturer's approved Distributor to review terms of Warranty, Maintenance procedures and contact information with Owner's Representative.

END OF SECTION

SECTION 32 90 01

COMMON PLANTING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Common procedures and requirements for landscaping work.
- B. Related Sections:
 - 1. Section 32 05 01: Common Earthwork Requirements.
 - 2. Section 32 84 23: Underground Sprinklers.
 - 3. Section 32 93 00: Plants
 - 4. Section 32 01 01: Plant Maintenance

1.2 SUBMITTALS

- A. Quality Assurance / Control:
 - 1. Pre-Bid Submission: Verification of plant quantities and report of discrepancies. Include with submission an itemized list of materials with quantities and units of measure of rock mulch, fertilizers, plants, herbicide, topsoil, and other landscaping materials anticipated to complete work of this Section. Purpose of submittal is to verify accuracy and consistency of interpretation of Contract Documents by each bidder.
 - 2. Pre-Bid Submission: Landscape Company's certification of specified qualifications.
 - 3. Within 30 days of contract award, provide written guaranty from plant supplier that shrubs specified will be reserved and held for this project. Include location where materials will be held.
- B. Closeout: At completion of landscape work, submit two copies of typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one full year after contract maintenance period ends.

1.3 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Landscaping Company:
 - a. Landscaping Company shall be required to produce certification of following requirements minimum 10 days bid opening:
 - 1) Have been in business for period of minimum five years while providing quality of labor and materials specified in this section.
 - 2) Provide evidence of having completed minimum ten projects of scope and quality as this project in a timely manner.
 - 3) Produce certifiable list of reputable landscape suppliers from whom it will be purchasing materials to be used on this project.

- 4) Produce evidence that it employs quality employees with specified experience and in a quantity sufficient to perform work of this Section within time limits established by Contractor.
 - 5) Produce evidence that all employees have legal documents to be working in the United States and that documents have been verified legitimate by the owner.
2. Workers:
- a. Trained personnel familiar with required planting procedures and Contract Documents shall perform planting.
 - b. Planting shall be performed under direction of foreman or supervisor with minimum five years experience in landscape installations.
- B. Pre-Installation Conferences:
1. Participate in pre-installation conference.
 2. Schedule planting pre-installation conference after completion of Fine Grading specified in Section 31 22 16, but before beginning landscape work. In addition:
 - a. Establish responsibility for maintenance of new landscaping during all phases of construction period.
 - b. Prepare two typical landscape planting excavations and conduct percolation test to verify that water drains away within one hour. Discuss results of percolation tests with Architect and Owner's representative.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer. Protect materials from deterioration during delivery and while stored at site.
- B. Deliver trees, plants and shrubs in healthy and vigorous condition and store in location on site where they will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.

1.5 SEQUENCING

- A. Do not plant trees and shrubs until major construction operations are completed. Do not commence landscaping work until work of Sections 31 22 16 and 32 84 23 has been completed and approved.
- B. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect site and Contract Documents to become thoroughly acquainted with locations of irrigation, ground lighting, and utilities. Repair damage to these and other items adjacent to landscaping caused by work of this Section or replace at no additional cost to Owner.

3.2 PREPARATION

- A. Before proceeding with work, verify dimensions and quantities. Report variations between Drawings and site to Architect before proceeding with landscape work.
 - 1. Plant totals are for convenience of Contractor only and are not guaranteed. Verify amounts shown on Drawings.
 - 2. All planting indicated on Drawings is required unless indicated otherwise.
- B. Protection:
 - 1. Take care in performing landscaping work to avoid conditions that will create hazards. Post signs or barriers as required.
 - 2. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
 - 3. Keep site well drained and landscape excavations dry.

3.3 INSTALLATION

- A. Hand excavate as required.
- B. Maintain grade stakes until parties concerned mutually agree upon removal.
- C. When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify Architect before planting.
- D. Interface With Other Work: Do not plant shrubs until major construction operations are completed. Do not commence landscaping work until work of Sections 31 22 16 and 32 84 23 has been completed and approved.
- E. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

3.4 FIELD QUALITY CONTROL

- A. Inspection:
 - 1. Do not place or plant trees, plants or shrubs until after inspection by Architect to verify they are in healthy and vigorous condition. Notify Architect 48 hours minimum before placing or planting of plants and shrubs.

2. Architect will inspect landscaping installation approximately two weeks before Substantial Completion. Replace landscaping that is dead or appears dead as directed by Architect within 10 days of notification and before Substantial Completion.

3.5 CLOSEOUT ACTIVITIES

- A. Replace damaged plantings at no additional cost to Owner.

3.6 CLEANING

- A. Immediately clean up soil or debris spilled onto pavement and dispose of deleterious materials.

3.7 PROTECTION

- A. Protect planted areas against traffic or other use immediately after planting is completed by placing adequate warning signs and barricades.
- B. Provide adequate protection of planted areas against trespassing, erosion, and damage of any kind. Remove this protection after Architect has accepted planted areas.

END OF SECTION

SECTION 32 91 13
FINISH GRADING AND TOPSOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Perform finish grading and topsoil preparation work required to prepare site for installation of landscaping as described in Contract Documents.
 - 2. Furnish and apply soil additives as described in Contract Documents.
 - 3. Place imported topsoil in shrub beds.

- B. Related Sections:
 - 1. None.

1.2 REFERENCES

- A. American Society For Testing And Materials:
 - 1. ASTM 1557-02, 'Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.'

1.3 SUBMITTALS

- A. Product Data: Product literature and chemical / nutrient analysis of soil amendments and fertilizers.

- B. Samples: Sample of soil conditioner for approval before delivery to site. Include product analysis list.

- C. Quality Assurance / Control:
 - 1. Delivery slips indicating amount of topsoil and soil conditioner delivered to Project site.
 - 2. Submit test on topsoil by licensed laboratory before use, using Owner Form 'Topsoil Test Report'. Imported topsoil shall meet minimum specified requirements and be approved by Architect before use.
 - 3. Submit report stating location of source of imported topsoil and account of recent use.

- D. Informational Submittals:
 - 1. Installer Reports: Delivery slips indicating amount of soil conditioner delivered to Project site.

1.4 QUALITY ASSURANCE

- A. Pre-Installation Conference: Participate in pre-installation conference.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil:
1. In planting beds with trees and shrubs, topsoil to be imported throughout entire shrub bed.
 2. Backfill of trees and shrubs to be imported topsoil, conditioned as required in details.
 3. Imported Topsoil used in landscaped areas shall be fertile, loose, friable soil meeting following criteria:
 - a. Physical Characteristics:
 - 1) Clean and free from toxic minerals and chemicals, noxious weeds, rocks larger than 1 inch in any dimension, and other objectionable materials.
 - 2) Soil shall not contain more than 2 percent by volume of rocks measuring over 3/32 inch in largest size.
 - 3) Gradation as defined by USDA triangle of physical characteristics as measured by hydrometer.
 - a) Sand: 15 to 60 percent.
 - b) Silt: 10 to 60 percent.
 - c) Clay: 5 to 30 percent.
 - b. Chemical Characteristics:
 - 1) Acidity / alkalinity range: pH 5.5 to 8.0.
 - 2) Soluble Salts: less than 2.0 mmhos/cm.
 - 3) Sodium Absorption Ratio (SAR): less than 3.0.
 - 4) Organic Matter: greater than 4 percent.
 4. Incorporate following amendments, fertilizers into imported topsoil:
 - a. Acceptable Fertilizers And Application Rates:
 - 1) Spread 30-10-0 fertilizer at label rate and 0-0-0-15 fertilizer at label rate.
 - 2) Equal as approved by Architect before installation. See Section 01 60 00.
 - b. Acceptable Soil Conditioners And Application Rates:
 - 1) Type One Acceptable Product.
 - a) Soil Pep from Mountain West Products, Rexburg, ID.
 - b) "Other" EPA Class 'A' co-compost or compost with SAR less than 10.0, Soluble Salts less than 5.0, CN ratio of less than 20:1, 98% passing through 3/8 inch mesh screen, 25%-35% moisture or other product approved by Architect before use. See Section 01 6000.
 - c) Apply one of the above acceptable soil conditioners at the following rates:
Shrub beds - No conditioner other than for backfill of trees and shrubs is required.
- B. Soil Amendments and Conditioners:
1. Incorporate following soil amendments and conditioners into approved imported topsoil used for project:
 - a. Acceptable Soils Amendments, Soil Conditioners and Application Rates (Choose one):
 - 1) No conditioner other than for backfill of trees and shrubs is required.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not commence work of this Section until grading tolerances specified in Section 31 22 16 are met.

3.2 PREPARATION

- A. Protection: Protect utilities and site elements from damage.
- B. Surface Preparation:
 - 1. Rip, disk, till, or aerate with approved agricultural aerator to min. depth of 6 inches.
 - 2. Seven days maximum before beginning seeding and planting:
 - a. Loosen area 4 inches deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
 - b. Rake area to remove clods, rocks, weeds, roots, and debris.
 - c. Grade and shape landscape area to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.
 - 3. Limit use of heavy equipment to areas no closer than 6 feet from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than 6 feet.
- C. Screen Imported Topsoil: Screen all imported topsoil to remove rock measuring 3/32". Contractor to ensure that topsoil contains no more than 2 percent by volume of rocks measuring over 3/32 inch in largest size.

3.3 PERFORMANCE

- A. Site Tolerances:
 - 1. Total Topsoil Depth:
 - a. Tree and Shrub Planting Areas: 12 inches minimum throughout entire tree and shrub planting area.
 - 2. Finish grade of planting areas before planting and after addition of soil additives shall be specified distances below top of adjacent pavement of any kind:
 - a. Shrub, Ground Cover and Rock Mulch Areas: 3 inches below.
- B. Do not expose or damage existing shrub or tree roots.
- C. Distribute approved imported topsoil. Remove organic material, rocks and clods greater than 1 inch in any dimension, and other objectionable materials.
- D. Where topsoil depth is 12 inches or greater, place topsoil in layers not to exceed 6 inches and, to prevent settling, compact to 85 percent relative density in accordance with ASTM D 1557. Do not place topsoil whose moisture content makes it prone to compaction during placement process.

- E. Slope grade away from buildings or structures for 12 feet minimum from walls at slope of 1/2 inch in 12 inches minimum unless otherwise noted. High point of finish grade at building foundation shall be 6 inches minimum below finish floor level. Direct surface drainage in manner indicated on Drawings by molding surface to facilitate natural run-off of water. Fill low spots and pockets with topsoil and grade to drain properly.
- F. Add specified chemical soil amendments at specified rates.
 - 1. Roto-till or otherwise mix amendments evenly into top 5 inches of topsoil.
 - 2. Incorporate and leach chemical soil amendments, which require leaching, such as gypsum, within such time limits that soil is sufficiently dry to allow proper application of fertilizer and soil conditioners.
- G. Apply fertilizers over planting areas.
- A. After landscape areas have been prepared, take no heavy objects over them. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.

END OF SECTION

SECTION 32 93 00

PLANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. Furnish and install landscaping plants as described in Contract Documents.
- B. Related Sections:
 - 1. Section 32 90 01: Common Planting Requirements.

1.2 REFERENCES

- A. American Nursery & Landscape Association / American National Standards Institute:
 - 1. ANLA / ANSI Z60.1-2004, 'American Standard for Nursery Stock.'

1.3 SUBMITTALS

- A. Samples:
 - 1. Top dressing rock mulch for approval before delivery to site.
 - 2. Soil pep for approval before delivery to site.
 - 3. Certification that plant material is available in the required varieties, sizes and condition.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver healthy and vigorous trees and shrubs.
 - 1. Do not prune before delivery, except as approved by Architect.
 - 2. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping and other handling and tying damage.
 - 3. Do not bend or bind-tie shrubs in such a manner as to destroy natural shape.
 - 4. Provide protective covering during delivery.
- B. Handle stock by root ball or container. Do not drop trees and shrubs during delivery.
- C. Deliver trees, shrubs and other plants after preparations for planting have been completed and install immediately.
 - 1. If planting is delayed more than six hours after delivery, set planting materials in shade and protect from weather and mechanical damage.
 - 2. Set balled stock on ground and cover ball with soil, saw dust, or other acceptable material approved by Architect. Do not place on pavement.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of tree and shrubs stored on site with fine mist spray. Water as often as necessary to maintain root systems in moist condition.

1.5 SEQUENCING

- A. Do not commence work of this Section until work of Section 32 91 13 has been completed and approved.

1.6 WARRANTY

- A. Guarantee furnished trees, shrubs and other plants to live and remain in strong, vigorous, and healthy condition for one year from date landscape installation is accepted as substantially complete.
- B. Warranty shall include:
 - 1. Removal of dead or damaged plant material immediately and the replacement of said dead or damaged plant material during acceptable planting periods as determined by Landscape Architect.
 - 2. Replacement of plant material that is more than 25 percent dead or in an unhealthy condition at the end of the warranty period
- C. Plant material that has been replaced during the warranty period shall be warranted an additional 1 year after replacement.

1.7 OWNER'S INSTRUCTIONS

- A. Provide written instructions covering maintenance requirements by Owner for the full guarantee period beyond Contract maintenance period specified in Section 32 01 01.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Plants:
 - 1. Conform to requirements of Plant List and Key on Drawings and to ANSI Z60.1.
 - 2. Nomenclature: Plant names used in Plant List conform to 'Standardized Plant Names' by American Joint Committee on Horticultural Nomenclature except in cases not covered. In these instances, follow custom of nursery trade. Plants shall bear a tag showing the genus, species, and variety of at least 10 percent of each species delivered to site.
 - 3. Trees specified as B & B are not acceptable in container grown condition without prior approval by the Architect.
 - 4. Quality:
 - a. Plants shall be sound, healthy, vigorous, free from plant disease, insect pests or their eggs, noxious weeds, and have healthy, normal root systems. Container stock shall be well established and free of excessive root-bound conditions.
 - b. Do not prune plants prior to delivery.
 - c. Plant materials shall be subject to approval by Architect as to size, health, quality, and character.
 - d. Provide plant materials from licensed nursery or grower.

5. Measurements:
 - a. Measure height and spread of specimen plant materials with branches in their normal position as indicated on Drawings or Plant List.
 - b. Measurement should be average of plant, not greatest diameter. For example, plant measuring 15 inches in widest direction and 9 inches in narrowest would be classified as 12 inch stock.
 - c. Plants properly trimmed and transplanted should measure same in every direction.
 - d. Where caliper or other dimensions of plant materials are omitted from Plant List, plant materials shall be normal stock for type listed.
 - e. Plant materials larger than those specified may be supplied, with prior written approval of Architect, and:
 - 1) If complying with Contract Document requirements in all other respects.
 - 2) If at no additional cost to Owner.
 - 3) If sizes of roots or balls are increased proportionately.
 6. Shape and Form:
 - a. Plant materials shall be symmetrical or typical for variety and species and conform to measurements specified in Plant List.
 - b. Well grown material will generally have height equal to or greater than spread. However, spread shall not be less than 2/3's of height.
- B. Planting Mix: Refer to details.
- C. Planting Tablets: 21 gram Agriform 20-10-5.
- D. Tree Stakes:
 1. Type Two Acceptable Products:
 - a. 2 inch diameter Lodgepole Pine.
 - b. Equal as approved by Architect before installation. See Section 016000.
- E. Tree Staking Ties:
 1. Type Two Acceptable Products:
 - a. Flex-strap tree ties by Jain Irrigation, Inc, Fresno, CA www.jainsusa.com.
 - b. Equal as approved by Architect before installation. See Section 01 6000.
- F. Pre-Emergent Herbicide:
 1. Category Four Approved Products.
 - a. Elanco XL.
 - b. Ronstar.
 - c. Surflan.
- G. Weed Barrier:
 1. Acceptable Products:
 - a. DeWitt PRO-5 Weed Barrier.
 - b. Equal as approved by Architect before bidding.
- H. Rock Mulch:
 1. Type Two Acceptable Products:
 - a. Refer to landscape plan.
 - b. Equal as approved by Architect before installation. Testing results will be required.
 - c. Required Testing - All rock mulch requested by contractor as an Equal shall have a sieve analysis (ASTM C136) with an accumulative % passing rating of 95% or

greater. All material shall meet a resistance to degradation test (ASTM C131) at 500 revolutions per minute with a percent of loss of 45% or less. Contractor to provide test results to Landscape Architect before shipping rock mulch to the site.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before proceeding with work, check and verify dimensions and quantities. Report variations between Drawings and site to Architect before proceeding with work of this Section.
- B. Plant totals are for convenience only and are not guaranteed. Verify amounts shown on Drawings. All planting indicated on Drawings is required unless indicated otherwise.

3.2 PREPARATION

- A. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas. Secure Architect's acceptance before planting. Make minor adjustments as may be requested.

3.3 INSTALLATION

- A. Excavation:
 - 1. If underground construction work or obstructions are encountered in excavation of planting holes, Architect will select alternate locations.
 - 2. Plant Excavation Size:
 - a. Diameter: Twice diameter of root ball or container minimum.
 - b. Depth – Refer to Details.
 - 3. Roughen sides and bottoms of excavations.
- B. Planting:
 - 1. Before planting, test two typical planting excavations with water and verify that water drains away within one hour. Inform Architect in writing if water does not drain properly. Do not plant trees and shrubs in holes that do not properly drain.
 - 2. Removing Binders And Containers:
 - a. Remove top one / third of wire basket and burlap binders.
 - b. Remove plastic and twine binders from around root ball.
 - c. Remove wood boxes from around root ball. Remove box bottoms before positioning plant in hole. After plant is partially planted, remove remainder of box without injuring root ball.
 - 3. Plant immediately after removing binding material and containers. Place shrubs in holes so, after watering and settling, top of root ball shall be approximately one inch higher than finished grade. Place trees in holes so, after watering and settling, top of root ball shall be approximately two inches higher than finished grade.
 - 4. Properly cut off broken or frayed roots.
 - 5. Center plant in hole and backfill with specified planting mix.

6. Install "PHC Tree Saver" per manufacturer's recommendations in all tree and shrub planting mixes.
 7. Add planting tablets in plant pit as follows. Place tablets in relation to root ball as recommended by Manufacturer.
 - a. One Gallon Shrub: 1 tablet.
 - b. 5 Gallon Shrub: 2 tablets.
 - c. 15 Gallon Tree: 4 tablets
 - d. 2" Caliper Tree: 6 tablets.
 8. Fill landscape excavations tamped planting mix. Settle by firming and watering to ensure top of ball one inch higher than surrounding soil.
 9. Do not use muddy soil for backfilling.
 10. Make adjustments in positions of plants as directed by Architect.
 11. Thoroughly water shrubs immediately after planting.
- C. Supports for New Trees:
1. Provide new supports for trees.
 - a. Remove nursery stakes delivered with and attached to trees.
 - b. Support shall consist of at least two tree stakes driven into hole base before backfill so roots are not damaged. Place stakes vertically and run parallel to tree trunk. Install stakes so 3 feet of stake length is below finish grade.
 - c. Place tree ties 6 to 12 inches below crotch of main tree canopy. Second set of tree ties may be required 18 to 24 inches above finish grade, if directed by Architect.
 - d. Remove tops of tree stakes so top of stake is 6 inches below main tree canopy to prevent damage to tree branches and canopy growth.
 2. Provide guying kits to support Evergreen trees.
- D. Post Planting Weed Control:
1. Apply specified pre-emergent herbicide to shrub and ground cover planting areas after completion of planting.
 2. Areas shall be free of existing weed growth prior to application of herbicide.
- E. Weed Barrier Fabric:
1. After planting and application of herbicide in shrub beds, apply covering of specified weed barrier fabric with fuzzy side down.
 2. Achieve 100 percent coverage over ground areas.
 3. Overlap seams 6 inches minimum.
 4. Staple at 5 feet on center each way with two at each corner.
- F. Mulching:
1. After application of herbicide, mulch shrub and ground cover planting areas with 3 inches deep layer of specified top dressing rock mulch.
 2. Place top dressing mulch to uniform depth and rake to neat finished appearance.

END OF SECTION

SECTION 33 05 01
ACRYLONITRILE-BUTADIENE-STYRENE (ABS) PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. The Section includes the furnishing and installation of ABS Pipe, fittings, joint materials, and appurtenances, for a complete and operable system in accordance with the Contract Documents.

1.2 RELATED WORK

- A. Related work specified in other sections includes but is not limited to:
1. Section 01 33 00 Submittals
 2. Section 05 45 00 Mechanical Metal Supports
 3. Section 31 23 15 Excavation and Backfill for Buried Pipelines

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM D 2235 Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
 2. ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 3. ASTM D 2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
 4. ASTM D 2661 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
 5. ASTM D 2680 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.
 6. ASTM D 2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping
 7. ASTM D 3311 Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
 8. ASTM D 3965 Standard Classification System and Basis for Specifications for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Materials for Pipe and Fittings
 9. ASTM F 477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 10. ASTM F 628 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core
 11. ASTM F 1498 Standard Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings
 12. ASTM F 1668 Standard Guide for Construction Procedures for Buried Plastic Pipe

13. ASTM F 2969 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS)
IPS Dimensioned Pressure Pipe

C. NATIONAL SANITATION FOUNDATION (NSF)

1. NSF 14 Plastics Piping System Components and Related Materials

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittals.
- B. Submit catalog information on all fittings shown on the Drawings. Information shall indicate manufacture specification compliance and dimensional data.

1.5 QUALITY ASSURANCE

- A. Reject any pipe which does not conform to Contract Documents or is damaged or otherwise unacceptable.

1.6 MEASUREMENT AND PAYMENT

- A. ABS Pipe shall not be measured or paid as a separate item, but shall be included as part of the various items to which it relates.

PART 2 PRODUCTS

2.1 ABS SOLID WALL PIPE (NON-PRESSURE SYSTEM)

- A. Pipe shall be plain end, schedule 40 shall conform to ASTM D 2661 for diameters 1-1/2 inch to 6 inch. Fittings shall conform to ASTM D 2661. Pipe and fittings shall conform to NSF International Standard 14.
- B. Joints shall be bell and spigot with solvent cement which complies with ASTM D 2235 or threaded joint which complies with ASTM F 1498.
- C. Material shall be rigid ABS plastic conforming to cell class 4-2-2-2-2 for pipe and cell class 3-2-2-2-2 for fittings as defined in ASTM D 3965.
- D. Manufacturer, or approved equal:
 - 1. Plastic Services & Products, LLC
 - 2. JM Eagle

2.2 ABS SCHEDULE 40 CELLULAR CORE PIPE (NON-PRESSURE SYSTEM)

- A. ABS cellular core pipe shall conform to ASTM F 628 for diameters 1-1/2 inch to 6 inch. Fittings shall conform to ASTM D 2661. Pipe and fittings shall conform to NSF International Standard 14.
- B. Joints shall be bell and spigot with solvent cement which complies with ASTM D 2235 or threaded joint which complies with ASTM F 1498.

- C. Material: Rigid ABS plastic conforming to cell class 4-2-2-2-2 for pipe and cell class 3-2-2-2-2 for fittings as defined in ASTM D 3965.
- D. Manufacturer, or approved equal:
 - 1. JM Eagle
 - 2. Plastic Services & Products, LLC
 - 3. Charlotte Pipe and Foundry Company

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. Installation shall comply with the manufacturer's latest installation instructions and shall conform to all applicable plumbing, fire, and building code requirements.
- C. Buried pipe shall be installed in accordance with ASTM D 2321 and ASTM F 1668.
- D. Solvent joints shall be made with solvent cement conforming to ASTM D 2335.
- E. Provide pipe supports every 4 feet, if required by code, or per Section 05 45 00 – Mechanical Metal Supports.
- F. The non-pressure system shall be hydrostatically tested after installation per local codes or the following procedure, whichever is more stringent:
 - 1. Fill the system with water at the highest point and allow any air trapped in the system to escape.
 - 2. Test the system with a hydrostatic pressure of 10 feet.
 - 3. If any leaks are found, repair the leak and then repeat the test procedure.
 - 4. Do not use compressed air or gas to test the system.

- END OF SECTION -

SECTION 33 05 02
REINFORCED CONCRETE PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. The CONTRACTOR shall construct the reinforced concrete storm drain pipeline complete and in place, including connections to new and existing structures, all in accordance with the Contract Documents.

1.2 RELATED WORK

- A. Related work specified in other Sections includes, but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 31 23 15 Excavation and Backfill of Buried Pipelines
 - 3. Section 33 08 30 Gravity Pipeline Testing

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)
 - 1. ASTM C 76 Standard Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - 2. ASTM C 443 Standard Specifications for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 - 3. ASTM C 596 Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement
 - 4. ASTM D 3212 Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
 - 5. ASTM F 477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's data sheets on reinforced concrete pipe showing pipe dimensions, rubber gaskets, pipe connectors, and other appurtenances.
- C. Submit manufacturer's information on grout.
- D. The CONTRACTOR shall furnish certificates to the ENGINEER guaranteeing that the pipe is in compliance with the requirements of these Specifications.

1.5 QUALITY ASSURANCE

- A. Pipe shall be subject to inspection at the place of manufacture. Notify the ENGINEER not less than 14 days prior to the start of any phase of the pipe manufacture. During

manufacture the ENGINEER shall be given access to all areas of the process and shall be permitted to make inspections necessary to confirm compliance with the Specifications.

- B. Materials used in the manufacture of the pipe shall be tested in accordance with this Section and the referenced standards. The CONTRACTOR shall perform said material tests. The ENGINEER shall have the right to witness testing provided that the CONTRACTOR's schedule is not delayed for convenience of the ENGINEER.

PART 2 PRODUCTS

2.1 PIPE MATERIALS

- A. Reinforced Concrete Pipe: For 12-inch through 30-inch diameter reinforced concrete pipes shall conform to the requirements of ASTM C 76 for Class III, Wall B, and Type II modified or V cement and for 36-inch through 72-inch diameter reinforced concrete pipes shall conform to the requirements of ASTM C 76 for Class III, Wall C, and Type II modified or V cement; provided, that pipe shall have tongue and groove joint designed to be self-centering. Pipe shall be designed for an internal pressure of 7 feet of water, and an external design loadings meeting AASHTO HS-20-44, soil weight of 120 pcf, and minimum cover depth of 1 foot. Pipe manufacturer shall be **Geneva Pipe and Precast, Inc., Oldcastle Infrastructure, Inc.**, or approved equal.
- B. Bell and spigot joints, including rubber gaskets, shall conform to the requirements of the latest revision of ASTM C443. Pipe joints shall be so designated as to provide for self-centering and when assembled, to compress the gasket to form a watertight seal. The gasket shall be confined in a groove on the spigot so that pipe movement or hydrostatic pressure cannot displace the gasket. Each pipe section shall be identified by a stamp indicating:
 - 1. Name of Manufacturer
 - 2. Date of Manufacture
 - 3. Pipe Classification
 - 4. Top of pipe
- C. Quick Setting Grout: Grout shall be a high strength, non-staining grout approved by the ENGINEER prior to use. It shall reach an initial set within 90 minutes at 70° F (21° C) and shall reach minimum compressive strength of 2,500 psi (17 mPa) within 24 hours. Shrinkage shall be less than 0.1 percent when tested, using the test procedures of ASTM C 596. The grout shall be mixed, handled, and placed in accordance with the manufacturer's written instructions.
- D. Service Connectors: Service connectors 3-inch through 6-inch diameter shall consist of a PVC hub, rubber sleeve, and stainless steel band. Connection shall be a compression fit into a cored wall of a mainline pipe. Rubber sleeve and gasket shall meet the requirements of ASTM F 477. Joints shall meet the requirements of ASTM D 3212. Service connector shall be **Inserta Tee by Inserta Fittings Co.**, or approved equal.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

- A. Excavation and backfill of trenches and for appurtenances and backfilling for reinforced concrete pipe shall be in accordance with Section 31 23 15 Excavation and Backfill for Buried Pipelines.

3.2 INSTALLATION

- A. All pipes shall be installed accurately to the defined line and grade. Variance from established line and grade shall not be greater than one thirty-second ($1/32$) of an inch per inch of pipe diameter and not to exceed one-half ($1/2$) inch, provided that such variation does not result in a level or reverse sloping invert; provided also that variation in the invert elevation between adjoin ends of pipe due to non-concentricity of joining surface and pipe interior surfaces does not exceed one sixty-fourth ($1/64$) inch per inch of pipe diameter, or one-half inch maximum.
- B. All concrete pipe installation shall proceed upgrade on a stable foundation with joints closely and accurately fitted. Rubber gaskets shall be fitted properly in place and care shall be taken in joining the pipe units to avoid twisting of gaskets. Joints shall be clean and dry before a joint lubricant, as recommended by the pipe supplier, shall be applied uniformly to the mating joint surface to facilitate easy positive joint closure.
- C. Pipe shall be installed with uniform bearing under the full length of the barrel, with suitable excavations being made to receive pipe bells.
- D. Select material shall be compacted around the pipe to firmly bed the pipe in position. If adjustment of position of a pipe length is required after being laid, it shall be removed and re-jointed as for a new pipe. When laying is not in progress, the ends of the pipe shall be closed with a tight-fitting stopper to prevent the entrance of foreign material.
- E. In addition to the above mentioned requirements, all pipe installation shall comply to the specific requirements of the pipe manufacturer.
- F. During the pipe installation, the trench shall be sufficiently dewatered that the joints will be free of water when jointed.

3.3 SERVICE CONNECTION

- A. Installation shall be in accordance with manufacturer's recommended installation guidelines. Backfill around the service connection shall be of the same material type and compaction level as specified for the mainline pipe installation.

3.4 PRELIMINARY CLEANING

- A. CONTRACTOR shall clean the pipeline as the work progresses by a means in accordance with good practice to insure that sand, rocks, or other foreign material are not left in any of the pipeline.
- B. Do not flush sand, gravel, concrete, debris or other materials into existing piping systems.

3.5 TESTING OF PIPELINE

- A. Testing for the reinforced concrete pipe shall be in accordance with Section 33 08 30 – Gravity Pipeline Testing.

- END OF SECTION -

SECTION 33 05 05
DUCTILE IRON PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall furnish and install all pipe, fittings, closure pieces, supports, bolts, nuts, gaskets, jointing material, polyethylene wrap, marker tape, tracer wire, and appurtenances as shown and specified, and as required for a complete and workable piping system.

1.2 RELATED WORK

- A. Related work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 01 50 30 Protection of Existing Utilities
 3. Section 09 90 00 Painting and Finishes
 4. Section 31 23 15 Excavation and Backfill for Pipelines
 5. Section 33 12 00 Mechanical Appurtenances
 6. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1. ASTM D 2041 Cast-Iron Pipe Flanges and Flanged Fittings Class 25, 125, and 250
- C. AMERICAN STANDARDS FOR TESTING AND MATERIAL (ASTM)
1. ASTM A 193 Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
 2. ASTM A 194 Standard Specification for Carbon Steel, Alloy Steel, and Stainless-Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
 3. ASTM A 283 Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
 4. ASTM A 536 Standard Specification for Ductile Iron Castings
- D. American Society of Mechanical Engineers (ASME)
1. ASME B1.1 Unified Inch Screw Threads, (UN And UNR Thread Form)
 2. ASME B18.2.1 Square, Hex, Heavy Hex, And Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, And Lag Screws (Inch Series)
 3. ASME B18.2.2 Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, And Coupling Nuts (Inch Series)

E. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 104 Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. AWWA C 105 Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C 110 Standards for Ductile-Iron and Gray-Iron Fittings, 3-inch Through 48-inch, for Water
4. AWWA C 111 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. AWWA C 115 Standard for Flanged Ductile-Iron Pipe with Ductile Iron or Gray-Iron Threaded Flanges
6. AWWA C 150 Standard for the Thickness Design of Ductile-Iron Pipe
7. AWWA C 151 Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water
8. AWWA C 153 Standard for Ductile-Iron Compact Fittings, 3-inch Through 64-inch for Water
9. AWWA C 219 Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe
10. AWWA C 600 Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
11. AWWA C 606 Standard for Grooved and Shouldered Joints
12. AWWA C 651 Standard for Disinfecting Water Mains
13. AWWA M 11 Steel Pipe – A Guide for Design and Installation

1.4 SUBMITTALS

- A. Submit catalog information on all pipe, fittings, valves, couplings, gaskets, tapes, bolts and nuts, wraps, safety tapes, and tracer wires as shown on the Drawings. Information shall indicate manufacture specification compliance and dimensional data.
- B. Submit shop drawings on all fabricated piping and pipe supports.
- C. Submit bolting patterns, procedures, and bolting equipment data, and calculations for target torque calculations.
- D. Certified affidavit of compliance for pipe and fittings or other materials furnished under this Section and as specified in the referenced standards.

1.5 QUALITY ASSURANCE

- A. Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE

- A. Ductile iron pipe shall conform to the requirements of the AWWA C151 and AWWA C150 and pipe must be certified for potable water use by the National Sanitation Foundation (NSF/ANSI 61) and must bear the logo "NSF-pw" or "NSF-61" indicating such certification. Pipe thickness rating shall be minimum Class 51 for pipe larger than 12" diameter, and Class 350 for pipe 12" diameter and smaller, unless otherwise noted on the drawings.

The pipe shall be provided with rubber gaskets, specials, and fittings as required. Nominal pipe laying lengths shall be 18 to 20-feet.

- B. Buried Ductile Iron Pipe shall be encased with 8 mil (minimum), Group 2, Class C black polyethylene, conforming to the requirements of AWWA C105. All seams in the polyethylene encasement shall be taped with a minimum 12 mil adhesive tape, **Polyken #900, 3M Scotchrap 51**, or approved equal, to completely seal the seam.

2.2 FITTINGS

- A. MJ and Push-on fittings shall conform to the (AWWA C110 or C153), be NSF certified to ANSI/NSF 61 and shall be for a minimum rated working pressure of 150 psi.
- B. Flanges shall conform to AWWA C110 AWWA C111, and ANSI B16.1, Class 125 and shall have either raised or plain faces, and shall have a minimum working pressure rating of 250 psi. For pipe sizes 24-inch and smaller, flanged joints may be rated for a maximum of 350 psi with the use of specially designed gaskets.
- C. All buried fittings shall be completely coated with food grade grease, **Chevron FM Grease**, or approved equal, and shall be completely encased with 8 mil (minimum), Group 2, Class C polyethylene, conforming to AWWA C105 and color to match the pipe wrap. All seams in the polyethylene encasement shall be taped with a minimum 12 mil adhesive tape, **Polyken #900, 3M Scotchrap 51**, or approved equal, to completely seal the seam.

2.3 DUCTILE IRON PIPE JOINTS

- A. Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, or restrained joints as required.
 - 1. Mechanical and push-on joints shall conform to the requirements of AWWA C111.
 - 2. Flanged joints shall conform to the requirements of AWWA C115.
 - 3. Restrained joints shall conform to the requirements of AWWA C151. Restrained joints shall be **Flex-Ring, Field Flex-Ring, or Lok-Ring by American Ductile Iron Pipe, Field Lok, TR-Flex by U.S. Pipe**, or approved equal.
 - 4. Joint restraining devices that impart point loads and/or wedging action on the pipe wall as a means of joint restraint shall not be allowed unless there are no other options available. CONTRACTOR may propose such devices by providing a formal substitution request indicating the locations the devices are to be used and that the devices is rated at least for the class of pipe being supplied. The devices shall be **MegaLug Model 1100 by EBAA Iron**, or approved equal.

2.4 MECHANICAL-TYPE COUPLINGS (GROOVED)

- A. Mechanical-type couplings shall be provided where indicated on the Drawings and shall conform to the requirements of AWWA C606. Mechanical type couplings shall be designed for a water working pressure not less than the design pressure of the pipe on which they are to be installed. Mechanical-type couplings shall be **Victaulic Style 31 (flexible or rigid)** or approved equal.
- B. Gaskets shall be the flush seal type.
- C. Mechanical-type couplings for equipment connections shall be provided with rigid grooved couplings or flexible type coupling with harness, unless thrust restraint is provided by other means.
- D. Grooved fittings, couplings and valves shall be furnished from the same manufacturer as the coupling. Grooving tools shall be from the same manufacturer as the grooved components.

2.5 SOLID SLEEVE-TYPE COUPLINGS

- A. Solid sleeve-type couplings shall be provided where shown on the Drawings. Coupling shall be of ductile iron and shall be of the size to fit the pipe and fittings shown. Coupling shall be pressure rated 250 psi and comply with AWWA C110. Restraints shall be provided where indicated on the Drawings.

2.6 BOLTED SLEEVE-TYPE COUPLINGS

- A. Sleeve-type couplings shall be provided where shown on the Drawings. Couplings shall be of ductile iron, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. Coating shall be fusion bonded epoxy. Couplings shall be pressure rated for 250 psi and comply with AWWA C219. Couplings shall be **Style 501 or FC1 by EJ Prescott, Style 501 by Romac**, or approved equal.

2.7 RESTRAINED BOLTED SLEEVE-TYPE COUPLINGS

- A. Restrained bolted sleeve-type couplings shall be provided where shown on the Drawings. Couplings shall be of ductile iron or ASTM A283 Grade C steel, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. Coating shall be fusion bond epoxy. Couplings shall be the rated for 250 psi and comply with AWWA C219. Sleeve length shall be 7 inches for pipe diameters 4-inch through 12-inch and 10 inches for pipe diameters 14-inch and larger. Restraint gland shall be ductile iron meeting the requirements of ASTM A 536. Couplings shall be **Series 470 by Smith-Blair, Style 400RG by Romac, Series 3800 by EBAA Iron, Inc.**, or approved equal.

2.8 FLANGE COUPLING ADAPTER (DISMANTLING JOINT)

- A. Provide flanged coupling adapters (dismantling joint) were shown on the Drawings. CONTRACTOR will not be allowed to substitute any other type of flanged coupling adapter unless approved by ENGINEER. The coupling shall be rated as indicated on the Drawings.

- B. Flanged coupling adapter bodies shall be fabricated from steel, ASTM A512 or A 513 or Ductile Iron ASTM A536, without pipe stop. The body shall not be less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. The follower ring shall be fabricated from steel, ASTM A576 or A36.
- C. For flanged coupling adapters installed in piping systems rated for positive pressure, the coupling shall be restrained with harness bolts or tie rods. Other means of restraining the coupling such as set screws will not be accepted. Harnesses shall be designed in accordance with AWWA Manual 11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed.
- D. Gaskets shall be composed of a rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions.
- E. Flanged coupling adapters (dismantling joints) shall be **Model 975 by Smith-Blair, Model 309 by JCM, Model DJ400 by Romac**, or approved equal.

2.9 GASKETS

- A. Except as otherwise provided, gaskets for flanged joints shall be 1/8-inch thick rubber fabric. Class 250 or less flange gaskets shall be **Flange-Tyte by U.S. Pipe**, higher pressure joint gaskets shall be **Garlock BLUE-GARD Style 3000**, or approved equal. Wherever blind flanges are shown, the gaskets shall consist of 1/8-inch thick cloth-inserted rubber sheet which shall cover the entire inside surface of the blind flange and shall be cemented to the surface of the blind flange.
- B. All buried fittings using steel bolts shall be coated with no-oxide wax and wrapped with polyethylene or as otherwise approved by ENGINEER.

2.10 BOLTS AND NUTS

- A. Bolts and nuts shall be rated for the system working pressure with a minimum safety factor of three.
- B. Bolts and nuts buried, submerged, and inside vaults shall be have a Xylan 1014 or 1424 fluoropolymer coating.
- C. Bolts and nuts above grade, exposed or inside structures, shall be zinc coated steel
- D. All flange bolt lengths shall be selected by CONTRACTOR such that three full threads, as a minimum, protrude from the hex nut and washer after assembly.
- E. Flange bolts shall have ASME B1.1, Class 2A threads, and be manufactured of ASTM A 193, Grade B7 steel. Bolts shall conform to ASME B18.2.1.
- F. Flange nuts shall have Class 2A fit, and be manufactured of ASTM A 194, Grade 2H steel, having square or hex heavy dimensions in accordance with ASME B18.2.2.
- G. Connection T-bolts for mechanical joint (MJ) fittings shall be Cor-Ten high strength, low alloy steel conforming to AWWA C111.

2.11 CEMENT MORTAR LINING

- A. Ductile iron pipe and fittings shall be lined with cement mortar in accordance with the requirements of the AWWA C104 except that the lining thickness shall be not less than 1/8 of an inch. The pipe interior surfaces shall be smooth and free from factures, excessive crazing, and roughness.

2.12 THRUST BLOCKS/ RESTRAINTS

- A. All fittings for pipe 20-inch diameter and larger shall not have thrust blocks, but joint restraints for the adjacent pipe shall be provided for the distances indicated on the drawings. All fittings for pipe smaller than 20-inch diameter shall have proper thrust blocks and restraints as noted for the type of installation required. Joint restraint shall be provided for all bends, fittings, and valves regardless of pipe size or location. Thrust blocks shall be concrete as per OWNER's Standards.
- B. Joint restraints may be tie rods, **TR Flex piping system as manufactured by US Pipe**, or approved equal, or a **Megalug system as manufactured by EBAA Iron**. Where the required pipeline deflection exceeds the recommended deflection of the TR Flex piping system, CONTRACTOR shall use Megalugs to achieve specified deflections.
- C. Restrained joints shall be suitable for 250 psi test pressures.

2.13 SAFETY TAPE

- A. Safety tape shall be a minimum of 3-inch wide by 5.0 mil overall thickness, with no less than a 0.35 gauge solid aluminum foil core. It shall be Safety Blue in color per American Public Works Association (APWA) National Color Code and shall be clearly labeled with the words "CAUTION WATER LINE BELOW" or similar wording approved by ENGINEER. Safety tape shall be **MagnaTec by Empire Level Mfg Corp**, or approved equal.

2.14 TRACER WIRE

- A. All piping (including service lines) shall be installed with 12 gauge solid copper THHN tracer wire for pipeline location purposes by means of an electronic line tracer.
 - 1. The wires must be installed along the entire length of the pipe on the top of the pipe and be held in place with poly tape at all pipe joints and at 5 foot intervals.
 - 2. Sections of wire shall be spliced together using approved splice caps and waterproof seals. Twisting the wires together is not acceptable.

2.15 PIPE COATINGS

- A. All exposed piping, valves, and fittings including inside vaults and buildings shall be painted as specified in Section 09 90 00 – Painting and Finishes. Exposed piping, valves and fittings to be painted shall be primed by the manufacturer in preparation for painting. CONTRACTOR shall provide verification from the finish coating supplier that the field applied coatings are compatible with the manufacturer's prime coat. Pipe to be painted shall not have asphalt emulsion coating. The exterior of buried pipe and fittings shall be an asphaltic coating approximately one-mil thick.

2.16 COLD-APPLIED WAX TAPE COATING

- A. Apply wax tape coating over all flanges, valves, actuators, joints, nuts, bolts, and all metallic appurtenances which are buried.
- B. Primer: Primer shall be a blend of petrolatums, plasticizers, and corrosion inhibitors having a paste-like consistency. The primer shall have the following properties:
1. Color Brown
 2. Pour Point 100°F to 110°F
 3. Flash Point 350°F
 4. Coverage 1 gallon/100 square feet
 5. Manufacturer **Trenton Wax Tape Primer, Denso Paste Primer**, or approved equal.
- C. Wax Tape: Wax tape shall consist of a synthetic-fiber felt, saturated with a blend of microcrystalline wax, petrolatums, plasticizers, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces. The tape shall have the following properties:
1. Color Brown
 2. Saturant Pour Point 115°F to 120°F
 3. Thickness 50 to 70 mils
 4. Tape Width 6 inches
 5. Dielectric Strength 100 volts/mil
 6. Manufacturer **Trenton No. 1 Wax Tape, Denso "Densyl Tape"**, or approved equal.
- D. Plastic Wrapper: Wrapper shall be a polyvinylidene chloride plastic with three 50-gauge plies wound together as a single sheet. The wrapper shall have the following properties:
1. Color Clear
 2. Thickness 1.5 mils
 3. Tape Width 6 inches
 4. Manufacturer **Trenton Poly-Ply, Denso Tape PVC Self-Adhesive**, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. Ductile iron fittings shall be installed in accordance with the ANSI/AWWA C600. Inspect each pipe and fitting prior to installation to verify there is no damage and clean each pipe and fitting prior to installation.
- C. Pipe shall be laid directly on the bedding material. Bell holes shall be formed at the ends of the pipe to prevent point loading.

- D. No pipe shall be installed on a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation before backfilling occurs.
- E. Immediately before joining the pipe, the bell end of the pipe shall be thoroughly cleaned. The spigot end of the pipe and the inside surface of the gasket shall be cleaned and lubricated. The lubricant shall be non-toxic, shall not support bacteria growth, shall not be harmful to the gasket material, and shall be compliant with NSF/ANSI 61 requirements. The lubricant shall not impart a taste or odor to the water in the pipe. Tilting of the pipe to insert the spigot into the bell will not be permitted.
- F. Buried Ductile Iron pipe shall be polyethylene encased in accordance with the requirements of AWWA C105 Method A. Remove all lumps of clay, mud, cinders, etc. on the pipe surface before installation of the encasement. During installation, soil or embedment material shall not be trapped between the pipe and the polyethylene. Cut polyethylene tube to a length at least 2 feet longer than the pipe section. Wrap shall overlap the adjacent pipe joint at least 1 foot. After assembling the pipe joint, overlap the joint with the polyethylene tube and secure to the pipe with adhesive tape completely around the seam. Overlap the joint on the previous pipe with the polyethylene tube and secure to the existing wrap with adhesive tape and completely seal the seam. Take up the slack width at the top of the pipe to make a snug but not tight fit along the barrel of the pipe and secure with poly tape at 5 foot intervals. For installations below the water table or wet areas, circumferential wraps of tape should be placed at 2 foot intervals along the barrel of the pipe prior to lowering the pipe into the trench.
- G. Repair punctures to the polyethylene wrap with adhesive tape. Repair cuts, tears, or damage to the polyethylene wrap with a tube cut open, wrapped around the pipe to cover the damaged area, and secure in place with **Polyken #900, 3M Scotchrap 51**, adhesive tape, or approved equal, to completely seal the seam.
- H. Provide openings for branches, service taps, blowoffs, air valves, and similar appurtenances by cutting an "X" in the polyethylene and temporarily folding back the film. After the appurtenance is installed, tape the slack securely to the appurtenance, and repair the cut and any other damaged areas.
- I. To make a direct tap, apply two or three wraps of adhesive tape completely around the polyethylene encased pipe to cover the area where the tapping machine and chain will be mounted. Install the corporation stop directly through the tape and polyethylene encasement. After the direct tap is completed, inspect for damage and repair if needed.
- J. Where polyethylene wrapped pipe joins an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of 3 feet. Secure the end with adhesive tape completely around the seam. Service lines with dissimilar metals shall be wrapped with polyethylene or approved dielectric tape for a minimum clear distance of 3 feet away from the ductile iron pipe.
- K. Valves shall be handled in a manner to prevent damage to any part of the valve. CONTRACTOR shall adjust stem packing and operate each valve prior to installation to insure proper operation. Valves shall be installed so that the valve stems are plumb and, in the location, indicated on the drawings.
- L. The pipe shall be plugged at the end of each work day or period of suspension.

- M. Safety tracer tape shall be installed 12-inches above the pipe along the entire length of pipeline.
- N. Tracer wire shall be brought up at valve boxes as shown on the Drawings. When splicing a wire use a greased filled or approved connector. All splices should occur within a valve box. Wire is to be continuous underground. Underground splices may only be used by specific permission of the OWNER and must be inspected before backfilling.

3.2 THRUST BLOCKS

- A. Thrust blocks shall be installed at points where the pipe changes direction such as: at all tees, elbows, wyes, caps, valves, hydrants, reducers, etc.
- B. Thrust blocks shall be constructed so that the bearing surface is in direct line with the major force created by the pipe or fitting.
- C. Thrust blocks shall bear against solid undisturbed earth at the side and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints or the pipe or fitting.
- D. Thrust blocks shall be sized and constructed per OWNER's Standards or the drawings, whichever is greater.

3.3 PRELIMINARY CLEANING AND FLUSHING

- A. CONTRACTOR shall flush the pipeline as the work progresses by a means in accordance with good practice to ensure that sand, rocks, or other foreign material do not remain in any of the pipeline. If possible, the flushing shall be made with an open pipe end.
- B. CONTRACTOR shall provide to ENGINEER a proposed schedule and method of flushing for review before the flushing starts.

3.4 BOLTING PROCEDURES FOR FLANGED JOINTS

- A. Flange joints shall be assembled per the gasket manufacturer's instructions and as specified herein. Utilize calibrated bolting equipment capable of applying a measured torque to flange bolts during joining. Bolting patterns, procedures, and bolting equipment data shall be submitted prior to pipe fitting and bolting.
- B. Gaskets, bolts, and anti-seize lubricant used in the bolting procedure shall be selected from those specified herein. Submit target torque calculations for each application. Calculations shall identify specific gasket (manufacturer, model, size, configuration, material), bolts (size and material), and anti-seize lubricant. The calculations shall document and take into consideration the pipe service, working and test pressures, pipe diameter, gasket data sheet, bolt material, gasket supplier-recommended assembly stress, and gasket-supplier recommended bolt stress. Calculations shall be stamped by a professional engineer. Target torque calculations shall be used in the assembly of bolted joints.
- C. Flange bolts, nuts, and washers shall be visually inspected and cleaned prior to bolting. Lubricate bolts and nuts; if hardened washers are not used, lubricate the flange surface around the bolt holes. This lubricant must be removed by cleaning solvent prior to applying

a coating system. Hand-tighten all nuts and bolts then tighten them to 10 to 20 percent of the target torque. The initial torque shall not exceed 20 percent of the target torque. The bolts shall be tightened according to the pattern included in AWWA Manual M11, Figure 12-3.

- D. For flanges having 4 to 8 bolts there shall be three rounds of tightening, after hand tightening, to 30 percent, 60 percent and then 100 percent of the target torque. For flanges having 12 or more bolts there shall be four rounds of tightening, after hand tightening, to 20 percent, 40 percent, 80 percent and 100 percent of the target torque. At 100 percent of target torque the flange gap shall be measured at every other bolt to confirm uniformity. The bolts shall be re-tightened to the target torque 24 hours after completion of the initial bolting sequence.

3.5 TRACER WIRE TESTING

- A. Tracer wire shall be installed where indicated above or shown on the Contract Drawings on the pipe along the entire length of pipeline.
- B. Upon completion of the pipe installation, CONTRACTOR shall demonstrate that the wire is continuous and unbroken through the entire run of the pipe.
 - 1. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of OWNER and/or ENGINEER.
 - 2. If the wire is broken, CONTRACTOR shall repair or replace it. Pipeline installation will not be accepted until the wire passes a continuity test.

3.6 TESTING OF PIPELINE

- A. CONTRACTOR shall provide additional temporary blow-off valves and fittings as required to flush and disinfect new pipelines. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.
- B. Source of Water
 - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for pressure testing of the pipeline.
- C. Testing Procedure
 - 1. Pipe shall be tested at a static pressure of 200 psi for 2 hours and in accordance with the AWWA C600 standards.
 - 2. In the case of pipelines that fail to pass the leakage test, CONTRACTOR shall determine the cause of the excessive leakage, shall take corrective measures necessary to repair the leaks, and shall repeat the pipeline test, all at no additional cost to OWNER.
 - 3. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test.
- D. Pressure and Leak Test
 - 1. CONTRACTOR shall test all piping either in sections or as a unit. The test shall be

made by placing temporary bulkheads as needed in the pipe and filling the line slowly with water. Care shall be taken to see that all air vents are open during the filling. Bulkheads, valves, and connections shall be examined for leaks. If any leaks are found, corrective measures satisfactory to ENGINEER shall be taken. The test shall consist of holding a minimum pressure as shown on the Drawings in the section being tested for a minimum period of two hours using either pneumatic or hydraulic means to maintain the pressure. Suitable means shall be provided by CONTRACTOR for determining the quantity of water lost by leakage under the test pressure. The testing allowance is defined as the quantity of water that must be applied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure. The maximum allowable leakage shall be defined as follows:

$$L = SD(P)^{1/2}/148,000$$

L = Testing allowance (makeup water) in gallons per hour of test

S = Length of pipe in feet

D = Nominal diameter of pipe in inches

P = Average Test Pressure in pounds per square inch (gauge)

3.7 DISINFECTING

- A. Disinfection shall be in accordance with Section 33 13 00 – Pipeline Testing and Disinfection.

3.8 PAINTING

- A. All exposed piping including inside vaults shall be painted as specified in Section 09 90 00 – Painting and Finishes.

- END OF SECTION -

SECTION 33 05 05.1
DUCTILE IRON FITTINGS FOR PVC PIPE

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall furnish and install all fittings, closure pieces, supports, bolts, nuts, jointing material and appurtenances for PVC AWWA C900 pipe as shown and specified, and as required for a complete and workable piping system.

1.2 RELATED WORK

- A. Related work specified in other sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
 2. Section 09 90 00 Painting and Finishes
 3. Section 31 23 15 Excavation and Backfill for Pipelines
 4. Section 33 02 07 Polyvinyl Chloride (PVC) Pressure Pipe, Rubber Joints (AWWA C900)
 5. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1. ANSI B16.1 Cast-Iron Pipe Flanges and Flanged Fittings
- C. AMERICAN WATER WORKS ASSOCIATION (AWWA)
1. AWWA C 104 Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
 2. AWWA C 105 Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
 3. AWWA C 110 Standards for Ductile-Iron and Gray-Iron Fittings
 4. AWWA C 111 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 5. AWWA C 115 Standard for Flanged Ductile-Iron Pipe with Ductile Iron or Gray-Iron Threaded Flanges
 6. AWWA C 150 Standard for the Thickness Design of Ductile-Iron Pipe
 7. AWWA C 151 Standard for Ductile-Iron Pipe, Centrifugally Cast,
 8. AWWA C 153 Standard for Ductile-Iron Compact Fittings
 9. AWWA C 219 Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe
 10. AWWA C 600 Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
 11. AWWA C 606 Standard for Grooved and Shouldered Joints
 12. AWWA C 651 Standard for Disinfecting Water Mains

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit catalog information on all fittings shown on the Drawings. Information shall indicate manufacture specification compliance and dimensional data.
- C. Submit shop drawings on all fabricated piping and pipe supports.
- D. Certified affidavit of compliance for fittings or other materials furnished under this Section and as specified in the referenced standards.

1.5 QUALITY ASSURANCE

- A. Except as modified herein, materials used in the manufacture of the pipe and fittings shall be tested in accordance with the requirements of the referenced standards as applicable.

PART 2 PRODUCTS

2.1 FITTINGS

- A. MJ and Push-on fittings shall conform to the (AWWA C110 or C153), be NSF certified to ANSI/NSF 61 and shall be for a minimum rated working pressure of 150 psi.
- B. Flanges shall conform to AWWA C110 AWWA C111, and ANSI B16.1, Class 125 and shall have either raised or plain faces, and shall have a minimum working pressure rating of 250 psi. For pipe sizes 24-inch and smaller, flanged joints may be rated for a maximum of 350 psi with the use of specially designed gaskets.
- C. All buried fittings shall be coated with a wax tape system.

2.2 JOINT RESTRAINTS

- A. Restraining devices that impart point loads and/or wedging action on the pipe or fitting wall as a means of joint restraint shall not be allowed unless there are no other options available. CONTRACTOR may propose such devices by providing a formal substitution request indicating the locations the devices are to be used and that the devices are rated at least for the class of pipe or fitting being supplied. The devices shall be **MegaLug Model 2000PV by EBAA Iron**, or approved equal.

2.3 SOLID SLEEVE-TYPE COUPLINGS

- A. Solid sleeve-type couplings shall be provided where shown on the Drawings. Coupling shall be of ductile iron and shall be of the size to fit the pipe and fittings shown. Coupling shall be pressure rated 250 psi and comply with AWWA C110. Restraints shall be provided where indicated on the Drawings.

2.4 BOLTED SLEEVE-TYPE COUPLINGS

- A. Sleeve-type couplings shall be provided where shown on the Drawings. Couplings shall be of ductile iron, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. Coating shall be fusion bonded epoxy. Couplings shall be pressure rated for 350 psi and

comply with AWWA C219. Couplings shall be **Style 501 or FC1 by EJ Prescott, Style 501 by Romac**, or approved equal.

2.5 BOLTS AND NUTS

- A. Bolts and nuts shall be rated for the system working pressure with a minimum safety factor of three.
- B. Connection T-bolts for mechanical joint (MJ) fittings shall be Cor-Ten high strength, low alloy steel conforming to AWWA C111.
- C. Bolts and nuts shall have a blue coating system, **Tripac 2000** using a Xylan 1014 or 1424 fluoropolymer system or equal.

2.6 THRUST BLOCKS/ RESTRAINTS

- A. All fittings for pipe 20-inch diameter and larger shall not have thrust blocks, but joint restraints for the adjacent pipe shall be provided for the distances indicated on the drawings. All fittings for pipe smaller than 20-inch diameter shall have proper thrust blocks and restraints as noted for the type of installation required. Joint restraint shall be provided for all bends, fittings, and valves regardless of pipe size or location. Thrust blocks shall be concrete as per OWNER's Standards.
- B. Restrained joints shall be suitable for 150 psi test pressures.

2.7 SAFETY TAPE

- A. Safety tape shall be a minimum of 3-inch wide by 5.0 mil overall thickness, with no less than a 0.35 gauge solid aluminum foil core. It shall be Safety Blue in color per American Public Works Association (APWA) National Color Code and shall be clearly labeled with the words "CAUTION WATER LINE BELOW" or similar wording approved by ENGINEER. Safety tape shall be **MagnaTec by Empire Level Mfg Corp**, or approved equal.

2.8 COLD-APPLIED WAX TAPE COATING

- A. Apply wax tape coating over all flanges, valves, actuators, joints, nuts, bolts, and all metallic appurtenances which are buried.
- B. Primer: Primer shall be a blend of petrolatums, plasticizers, and corrosion inhibitors having a paste-like consistency. The primer shall have the following properties:
 - 1. Color Brown
 - 2. Pour Point 100°F to 110°F
 - 3. Flash Point 350°F
 - 4. Coverage 1 gallon/100 square feet
 - 5. Manufacturer **Trenton Wax Tape Primer, Denso Paste Primer**, or approved equal.
- C. Wax Tape: Wax tape shall consist of a synthetic-fiber felt, saturated with a blend of microcrystalline wax, petrolatums, plasticizers, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces. The tape shall have the following properties:

- | | |
|------------------------|--|
| 1. Color | Brown |
| 2. Saturant Pour Point | 115°F to 120°F |
| 3. Thickness | 50 to 70 mils |
| 4. Tape Width | 6 inches |
| 5. Dielectric Strength | 100 volts/mil |
| 6. Manufacturer | Trenton No. 1 Wax Tape, Denso "Densyl Tape", or approved equal. |

D. Plastic Wrapper: Wrapper shall be a polyvinylidene chloride plastic with three 50-gauge plies wound together as a single sheet. The wrapper shall have the following properties:

- | | |
|-----------------|---|
| 1. Color | Clear |
| 2. Thickness | 1.5 mils |
| 3. Tape Width | 6 inches |
| 4. Manufacturer | Trenton Poly-Ply, Denso Tape PVC Self-Adhesive, or approved equal. |

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 Excavation and Backfill for Buried Pipelines.
- B. Ductile iron fittings shall be installed in accordance with the AWWA C600.
- C. All buried Ductile Iron fittings and valves shall be completely coated with food grade grease, **Chevron FM Grease**, or approved equal, and shall be encased with polyethylene wrap and installed in conformance with AWWA C105 standards. All seams in the polyethylene encasement shall be taped with **Polyken #900 Adhesive Tape**, or approved equal, to completely seal the seam.

3.2 THRUST BLOCKS

- A. Thrust blocks shall be installed at points where the pipe changes direction such as: at all tees, elbows, wyes, caps, valves, hydrants, reducers, etc.
- B. Thrust blocks shall be constructed so that the bearing surface is in direct line with the major force created by the pipe or fitting.
- C. Thrust blocks shall bear against solid undisturbed earth at the side and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints or the pipe or fitting.
- D. Thrust blocks shall be sized and constructed per OWNER's Standards or the drawings, whichever is greater.

3.3 COLD-APPLIED WAX TAPE COATING APPLICATION

- A. Surfaces shall be clean and free of all dirt, grease, water, and other foreign material prior to the application of the primer and wax tape.

- B. Apply primer by hand or brush to all surfaces of the pipefitting or valve. Work the primer into all crevices and completely cover all exposed metal surfaces.
- C. Apply the wax tape immediately after the primer application. Work the tape into the crevices around fittings. Wrap the wax tape spirally around the pipe and across the fitting. Use a minimum overlap of 55 percent of the tape width.
- D. Work the tape into the crevices and contours of irregularly shaped surfaces and smooth out so that there is a continuous protective layer with no voids or spaces under the tape. For larger voids or irregular shaped surfaces fill spaces with a moldable mastic. Moldable mastic shall be **Trenton Fill-Pro PM-GP**, or approved equal.
- E. Overwrap the completed wax tape installation with the plastic wrapping material. Wrap spirally around the pipe and across the fitting. Use a minimum overlap of 55 percent of the tape width and apply two layers or applications of overwrap. Secure plastic wrapper to pipe with adhesive tape.

3.4 DISINFECTING

- A. Disinfection shall be in accordance with Section 33 13 00 – Pipeline Testing and Disinfection.

- END OF SECTION -

SECTION 33 05 07.2
POLYVINYL CHLORIDE (PVC) SEWER PIPE
(ASTM D 3034 and F 679, MODIFIED)

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall furnish and install all PVC sewer pipe and appurtenances as shown and specified, and as required for a complete and workable piping system.

1.2 RELATED WORK

- A. Related work specified in other sections:
1. Section 01 33 00 Submittal Procedures
 2. Section 31 23 15 Excavation and Backfill for Pipelines

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM C 425 Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
 2. ASTM D 1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride)(PVC) Compounds
 3. ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 4. ASTM D 2412 Standard Specification for External Loading Properties of Plastic Pipe by Parallel-Plate Loading
 5. ASTM D 2444 Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
 6. ASTM D 3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 7. ASTM D 3212 Standard Specification for Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals
 8. ASTM F 477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 9. ASTM F 913 Standard Specification for Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 10. ASTM F 679 Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
 11. ASTM F 1417 Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit Shop Drawings and laying diagrams of pipe, joints, bends, special fittings, and piping appurtenances.
- C. Submit manufacturer's certificate that the pipe conforms to these specifications.
- D. Submit plan for commissioning the sewer pipeline, including but not limited to cleaning and testing plan. The written testing plan shall include methods for water conveyance, leak testing, and water disposal.

PART 2 PRODUCTS

2.1 POLYVINYL CHLORIDE PIPE

- A. PVC sewer pipe shall conform to the requirements of ASTM D 3034 for pipe sizes 3-inch to 15-inch and to ASTM F 679 for pipe sizes 18-inch to 48-inch. Material for PVC pipe shall conform to the requirements of ASTM D 1784, for cell classification 12454 or 12364 as defined therein. The manufacturer shall test a sample from each batch according to ASTM D 2444.
- B. Joints shall conform to ASTM D 3212. Elastomeric seals for compression type joints shall conform to the requirements of ASTM F 477 or ASTM F 913.
- C. Pipe sections shall be clearly marked to:
 - 1. Identify manufacturer's name or trademark
 - 2. Nominal pipe size and OD base
 - 3. ASTM material code designation
 - 4. Dimension Ratio
 - 5. ASTM specification designation
 - 6. Product record code
- D. The PVC pipe shall meet the testing in accordance with ASTM D 2412 and shall be SDR 35 for a maximum bury depth of 20 feet.

2.2 FITTINGS

- A. Fittings shall conform to the requirements of ASTM D 3034. The ring groove and gasket ring shall be compatible with PVC pipe ends.
- B. The stiffness of the fittings shall be not less than the stiffness of adjoining pipe.

2.3 FLEXIBLE COUPLINGS

- A. Flexible couplings shall be neoprene, full-circle, clamp-on type conforming to ASTM C 425 and provided with 2 stainless steel band screw-clamps to secure the coupling tightly to entering and exiting pipes. Screw-clamp hardware shall be Type 304 or Type 316 stainless steel. Neoprene material shall be suitable for sewage service.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. PVC pipe shall be installed in accordance with the requirements of ASTM D 2321 and as indicated. Pipe sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointings, the bedding for the pipe shall be checked for firmness and uniformity of slope.
- C. Handling of the pipe shall be done with tools as recommended by the pipe manufacturer to insure the pipe is not damaged in any manner during storage, transit, loading, unloading and installation. Pipe shall be inspected both prior to and after installation in the ditch and all defective lengths shall be rejected and removed from the working area.
- D. Fittings shall be lowered into the trench by means of rope, cable, chain, or other means without damage. Cable, rope, or other devices used for lower the fitting into the trench shall be attached around the exterior of the fitting for handling never through the interior of the fitting.
- E. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be the CONTRACTOR's responsibility.
- F. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the CONTRACTOR in cooperation with owners of such utility structures. Unless otherwise indicated, protection of existing utility structures shall be the CONTRACTOR's responsibility.
- G. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe that has floated shall be removed from the trench, cleaned, and re-laid in an acceptable manner. No pipe shall be laid when, in the opinion of the ENGINEER, the trench conditions or weather are unsuitable.

3.2 PIPE PREPARATION

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly

3.3 PIPE JOINTS

- A. Each pipe compression type joint shall be joined with a lock-in rubber ring and a ring groove that is designed to resist displacement during pipe insertion.
- B. The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. A thin film of lubricant shall be applied to the exposed surface of the ring and to the outside of the clean pipe end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be then forced into the ring to complete the joint.

- C. The pipe shall not be deflected either vertically or horizontally in excess of the printed recommendations of the manufacturer of the coupling.
- D. Fittings shall be carefully connected to pipe and joint shall be checked to insure a sound and proper joint.

3.4 PRELIMINARY CLEANING AND FLUSHING

- A. CONTRACTOR shall flush the pipeline as the work progresses by a means in accordance with good practice to insure that sand, rocks, or other foreign material are not left in any of the pipeline. If possible the flushing shall be made with an open pipe end.
- B. CONTRACTOR shall provide to ENGINEER a proposed schedule and method of flushing for review before the flushing starts.

3.5 INSPECTION AND TESTING OF PIPELINE

- A. PVC sewer pipes and service laterals shall be tested for exfiltration or infiltration and deflection as indicated. Pipes shall be backfilled prior to testing. Leakage tests shall be completed and approved prior to placing of permanent resurfacing of pavement. When leakage or infiltration exceeds the allowed amount, the CONTRACTOR shall locate the leaks and make the necessary repairs or replacements to reduce the leakage or infiltration to the allowable limits. Individually detectable leaks shall be repaired, regardless of whether the test results are acceptable or not.
- B. Source of Water
 - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection and/or pressure testing of the pipeline.
- C. No materials shall be used which would be injurious to pipeline structure and future function. Air test gauges shall be laboratory-calibrated test gauges and shall have a size and pressure range appropriate for the pipe being tested.
- D. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that the ENGINEER may be present during the test.
- E. PVC sewer pipe 30-inches and smaller shall be tested for deflection by the mandrel (deflection gauge) test. Larger flexible pipe shall be tested by a method approved by the ENGINEER. The outside diameter of the mandrel shall be 95 percent of the inside diameter of the pipe. The mandrel barrel length shall be at least 75 percent of the pipe inside diameter. The mandrel shall utilize a nine arm design and shall be **938-96 Series by Petersen**, or approved equal. Provide a proving ring or mandrel that is field verifiable without a proving ring. Excessively deflected pipe shall be removed and replaced.

3.6 WATER EXFILTRATION TEST

- A. Each section of sewer shall be tested between successive manholes by closing the lower end and the inlet sewers of the upper manhole with stoppers or inflatable plugs. The pipe and manhole shall be filled with water to a point at least 2-feet above the centerline of the sewer at the center of the upper manhole; or if ground water is present, 2-feet above the average adjacent ground water level, whichever is higher.

- B. During testing the maximum internal pipe pressure at the lowest end should not exceed 10.8 psi (25 feet). The average internal pressure should not exceed 5 psi (11.6 feet).
- C. Water shall remain in the pipe for at least one hour or until the water level stabilizes, whichever is longer, before the test begins. The minimum test duration shall be 4 hours.
- D. Unless indicated otherwise, the CONTRACTOR shall measure exfiltration. Measure the amount of water added to the upstream manhole to maintain the water level at the elevation set above. Compare the amount added to the allowable leakage calculated below, and if the amount added is equal to or less than the allowable amount, the tested section of the pipe has passed.
- E. The allowable leakage shall not exceed 25 gallons per inch of internal pipe diameter per mile per day.

3.7 WATER INFILTRATION TEST

- A. The end of the sewer at the upper structure shall be closed to prevent the entrance of water, and pumping of ground water shall be discontinued for at least 3 days, after which the section shall be tested for infiltration.
- B. The infiltration into each individual reach of sewer between adjoining manholes shall not exceed 25 gallons per inch of internal pipe diameter per mile per day.
- C. Unless otherwise indicated, infiltration shall be measured by the CONTRACTOR.

3.8 AIR PRESSURE TEST

- A. The CONTRACTOR shall furnish all materials, equipment, and labor for making an air test. Air test equipment shall be approved by the ENGINEER.
- B. The test of the pipe and service laterals shall be conducted in the presence of the ENGINEER. Testing of pipe shall be performed in accordance with ASTM F 1417.
- C. Air pressure in the sewer line shall be increased to 4.0 psi above groundwater pressure (1.0 psi for each 2.3 feet of water elevation above the highest point of the pipe). Do not allow the pressure at any point in the pipe to reach 9 psi under any circumstances. Allow the pressure to stabilize for 5 minutes, then reduce the pressure to 3.5 psi above groundwater pressure and start the test. Stop the air release and record the decrease in pressure over time.
- D. Pass/Fail Criterion: The time taken for the pressure to decrease from 3.5 to 2.5 psi above groundwater pressure shall be equal to or greater than the time in Table 1.

Table 1: Air Pressure Test Times By Pipe Diameter

Nominal Pipe Diameter (inch)	Minimum Time (min:sec)	Length for Minimum Time (feet)	Increased Time for Longer Lengths (seconds per foot)
4	3:46	597	0.380
6	5:40	398	0.854
8	7:34	298	1.520
10	9:26	239	2.374
12	11:20	199	3.418
15	14:10	159	5.342
18	17:00	133	7.692
21	19:50	114	10.470
24	22:40	99	13.674
27	25:30	88	17.306
30	28:20	80	21.366
33	31:10	72	25.852
36	34:00	66	30.768
42	39:48	57	41.883
48	45:34	50	54.705

- E. For pipe larger than 24-inches, air pressure tests may be performed on each joint. The time for the pressure to fall from 3.5 to 2.5 psi, both above groundwater pressure, shall not be less than 10 seconds regardless of pipe diameter.
- F. If the time is less than the allowable time, the pipe will be considered defective and shall be repaired and retested.

3.9 DEFLECTION TEST

A. Mandrel Test

- 1. The CONTRACTOR shall test all flexible pipe 30-inches and smaller for deflection, joint displacement, and other obstructions by passing the mandrel through the pipe not less than 30 days after completion of the trench backfill, but prior to permanent pavement resurfacing.

2. Pipe with diameter less than the mandrel will be considered defective, and the CONTRACTOR shall replace it.
- B. Flexible pipe in sizes larger than 30-inches shall have deflections measured by a rigid metal bar, a rigid frame, or other method approved by the ENGINEER.

3.10 VIDEO INSPECTION

- A. Inspect PVC sewer pipe and document the inspection by video camera taping of the entire pipe. Provide two (2) copies of the video inspection in DVD format to the OWNER.

- END OF SECTION -

SECTION 33 05 13
PRECAST CONCRETE MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide precast concrete manholes and vaults, complete and in place, in accordance with the Contract Documents.

1.2 RELATED WORK

- A. Related work specified in other sections:
1. Section 01 33 00 Submittals
 2. Section 01 45 00 Quality Control and Materials Testing
 3. Section 01 60 00 Product Requirements
 4. Section 01 60 00 Product Requirements
 5. Section 31 23 15 Excavation and Backfill for Buried Pipelines
 6. Section 31 23 23 Excavation and Backfill for Structures
 7. Section 33 05 05 Ductile Iron Pipe
 8. Section 33 05 07 Polyvinyl Chloride (PVC) Pipe

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)
1. ASTM A 48 Standard Specification for Gray Iron Castings
 2. ASTM A 536 Standard Specification for Ductile Iron Castings
 3. ASTM A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 4. ASTM C 150 Standard Specification for Portland Cement
 5. ASTM C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections
 6. ASTM C 497 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
 7. ASTM C 857 Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 8. ASTM C 858 Standard Specification for Underground Precast Concrete Utility Structures

- 9. ASTM C 913 Standard Specification for Precast Concrete Water and Wastewater Structures
- 10. ASTM C 923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
- 11. ASTM C 990 Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate manhole and concrete structure locations, elevations, and piping sizes, material, and elevations of penetrations.
- C. Product Data: Submit cover and frame construction, features, configuration and dimensions. Submit pipe connector materials and dimensions. Submit manhole step materials and dimensions. Submit manhole and structure joint sealant materials.

1.5 QUALITY ASSURANCE

- A. The CONTRACTOR shall demonstrate that manholes and structures have been properly installed, level, with tight joints, at correct elevations and orientations, and have been backfilled and compacted in accordance with the specifications.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes and structures.
- C. Store precast concrete manholes and structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.
- D. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

PART 2 PRODUCTS

2.1 MANHOLES

- A. Reinforced precast concrete manholes in accordance with ASTM C 478 with HS-20 loading. Axial length of barrel sections shall be selected to provide the correct total height with the fewest joints. Conical sections shall be designed to support cast iron frames and covers under H-20 loading, unless noted otherwise. Design criteria shall be as shown on the drawings. Manholes shall be manufactured by **Oldcastle Precast, Geneva Pipe and Precast**, or approved equal.

- B. Joints shall be sealed with butyl-rubber sealants, **ConSeal CS-102, Ram-Nek RN101**, or approved equal, conformation to ASTM C 990
- C. Barrel section to pipe connections shall be sealed with resilient connectors, **Kor-N-Seal by Trelleborg**, or approved equal, complying with ASTM C 923. Mechanical devices shall be stainless steel.

2.2 STRUCTURES

- A. Provide reinforced concrete structures and vaults designed for the applications and sizes as shown on the drawings. Structures shall conform to the requirements of ASTM C 857, ASTM C 858, or ASTM C 913 as required. Minimum wall thickness shall be 5-inches. Cement shall be Type V Portland cement conforming to the requirements of ASTM C 150. The minimum 28-day concrete compressive strength shall be 4,000 psi. Reinforcing steel shall be embedded in the concrete with a minimum rebar clear cover as recommended by ACI 318. Structure and vaults shall be manufactured by **Oldcastle Precast, Geneva Pipe and Precast**, or approved equal
- B. Structures in areas subject to traffic shall be designed for H-20 traffic loading. Vaults in other areas shall be designed for a vertical live load of 300 psf.
- C. Where joints are required, joints shall be interlocking to secure proper alignment between members and shall prevent migration of soil through the joint. Joints shall be sealed with butyl-rubber sealants, **ConSeal CS-102, Ram-Nek RN101**, or approved equal, conformation to ASTM C 990.
- D. Openings, where required, shall be of the size and location indicated on the drawings and shall be provided without obstructions from brackets and supports. Unless noted otherwise, frames and covers shall be fabricated from steel and galvanized after fabrication. Frames shall be integrally cast into the structure concrete sections. Covers shall be tight fitting to prevent dirt and debris entering the structure.
- E. Where penetrations are required for piping, conduits, or ducts, such penetrations shall be through precast openings or core drilled through unreinforced thin-wall knock-out sections. Penetrations shall be smooth and exposed reinforcing steel will not be allowed. Unless noted otherwise, structures do not need to be designed to resist thrust from piping passing through the structure.

2.3 FRAMES AND COVERS

- A. Manufacturers:
 - 1. D & L Foundry and Supply, East Jordan Iron Works, Neenah Foundry Co., or approved equal. Model Number as shown on the Drawings.
- B. Product Description: Casting frames and covers shall be non-rocking and shall conform to the requirements of ASTM A 48, Class 35B for Gray Iron and ASTM A 536 for ductile iron. Unless noted otherwise, cast iron covers and frames shall be 30-inches in diameter, , machined flat bearing surface, removable lid; HS-20 load rating; with embossed lettering saying (“IRRIGATION”, “WATER”, “SEWER”, “STORM DRAIN”) cast into cover.

2.4 COMPONENTS

- A. Manhole and Structure Steps shall have a 1/2-inch ASTM A 615 grade 60 steel reinforcement rod encased in polypropylene copolymer plastic. Steps shall have a tread width of 14-inches nominal. Steps shall be manufactured by **American Step Company, Inc., M.A. Industries**, or approved equal.

2.5 CONFIGURATION

- A. Shaft Construction: Square or rectangular with flat lid top section; lipped male/female joints; shaped to receive pipe sections.
- B. Clear Inside Dimensions: As indicated on Drawings.
- C. Design Depth: As indicated on Drawings.
- D. Clear Cover Opening: As indicated on Drawings.

2.6 BEDDING AND COVER MATERIALS

- A. Bedding: 3/4" Washed Rock as specified in Section 31 23 23.
- B. Soil Backfill to Finish Grade: Trench Backfill Material as specified in Section 31 23 15.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify built-in items are in proper location, and ready for roughing into Work.
- C. Verify correct size of manhole and structure excavation.

3.2 PREPARATION

- A. Do not install structures where site conditions induce loads exceeding structural capacity of structures.
- B. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.3 PRECAST CONCRETE MANHOLE AND STRUCTURE INSTALLATION

- A. Lift precast components at lifting points designated by manufacturer.
- B. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.
- C. Set precast structures bearing firmly and fully on crushed stone bedding, compacted in accordance with provisions of Section 31 23 23.

- D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.
- E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.
- F. Joint sealing materials may be installed on site or at manufacturer's plant.
- G. Verify manholes and structures installed satisfy required alignment and grade.
- H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe.
- I. Steps shall be installed 12-inches on centers vertically not more than 1/2-inch out of plumb. The top step shall not be more than 12-inches below the manhole cover.
- J. Prior to backfilling, fill all cracks and voids in the manholes or vaults with non-shrink grout, polyurethane sealant, or both.

3.4 FRAME AND COVER INSTALLATION

- A. Set frame and cover 2-inches above finished grade for manholes and structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1-inch below top surface of frame.
- B. In paved areas set frame and cover 1/4" below finished grade and install concrete collar.

3.5 FIELD QUALITY CONTROL

- A. Section 01 45 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Vertical Adjustment of Existing Manholes and Structures
 - 1. Where required, adjust top elevation of manholes and structures to finished grades shown on Drawings.
 - 2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.

- END OF SECTION -

SECTION 33 05 26
UTILITY IDENTIFICATION

PART 1 GENERAL

1.1 DESCRIPTION

- A. The CONTRACTOR shall provide and install identification markers for all exposed valves, piping, equipment, tanks, and warning signs, all in accordance with these specifications and the Contract Documents.

1.2 RELATED WORK

- A. Related work specified in other sections includes:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 09 90 00 Painting and Finishes

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - 1. ANSI A13.1 Scheme for the Identification of Piping Systems
 - 2. ANSI Z535 Safety Signs and Colors
- C. AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)
 - 1. ASTM D 1593 Standard Specification for Nonrigid Vinyl Chloride Plastic Film and Sheeting
 - 2. ASTM D 3652 Standard Test Method for Thickness of Pressure-Sensitive Tapes

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's data sheets showing wording, symbols, letter size, and color coding.
- C. Submit one sample of each type of identification device to be used.
- D. Submit sample of each proposed color required by the color schedule.
- E. Submit the manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. Product manufacturer shall be ISO 9001 Quality Certified.

PART 2 PRODUCTS

2.1 VALVE TAGS

- A. General: Provide each valve of size 2-inch and larger with an identification tag. Tag shall show the pipeline station (if applicable), type, manufacturer, date of manufacture, and pressure rating.
- B. Plastic Tags:
 - 1. Acrylic: Flexible 0.060-inch (1.52 mm) thick, multi-layered acrylic, square engraved tags. Model **Setonply by Seton, B-418 by Brady**, or approved equal.
- C. Metal Tags:
 - 1. Brass: 19 gauge thick solid brass, with 3/16-inch (5 mm) top hole for fastener, natural brass finish. Manufacturer shall be **Seton, Brady**, or approved equal.
 - 2. Aluminum: 19 gauge thick aluminum. Teflon coated both sides, with Code 39 bar codes. Manufacturer shall be Seton, Brady, or approved equal.
 - 3. Stainless Steel: 0.6 mm (0.025 inch) thick, Grade 304 stainless steel. Manufacturer shall be **Seton, Brady**, or approved equal.
 - 4. Lettering: Stamped letters; character size and words according to ANSI A13.1.
- D. Beaded Chains: No. 6 brass, 114 mm (4-1/2 inch) long, with locking link.
- E. Chart: Typewritten letter size list in anodized aluminum frame.

2.2 PIPE MARKERS

- A. General: Labels for piping shall bear the full piping system name. Provide flow arrows and working pressure next to each label.
- B. Mechanically Fastened Pipe Markers:
 - 1. Vinyl: Factory fabricated vinyl, 0.020 inch to 0.030 inch thick, performed to fit around pipe or pipe covering. Model **Setmark by Seton, B-915 Brady SnapOn Vinyl by Brady**, or approved equal.
- C. Self-Adhesive Pipe Markers:
 - 1. Vinyl: Factory fabricated vinyl, 0.102 mm (5 mil) thick, preformed to fit around pipe or pipe covering. Model **Opti-Code by Seton, B-946 by Brady**, or approved equal.
 - 2. Polyester: Factory fabricated polyester, 0.05 mm (2 mil) thick, coated with acrylic adhesive. Model **Poly-Code by Seton**, or approved equal.
 - 3. Plastic: Factory fabricated plastic film, roll formed, clear laminated to protect lettering.
- D. Nylon Ties: Clear, 150 mm (6 inches) long, nonconductive, locking type.

E. Identify fluid being conveyed and include flow direction arrow.

1. Language: English.
2. Lettering: Size and Color according to ANSI A 13.1.

F. Color and Text per the Schedule at the end of this Section.

2.3 HOSE BIB SIGNS NON-POTABLE WATER

A. Provide a properly labeled, rigid sign for each hose bib. Signs shall contain the header, pictogram/alert symbol, and messaging conforming to OSHA/ANSI A 535 requirements. Minimum size shall be 7-inch high by 10-inch wide. Signs shall be plastic with overlamine and be pre-drilled for mounting. Manufacturer shall be **Seton, Brady**, or approved equal.

2.4 LABELS FOR EQUIPMENT AND TANKS

A. Provide a label for each piece of mechanical equipment and/or tank. The label shall contain the equipment name, tag number, and identifying information such as size, liquid, horsepower, etc. Minimum label size shall be 1-1/2 inches by 4-inches. Labels shall be stainless steel, brass, or aluminum. Fiberglass labels may be used for corrosive environments. Manufacturer shall be **Brady, Seton**, or approved equal.

2.5 LABELS FOR AUTOMATIC START/STOP EQUIPMENT

A. Provide a sign reading "CAUTION – EQUIPMENT STARTS AND STOPS AUTOMATICALLY" on equipment as shown on the drawings on identified in the specifications. Signs shall be vinyl with self-adhesive for application to the equipment. Minimum size shall be 7-inches by 10-inches. Manufacturer shall be **Brady, Seton**, or approved equal.

2.6 WARNING SIGNS

A. Provide a properly labeled, rigid warning sign as shown on the drawings. Signs shall contain the header, pictogram/alert symbol, and messaging conforming to OSHA/ANSI A 535 requirements. Minimum size shall be 7-inch high by 10-inch wide. Signs shall be plastic with overlamine and be pre-drilled for mounting. Manufacturer shall be **Seton, Brady**, or approved equal.

PART 3 EXECUTION

3.1 GENERAL

A. Markers and identification tags shall be installed in accordance with the manufacturer's printed instructions and shall be neat and uniform in appearance. Tags and markers shall be readily visible from all normal working locations.

3.2 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.3 INSTALLATION

A. Valve Tags:

1. Install tags with corrosion resistant chains.
2. Identify valves in main and branch piping with tags.
3. Identify small devices, such as in-line pumps, with tags.
4. Tag automatic controls, instruments, and relays.

B. Pipe Markers:

1. Identify all above grade piping. Include service, flow direction, and working pressure.
2. Provide snap-on type markers for pipes 6-inch diameter and smaller. Provide strap-on type for pipes over 6-inch diameter.
3. Each pipe shall be marked at:
 - a. Intervals of 20-feet in straight runs.
 - b. At least once in every room.
 - c. Within 2 –feet of bends and valves.
 - d. On the upstream side of Tees, branches, and other distribution points.
 - e. On both sides of walls and floors through which the piping passes.

C. Automatic Start/Stop Equipment

1. Attach signs for exposed equipment directly to the equipment.
2. Attach signs for sump pumps on the adjacent wall.

D. Warning Signs

1. Attach to walls according to the manufacturer's recommendations.

E. Equipment and Tank Labels

1. Attach labels to equipment with a pop rivet or equal.

3.4 SCHEDULES

Color Schedule				
Pipe Contents		Pipe Color	Marker Color	Letter Color
Abbreviation	Identification			
AHP	Air, High Pressure	Dark Green	Blue	White
AI	Air, Instrument	Dark Green	Blue	White
CL	Chlorine (gas or liquid state)	Yellow	Orange	Black
CLS	Chlorine Solution	Yellow	Orange	Black
CLV	Chlorine Gas Under Vacuum	Yellow	Orange	Black
CV	Chlorine Vent & Detection Line	Yellow	Orange	Black

Color Schedule				
Pipe Contents		Pipe Color	Marker Color	Letter Color
Abbreviation	Identification			
EE	Engine Exhaust		Yellow	Black
EWR	Engine Cooling Water Return		Green	White
EWS	Engine Cooling Water Supply		Green	White
FL	Fluoride	Light Blue/Red	Orange	Black
FOR	Fuel Oil Return		Brown	White
FOS	Fuel Oil Supply		Brown	White
FSP	Fire Protection Sprinkler System	Red	Red	White
HWR	Domestic Hot Water Return		Yellow	Black
HWS	Domestic Hot Water Supply		Yellow	Black
LSS	Landscape Sprinkler System		Green	White
NG	Natural Gas	Org-Red/Black	Yellow	Black
OF	Overflow		Green	White
PD	Plant Drain	Green	Green	White
PPS	Pump Suction (Potable Water)	Light Blue	Green	White
PTW	Pump to Waste	Green	Yellow	Black
PW	Potable Water	Dark Blue	Green	White
RS	Raw Sludge	Black	Yellow	Black
RWL	Rain Water Leader		Green	White
RW	Raw Water	Olive Green	Green	White
SA	Sample Line		Yellow	Black
SD	Sanitary Drains	Dark Gray	Yellow	Black
SDR	Storm Drain	Green	Green	White
SL	Sludge	Dark Brown	Yellow	Black
SUC	Structure Underdrain Collector		Green	White
UW	Utility Water (Non-Potable Water)	Magenta	Yellow	Black
V	Vent	Dark Brown	Yellow	Black

- END OF SECTION -

SECTION 33 08 30
GRAVITY PIPELINE TESTING

PART 1 GENERAL

1.1 DESCRIPTION

- A. The CONTRACTOR shall test sanitary system, overflow, storm drain, and other gravity drains in accordance these specifications and with the Contract Documents.
- B. The CONTRACTOR shall be responsible for obtaining permits for discharging excess testing water and de-chlorination of such water, if required.

1.2 RELATED SECTIONS

- A. Including but not limited to the following:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 33 05 02 Reinforced Concrete Pipe
 - 3. Section 33 05 07.2 PVC Sewer Pipe

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM C 828 Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines
 - 2. ASTM C 969 Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
 - 3. ASTM C 1103 Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
 - 4. ASTM D 3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 - 5. ASTM F 1417 Standard Test Method for Installation of Plastic Gravity Sewer Line Using Low Pressure Air

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Furnish a written testing plan and schedule, including water source and methods for conveyance to the project, sequence, control, and disposal.
- C. Where deflection testing of flexible pipe is required, submit a method for mandrel testing or other measurement, as applicable to pipe size.

1.5 PERFORMANCE REQUIREMENTS

- A. Gravity flow sanitary sewers are required to have a straight alignment and uniform grade between manholes.

- B. Flexible pipe, including “semi-rigid” pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of a line segment but prior to final acceptance using a standard mandrel to verify that installed pipe is within specified deflection tolerances.
- C. Maximum allowable leakage for infiltration and exfiltration:
 - 1. The total infiltration or exfiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of 2 feet above the crown of the pipe at the upstream manhole or 2 feet above the groundwater elevation, whichever is greater.
- D. Time allowed for pressure loss from 3.5 psig to 2.5 psig shall be per Table 33 08 30 – 2 at the end of this section.

PART 2 MATERIALS

2.1 DEFLECTION MANDREL

- A. Design: The CONTRACTOR shall construct a mandrel of steel or rigid plastic which can withstand a force of 200 psi without deforming. The mandrel shall have 9 or more "runners" or legs, as long as the number is an odd number. The mandrel barrel length shall be at least 75 percent of the pipe inside diameter.
- B. Sizing: The rigid mandrel shall have an outside diameter (O.D.) equal to 95 percent of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. Dimensions shall be per appropriate standard. Statistical or other “tolerance package” shall not be considered in mandrel sizing.

2.2 VIDEO EQUIPMENT

- A. Use color video equipment. Prepare three copies of the video in DVD format and deliver two copies to the OWNER and one copy to the ENGINEER. Record the project name, contractors name, date recorded, and locations of the video on the DVD.
- B. Produce a DVD using a pan-and-tilt radial-viewing pipe inspection camera that pans 275 degrees and rotates 360 degrees. Use a camera with an accurate footage counter which displays on the monitor the exact distance of the camera from the centerline of the starting manhole. Use a camera with camera height adjustment so that the camera lens is always centered at one-half the inside diameter, or higher, in the pipe being videoed. Provide a lighting system that allows the features and condition of the pipe to be clearly seen. A reflector in front of the camera may be required to enhance lighting in dark or large diameter pipe.

PART 3 EXECUTION

3.1 GENERAL

- A. Gravity pipes shall be tested for exfiltration or infiltration and deflection as indicated. Manholes and pipe shall be backfilled prior to testing. The maximum length of pipe tested

shall be the 4 reaches between 5 manholes. Leakage tests shall be completed and approved prior to placing of permanent resurfacing of pavement. When leakage or infiltration exceeds the allowed amount, the CONTRACTOR shall locate the leaks and make the necessary repairs or replacements to reduce the leakage or infiltration to the allowable limits. Individually detectable leaks shall be repaired, regardless of whether the test results are acceptable or not.

- B. CONTRACTOR shall assume all responsibility to obtain the necessary water for testing of the gravity pipes.
- C. No materials shall be used which could damage the pipeline.
- D. Air test gauges shall be laboratory-calibrated test gauges, and if required by the ENGINEER, shall be recalibrated by a certified laboratory prior to the leakage test. Air test gauges shall have a size and pressure range appropriate for the pipe being tested.
- E. Testing shall be performed in the presence of the OWNER and/or ENGINEER.
- F. Remove debris, sediment and other material from installed pipe prior to testing. Do not discharge or flush sand, gravel, concrete, debris or other foreign material into any existing pipeline system. Flushing with clean water only will be allowed but with minimal flows to eliminate exceeding capacities of the existing gravity systems.

3.2 TESTING SCHEDULE

A. Leakage Tests

- 1. Perform leakage tests as determined from the Table 33 08 30 - 1 below:

TABLE 33 08 30 - 1				
Pipe Size	Criterion 1 Slope Between Manholes		Criterion 2 Difference in Water Levels	
	Manhole Delta H (feet)		Test Water vs Ground Water Delta H (feet)	
	Less than or equal to 10 ft	Greater than 10 ft	Greater than or equal to 4 ft	Less than 4 ft
Less than or equal to 24 inches	See Criterion 2	Infiltration or Air (See Note 1)	Exfiltration	Infiltration or Air
Greater than 24 inches	See Criterion 2	See Criterion 2	Exfiltration	Infiltration
Notes: 1) If groundwater is present and at least 1 foot above the top of the pipe, perform an infiltration test. If groundwater is not present, perform an air test. 2) Definitions: a) Manhole Delta H is the invert elevation difference between two adjacent manholes. Test Water vs Groundwater Delta H is the required elevation of water surface for testing minus the average elevation of groundwater adjacent to the pipe to be tested.				

3.3 AIR PRESSURE TEST

- A. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.

- B. Lines 36-inch average inside diameter and larger shall be “joint” tested at each joint. The minimum allowable for the pressure drop from 3.5 psig to 2.5 psig during a joint test shall be 10 seconds, regardless of pipe size. Joint test shall be conducted as follows:
1. Each joint shall be tested successfully.
 2. Joint tester shall be set over joint to be tested so that the two inflation tubes straddle the joint.
 3. Inflate tubes to 25 psig to seal off joint to be tested.
 4. Apply air pressure into void between inflation tubes until pressure reaches 4 psig.
 5. After pressure has stabilized, bleed air pressure back to 3.5 psig.
 6. Record time required for pressure to drop from 3.5 psig to 2.5 psig.
 7. If the time in seconds for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than 10 seconds, the joint shall be presumed to be free from defect. When the time is less than 10 seconds pipe breakage, joint leakage, or leaking testing seals are indicated and an inspection must be made to determine the cause. The CONTRACTOR shall affect such repairs as may be required to accomplish a successful air joint test.
- C. For pipe sections less than 36-inch average inside diameter:
1. Determine the groundwater level.
 2. Plug both ends of the pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug pipe.
 3. After a manhole to manhole section of pipe has been sliplined and prior to any services lines being connected to new liner, plug liner at each manhole with pneumatic plugs.
 4. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in the system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 33 08 30 - 2 at the end of this Section.
 5. To determine air loss, measure the time interval for pressure to drop to 2.5 psig. The time must exceed that listed in the Table 33 08 30 - 2 at the end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.
- D. The test of the pipe and service laterals shall be conducted in the presence of the ENGINEER. Testing of pipe, regardless of the pipe material, shall be performed in accordance with ASTM C 828, C 1103, or ASTM F 1417, as applicable.
- E. Any section of pipe which fails to meet requirements shall be repaired and retested.

3.4 EXFILTRATION TEST

- A. Exfiltration testing shall be completed in accordance with ASTM C 969 and as modified below. Testing shall be conducted in the presence of the ENGINEER and/or OWNER.
- B. Each section of gravity lines shall be tested between successive manholes by closing the lower end and the inlet gravity lines of the upper manhole with stoppers or inflatable plugs. The pipe and manhole shall be filled with water to a point 4-feet above the centerline of the gravity line at the center of the upper manhole; or if ground water is present, 4-feet above the average adjacent ground water level, whichever is higher.
- C. Water shall remain in the pipe for at least one hour or until the water level stabilizes, whichever is longer, before the test begins. The minimum test duration shall be 4 hours.

- D. Unless indicated otherwise, the CONTRACTOR shall measure exfiltration. Measure the amount of water added to the upstream manhole to maintain the water level at the elevation set above. Compare the amount added to the allowable leakage calculated below, and if the amount added is equal to or less than the allowable amount, the tested section of the pipe has passed.
- E. The allowable leakage will be computed by the formula:

$$E = 0.000012 LD (H)^{1/2}$$

Where:

- E = Allowable leakage in gallons per minute of gravity line tested.
L = Length of gravity line and house connections tested, in feet.
D = Internal diameter of the pipe, in inches.
H = Elevation difference in feet between the water surface in the upper manhole and the centerline of the pipe at the lower manhole; or if ground water is present above the centerline of the pipe in the lower manhole, the difference in elevation between the water surface in the upper manhole and the ground water at the lower manhole.

3.5 INFILTRATION TEST

- A. Infiltration testing shall be completed in accordance with ASTM C 969 and as modified below. Testing shall be conducted in the presence of the ENGINEER and/or OWNER.
- B. Groundwater elevation must be not less than 2 feet above the highest point of pipe or service lead (house service).
1. Determine groundwater elevation
 2. Plug incoming pipes in upstream manhole.
 3. Insert calibrated 90° V-notch weir in pipe on downstream manhole.
 4. Allow water to rise and flow over weir until it stabilizes.
 5. Take five readings of accumulated volume over a period of 2 hours and use average for infiltration. The average must not exceed that calculated using the equation in paragraph 3.4.D above.

3.6 DELFECTION TEST

- A. Mandrel Test
1. The CONTRACTOR shall test all flexible and semi-rigid pipe 30-inches and smaller for deflection, joint displacement, and other obstructions by passing the mandrel through the pipe not less than 30 days after completion of the trench backfill, but prior to permanent pavement resurfacing.
 2. Testing shall confirm the pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Pull the approved mandrel by hand through sewer sections.
 3. Pipe with diameter less than the mandrel will be considered defective and the CONTRACTOR shall replace it.
- B. Flexible or semi-rigid pipe larger than 30-inches shall have deflections measured by a rigid metal bar, a rigid frame, or other method approved by the ENGINEER.

1. The average inside diameter shall be measured before the pipe is installed and backfilled.
2. Deflection is defined as the difference between vertical inside diameter in the pipe before and after installation and backfilling.

3.7 MANHOLE TEST

- A. Manholes shall be hydrostatically tested for leakage prior to backfilling. Prior to testing, manholes shall be visually inspected for obvious defects. Leaks or cracks shall be repaired to the satisfaction of the ENGINEER.
- B. All pipes entering the manhole shall be sealed at a point outside the manhole walls to include testing of the pipe to manhole joints. The manhole shall be filled with water to a level 2-inches below the top of the frame. Safety lines shall be secured to all plugs utilized. After a period of at least one hour to allow the water level to stabilize, the manhole shall be refilled and the water level shall be marked. The water level shall again be checked after 4 hours. The maximum leakage shall be 0.025 gallons per foot of manhole diameter per foot of manhole depth per hour. The exterior of the manhole shall be inspected during this period for visible evidence of leakage. Visible moisture, sweating, or beads of water on the exterior of the manhole shall not be considered leakage, but any water running across the surface will be considered leakage and shall be repaired to the satisfaction of the ENGINEER regardless of the volume of water lost.

3.8 VIDEO INSPECTION

- A. Immediately after cleaning and testing, video the gravity pipeline to document the condition of the line. Notify the ENGINEER 24 hours in advance of any video inspection so that the ENGINEER or RESIDENT PROJECT REPRESENTATIVE may observe inspection operations.
- B. Survey video inspection DVDs shall be continuous for pipe segments between manholes. Do not leave gaps in the videotaping of a segment between manholes and do not show a single segment on more than one DVD.
- C. Do not pull or propel the video camera through the line at a speed greater than 30 feet per minute.

3.9 ALIGNMENT AND GRADE TEST

- A. Line and grade of pipe may not vary more than 1/2 inch in 10 feet and not more than 1 inch variance from true line at any location.
- B. Grade of pipe may not vary more than 1/4 inch in 10 feet for all design grades less than or equal to 1 percent and not more the 1/2 inch total variance from true grade at any location. Also, grade of pipe may not vary more than 1/2 inch in 10 feet for all design grades greater than 1 percent and not more than 1 inch total variance from true grade at any location. These tolerances shall be acceptable provided that such variation does not result in a level or reverse sloping invert.
- C. The variation in the invert elevation between adjoining ends of pipe due to eccentricity of joining surface and pipe interior surfaces shall not exceed 1/64 inch per inch of pipe diameter, or 1/4 inch maximum.

TABLE 33 08 30 – 2 (1.0 psi Pressure Drop)												
Pipe Diameter (inch)	Minimum Time (min:sec)	Length for Minimum Time (ft)	Time for Longer Length (sec/ft)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06
21	19:50	114	10.4708	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05
36	34:00	66	30.768	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	256:24
42	39:48	57	41.883	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07	349:02
48	45:34	50	54.705	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17	455:53
54	51:02	44	69.236	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16	576:58
60	56:40	40	85.476	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04	712:18

- END OF SECTION -

SECTION 33 11 33
PUMP AND PUMP MOTOR

PART 1 GENERAL

1.1 DESCRIPTION

- A. Furnish, deliver and install a product lubricated surface discharge deep well turbine pump into existing well casings of 24-inches in diameter to depths as shown on the drawings.

1.2 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:

B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI B 16.1 Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 36 Structural Steel
2. ASTM A 48 Gray Iron Castings
3. ASTM A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
4. ASTM A 108 Steel Bars, Carbon, Cold Finished, Standard Quality

D. AMERICAN WATER WORKS ASSOCIATION

1. AWWA C 651 Standard for Disinfecting Water Mains
2. AWWA C 652 Standard for Disinfecting of Water-Storage Facilities
3. AWWA E 101 Standard Specifications for Vertical Turbine Pumps, Line-Shaft Type

1.3 SUBMITTALS

- A. CONTRACTOR shall submit for review to the CONSTRUCTION MANAGER, sufficient literature, detailed specifications, and drawings to show dimensions, make, style, speed, size, type, horsepower, head-capacity, efficiency, materials used, design features, internal construction, weights, and any other information required by CONSTRUCTION MANAGER for review of all pumping equipment. No pumping equipment will be accepted, and installation will not be allowed, until such review has been completed. All submittals shall clearly state any deviations from the specified requirements. The following shall also be furnished with the submittal:

1. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. The equipment manufactured shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the specified design point.
2. Equipment manufactured shall provide complete and detailed information regarding the installation of the pumps. Any installation requirements or operating conditions

- which the supplier or manufacturer' feel to be critical to the safe and reliable operation of the pumps should be identified and described in detail.
3. Shop drawings submitted for review also shall include electrical diagrams, schematic control diagrams, and a detailed description of how the control system is to function.

1.4 OPERATING CONDITIONS

- A. Table I indicates the operating conditions of the pumps.

**TABLE I
OPERATING CONDITIONS DEEP WELL TURBINE PUMP**

DESCRIPTION	WELL #8
Design capacity of pump (gpm)	450
Design total dynamic head (feet)	705
Pump Setting Depth	600
Nominal Operating Speed (rpm)	1770
Minimum Efficiency at Design Point	79%
Maximum NPSHR at Design Point	12.1 feet
Minimum Motor Horsepower	250
Minimum Column Size (diameter)	6-inch
Minimum Shaft Size (inches)	1-1/2 (SS 416)
Diameter of Well Casing	20-inch (19" I.D.)
Maximum Bowl Diameter	13 in.
Approx. Elevation (ft. above MSL)	4,920
Model No.: National	K10MC (16 stage)
Utility Power (volts, phase, hertz)	480, 3, 60

- B. Table II shows the system head curve required to be met by the pump submitted by the CONTRACTOR.

**TABLE II
SYSTEM HEAD CURVE AND SUBMITTED PUMP PERFORMANCE**

System Head Curve			Submitted Pump (To be provided by CONTRACTOR)	
Flowrate (gpm)	Pump Lift (feet)	Minimum Efficiency (%)	Pump Speed (rpm)	Pump Efficiency (%)
350	696.1	75		
400	700.1	78		
450	704.5	79		
500	709.4	79		
550	714.8	79		
600	720.5	79		

1.5 MECHANICAL DEFECTS AND REJECTIONS

- A. CONTRACTOR furnished pumps that have mechanical defects or do not meet the requirements for head-capacity, horsepower, efficiency, and vibration requirements will be rejected, and shall be replaced without additional cost to OWNER for furnishing, removal, reinstallation, and retesting. Mechanical defects shall include excessive vibration, improper balancing of any rotating parts, improper tolerances, binding, excessive bearing or motor heating, defective materials, including materials that do not conform to the Specifications, improper fitting of parts, and any other defect which will in time damage the pump or unreasonably impair its efficiency or operation.

1.6 WARRANTY

- A. CONTRACTOR furnished equipment covered by these specifications shall be warranted against defective parts due to faulty material or workmanship for one (1) year after date of installation. CONTRACTOR shall guarantee to replace any defective parts within the period of time specified at no additional cost to OWNER. If CONTRACTOR has to pull pump to replace defective parts, CONTRACTOR shall guarantee to pull and replace pump at no additional cost to OWNER.

1.7 MEASUREMENT AND PAYMENT

- A. There shall be no separate measurement and payment for the pumps and motors. Full compensation for pumps and motors shall be considered as included in the contract lump sum bid prices for the various items of the contract to which it relates.

PART 2 PRODUCTS

2.1 DEEP WELL VERTICAL TURBINE PUMP

- A. The pumps shall be of the deep well, product lubricated, vertical turbine type suitable for pumping culinary water. All material, manufacturing and performance standards shall be in accordance with AWWA E 101.
- B. Performance Requirements

1. Pump Speed - The pumps shall operate as specified in Table I.
2. Pump Characteristics - The pump shall be characterized by head capacity curves of steadily decreasing head with increasing capacity. Maximum head shall be at zero flow. The pump shall have a minimum efficiency as provided in Table I during operation against the system head. Pump head - capacity curves shall indicate that these losses have been included. Pumps shall have head-capacity curves similar to that of the specified pump. Pumps having curves that show a flatter or near horizontal slope over a section in the head – capacity curve will not be accepted. Curves with head-capacity curves with slopes of the curve flatter than that shown for the specified pump will not be accepted.
3. The pump and motor shall be capable of producing the flow rate and total dynamic heads indicated in Table I.
4. Motor Characteristics - Under no operating conditions shall the required pump brake horsepower exceed the nameplate rating of the motor being furnished.
5. The pump shall be designed to operate throughout its entire range without excessive vibration or noise.

C. Vertical Turbine Pump Components

1. Pumps
 - a. The vertical turbine pump for the wells shall be as manufactured by National Pumps or approved equal and shall be a multi stage product lube bowl assembly (or equal).
 - b. Unless otherwise stated herein, the pump shall in all respects conform to the American National Standard ANSI/AWWA-E101 for “Vertical Turbine Pumps, Line Shaft Type” and shall comply with all local and state sanitary and safety regulations.
2. Discharge Head
 - a. The discharge head shall be fabricated steel (ASTM A53 Grade B Pipe and ASTM A 36 Steel Plate), accurately machined and with a surface discharge. Discharge flange shall be machined and drilled to ANSI standards for 150 lb. rating and shall be sized to match the specified system. The top of the discharge head shall have a rabbet fit to accurately locate the vertical hollow shaft driver, and have a diameter equal to the driver base diameter (BD) and not less than 20.5- inches. Lifting lugs of sufficient strength to support the weight of the complete unit shall be provided. The base shall be round or square. Head must be able to accept the monitoring tube, well vent, and other tubing as shown on the drawings. CONTRACTOR shall modify the well base dimensions on the drawings to match supplied head.
 - b. The discharge head shall be equipped with a tube tensioning device to apply and maintain proper tension to the shaft enclosing tube. This device shall consist of a cast iron ASTM A48 Class 30 tube tension plate and bronze ASTM B584 alloy C83800 combination tube tension nut and bearing. Tension shall be applied to the shaft enclosing tube through internal threads in the top tube After proper tensioning, nut shall be locked into position with a steel cap screw. Sealing between the plate and the discharge head and the plate and shaft enclosing tube shall be accomplished by means of “O” rings.
 - c. Discharge head shall be equipped with a connection for a 1” prelube pipe and solenoid valve (120 VAC), if shown on drawings.
 - d. The top line shaft (head shaft) shall be of A582 Grade 416 Stainless Steel and shall not exceed 10 feet in length. Impeller adjustment shall be provided at the top

- of the head shaft by means of a bronze adjusting nut of ASTM B584 alloy C83800 which shall be positively locked in position.
- e. A lifting soleplate shall be supplied and installed, if required by the pump manufacturer.
 - f. The pump manufacture shall include the method of adjusting the pump impellers at the top of the head shaft. This method shall provide a positive locking device.
 - g. CONTRACTOR shall be responsible for ensuring that the discharge head is structurally and mechanically adequate for the provided and installed pump configuration.
3. Column Assembly
- a. The line shaft for the well shall be of A582 Grade 416 Stainless Steel (118,000 psi min.). They shall be furnished in interchangeable sections not over 10 feet in length.
 - b. The butting faces shall be machined square to the axis of the shaft, with maximum permissible axial misalignment of the thread axis with the shaft axis 0.002" in 6". The size of the shaft shall be no less than that determined by ANSI/AWWA E101 Specifications, Section 5.5 for C1045 line shaft, adjusted for A582 Grade 416 Stainless Steel material, and shall be such that elongation due to hydraulic thrust will not exceed the axial clearance of the impellers in the pump bowls. Maximum runout in 10-feet shall not exceed 0.005-inches.
 - c. The line shaft bearing shall be provided with ASTM A269 grade 416 stainless steel sleeves at the location of each line shaft bearing. The line shaft bearing shall be of 70 minimum shore hardness, neoprene, snap-in type, internally spiral grooved to flush out sand and other abrasives and mounted in ductile iron A536 Gr. 60-40-18 bearing retainers held in position in the column coupling by means of the butted ends of the column pipe. Bearing spacing shall not exceed 10 feet.
 - d. The outer column piping shall be of ASTM A53 Grade B Schedule 40 steel pipe in interchangeable sections not over 10 feet in length with the ends of each section faced parallel and machined with 8 straight threads per inch permitting the ends to butt and ensuring alignment when connected by standard mill steel couplings. The weight of the column pipe shall be no less than that stated in ANSI E 101, Section 5.1, "Standard Specifications for Discharge Column Pipe". Top and bottom sections of column pipe shall not exceed 5-feet in length.
 - e. CONTRACTOR shall be responsible for ensuring that the column piping is structurally and mechanically adequate for the provided and installed pump configuration.
4. Pump Bowl Assembly
- a. Pump bowl castings shall be of close-grained cast iron ASTM A48 Class 30 or ASTM A536 ductile iron Class 60-40-18 where required to meet the hydrostatic pressure criteria listed below. The water passages shall be free of blowholes, sand holes, and other detrimental defects, shall be lined with porcelain enamel, and shall be accurately machined and fitted. The finished bowls shall be capable of withstanding a hydrostatic pressure equal to twice the head at rated capacity or 1-1/2 times the shut-off head, whichever is greater.
 - b. The impellers shall be bronze ASTM B584 alloy C83800, enclosed type, and shall be statically balanced, and shall be fastened securely to the impeller shaft with taper split bushings of steel. Impellers shall be adjustable vertically by an external means. Impeller skirt and series case throat area shall be thick enough to allow for machining and wearing at the time of repair. The bowl wear rings and impeller wear rings shall be hardened 17-4 stainless steel with a Rockwell C-Scale Hardness number of 44.

- c. The pump shaft shall be of A582 Grade 416 Stainless Steel turned, ground and polished. Bearings shall be Morse Marine Bearings consisting of sleeve bearings with a Naval Brass outer shell super-bonded to a fluted rubber bearing surface (or approved equal) above and below each impeller. The pump shaft shall have chromed journals at the bearing points. The size of the shaft shall be no less than that determined by ANSI/AWWA Specifications E101, Section A4.3, Paragraph 4.3.3.
 - d. The discharge case shall be threaded on the outside for column sizes up to 14 inches and fitted with a cast iron ASTM A48 Class 30 column adaptor of the proper size to connect to the column selected. Likewise, the suction case shall also be threaded on the O.D. and fitted with a cast iron or steel suction adaptor.
5. Suction Pipe and Strainer.
- a. The suction pipe shall not be required.
 - b. A galvanized cone strainer shall be provided having a net inlet area equal to at least four times the suction pipe area. The maximum opening size shall not be more than 75% of the minimum opening of the water passage through the bowl or impeller.

2.2 ANALYSIS

- A. Tests may be conducted with shop motor to facilitate the manufacturing process.
- B. A minimum speed curve shall be plotted on the performance curve, based on the affinity laws and the test data.
- C. All gauges shall be calibrated within 30 days of the scheduled test and certified calibration data shall be provided. All flow meters and other test instruments shall be calibrated as required by ANSI/HI standards.
- D. In order to ensure that neither harmful nor damaging vibrations occur to the pump structure at any speed within the specified operating range, the following analysis shall be required:
 - 1. Pump manufacturer shall perform a structural frequency analysis of the above ground structural components utilizing a FEA method to ensure that no structural natural frequencies are excited to a degree that would cause measured vibration amplitudes at the top of the discharge head to exceed the requirements of ANSI/HI 9.6.4-2009. When deemed necessary by the experience of the manufacturer, the below ground structural components shall also be included in the analysis.
 - 2. The FEA method should include the use of ProE/Mechanica or an equivalent software. All pump assembly components, including the motor, shall be represented as solid elements, and if idealizations are used in place of solid elements, then a complete description of method for the idealization shall be included in the report. The analysis shall also include all modes of interest and pictorially represent each mode shape. Modes of interest are defined as those structural frequencies that exist below 120% of the maximum operating speed. When significant modifications are required to lower the system's natural frequency, the pump structure's stresses and deflections shall also be reviewed. Analysis reports shall conclude acceptable operation at the analyzed operating speeds. The design critical frequency shall be at least 20% above or below the operating range of the pump.

- E. Manufacturer to provide documentation of the analysis ensuring that the specified requirements have been met, and that documentation should be signed and stamped by the professionally licensed engineer who performed the analysis work.
- F. When measured in the direction of maximum amplitude on the pump and motor bearing housings, shall not exceed limits given in the latest ANSI/HI nomograph for the applicable pump type.

2.3 MOTOR

- A. Pump motors shall be a vertical hollow shaft, premium efficiency, inverter duty, electric motor, and shall be sized as noted in Table 1. They shall have a non-reverse ratchet, P-base, squirrel cage induction design. Motor shall have Class B or Class F insulation with temperature rise as specified by NEMA standards for class of insulation used and shall have a 1.15 service factor. The pump motor will be operating in an ambient temperature range of 40° - 110° Fahrenheit.
- B. Pump motors shall be provided with a vibration switch. Switch rating 120 VAC, 2 amps minimum.
- C. Pump motors shall have over temperature protection, which shall consist of a minimum of six RTD's embedded in the motor windings and two RTD's at the two bearings. Wiring to an external junction box shall be provided. RTD's shall be 100- ohm platinum three wire elements.
- D. Thrust bearing shall be chosen to handle the continuous down-thrust as specified by the pump manufacturer with an AFMBA B-10 one year minimum or five year average life under design conditions. Provisions shall be made for momentary up-thrust equal to 30% of rated down-thrust.
- E. The motor shall be suitable for across-the-line starting, soft start, and shall be capable of reduced-voltage starting.
- F. The motor rating shall be such that at design it will not be loaded beyond nameplate rating and at no place on the pump curve shall the loading exceed the service factor.
- G. The motor temperature shall be rated no higher than the allowable operating temperature of the motor thrust and radial bearings and in no case shall it exceed the temperature rating of the insulation class used to wind the motor.
- H. The junction box shall be oversized to accommodate wiring connection.

2.4 APPURTENANCES

- A. Well Monitoring Tube
 - 1. The CONTRACTOR shall furnish and install two 1 1/2-inch diameter well monitoring tubes in each well consisting of Schedule 80 PVC pipe. The tubes shall be furnished in sections not over 20 feet in length and shall be joined with flush threaded couplings. The PVC tube shall be joined and banded to the pump column with stainless steel bands at maximum of 10 feet. A minimum of two 1/4-inch diameter vent holes for every 10 feet of length shall be provided throughout the entire length of the monitoring

tube. The depth of the monitoring tube shall be as indicated on the drawings. The bottom end shall be capped.

B. Well Vent

1. The well vent shall consist of galvanized steel 1 inch diameter pipe through the well surface plate extended up to 18" above the bottom plate of the pump discharge head with a 180 degree bend made of two steel ells. The outlet end of the vent pipe shall be covered with No. 14 stainless steel wire mesh securely fastened by a stainless steel band. The lower end of the vent pipe shall be threaded into the well surface plate and provide a water tight seal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pump and motor at the location shown on the drawings and according with manufacturer's recommendations.
- B. All pumps, complete with drive system, in place at the jobsite, shall not exceed acceptable field vibration limits given in the latest revisions of the Hydraulic Institute Standards. All pumps shall be free of static unbalance; shall be free of dynamic unbalance up to the maximum speed of the pump and drive system; shall be free of torsional vibration from 10 percent below the minimum speed to 10 percent above the maximum speed of the pump and drive system; and shall be free of apparent unbalance caused by defective bearings, by close fittings parts which may rub on the rotating parts intermittently, or by loose discs or rotor parts, or unbalanced loads.
- C. The motor/discharge head assembly shall be shimmed with respect to the well casing flange to bring the motor/discharge assembly into optimum alignment with any variations that the pump column and line shaft may exhibit from being truly plumb. Such shims must be structurally sound and securely attached. The water tight seal between the discharge head and the well casing flange must be maintained.

3.2 FIELD TESTS

- A. After installation, the pump shall be given an operating test to demonstrate freedom from mechanical defects, excessive noise, and vibration. The test shall include operating the pump continuously while throttling the discharge as needed. The operating test shall be performed for a minimum of one hour, or as directed by CONSTRUCTION MANAGER. Pumps with variable speed drives shall be tested at maximum speed, and at the average and minimum speeds listed under the specification for the pumps. A copy of actual test data shall be furnished to CONSTRUCTION MANAGER.
- B. Tests for acceptable vibration shall be made, at no additional cost to OWNER, in the field on each pump system, which in the opinion of CONSTRUCTION MANAGER, seem to have excessive vibration. All field tests shall be running tests with the pump pumping the product for which it is intended and each pump system shall be tested separately with no other pumps running. All testing shall be done in the presence of CONSTRUCTION MANAGER. Amplitude as used in this Specification, shall mean total peak-to-peak displacement. The required test for acceptable vibration will be the measurement of this

peak-to-peak displacement and will be performed with an IRD Vibration Meter, Model 306; Bently-Nevada TK-8; or equal.

3.3 DISINFECTING

A. Source of Water

1. The Contractor shall assume all responsibility to obtain the necessary water supplies for disinfection of the pumping system.

B. Testing Procedure

1. Leakage and pressure testing must be completed prior to disinfection procedures.
2. All water piping installed under this Contract shall be disinfected using an approved disinfection method in accordance with the "American Water Works Association Standard for Disinfecting Water Mains" (AWWA C651)
3. Pump and related piping installed under this Contract shall be disinfected using an approved disinfection method in accordance with the "American Water Works Association Standard for Disinfecting Water Mains" (AWWA C6512).
4. Heavily chlorinated water shall not be discharged onto the ground. Upon completion of disinfection, Sodium Bisulfate (NaHSO_3) shall be applied to the heavily chlorinated water to neutralize thoroughly the chlorine residual remaining. Water shall be neutralized to less than 1 ppm.
5. After approval of disinfection, the Contractor shall flush the new system until the chlorine residual is a maximum of 0.3 ppm.
6. At the end of 24 hours, a bacteriological test will be performed by the Owner to insure adequate disinfection. If the initial disinfection fails to provide satisfactory bacteriological results, or shows the presence of coliform, then the line shall be re-chlorinated, flushed, and retested until satisfactory results are obtained at the expense to the Contractor.

- END OF SECTION -

SECTION 33 12 00
MECHANICAL APPURTENANCES

PART 1 GENERAL

1.1 SUMMARY

- A. CONTRACTOR shall furnish and install all valves, and equipment, complete and operable in accordance with the Specifications.
- B. Where 2 or more valves or equipment of the same type and size are required, the valves shall be furnished by the same manufacturer.
- C. CONTRACTOR shall verify that flanges on pipe match the bolt hole pattern of the flanges on the mechanical appurtenances.

1.2 RELATED WORK

- A. Related work specified in other sections:
 - 1. Section 01 33 00 Submittals
 - 2. Section 01 45 00 Quality Control & Materials Testing
 - 3. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
 - 4. Section 31 23 15 Excavation and Backfill for Buried Pipelines
 - 5. Section 31 23 23 Excavation and Backfill for Structures
 - 6. Section 33 05 05 Ductile Iron Pipe and Fittings
 - 7. Section 33 05 07.1 Polyvinyl Chloride (PVC) Pressure Pipe (ASTM D 1785)
 - 8. Section 33 92 10 Steel Pipe, Specials, and Fittings (AWWA C200, modified)

1.3 REFERENCES

- A. The latest edition of the following publications form a part of these specifications to the extent referenced. The publications are referred to in the text to by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. A 126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 2. A 216 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
 - 3. B 584 Standard Specification for Copper Alloy Sand Castings for General Applications
- C. AMERICAN WATER WORKS ASSOCIATION (AWWA)
 - 1. C 504 Rubber-Seated Butterfly Valves, 3-inch through 72-inch
 - 2. C 509 Resilient-Seated Gate Valves for Water Supply Service
 - 3. C 512 Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
 - 4. C 515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
 - 5. C 518 Dual-Disc Swing-Check Valves for Waterworks Service
 - 6. C 550 Protective Interior Coatings for Valves and Hydrants

D. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. B 16.1 Gray Iron Pipe Flanges and Flanged Fittings
2. B 16.34 Valves – Flanged, Threaded, and Welding End

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittals.
- B. Submit catalog cut sheets on all mechanical appurtenances including: fittings, valves, or other items shown on the Drawings referencing each item by mark number. Information shall indicate manufacturer specification compliance, Cv factor, pressure rating, and dimensional data.

PART 2 PRODUCTS

2.1 GATE VALVES

- A. Gate valves shall conform to the requirements of AWWA C-509 or C-515. Valves shall be of the resilient-seat type with non-rising stem (NRS), opening to the left, and provided with a 2-inch square operating nut for buried valves or hand wheel for valves located in structures. Buried valves shall be of flange or mechanical joint design to match pipe joint system.
- B. Valves, valve-operating units, stem extensions and other accessories shall be installed by CONTRACTOR where shown, or where required in the opinion of ENGINEER, to provide for convenience in operation. Where buried valves are indicated, CONTRACTOR shall furnish and install valve boxes to 3-inches above grade in unimproved areas or at grade with concrete collar in improved areas. All valves and gates shall be new and of current manufacture.
- C. The valve shall have a two part thermosetting or fusion bonded epoxy protective coating (10 mil minimum inside and out) system that is non-toxic and imparts no taste to water. The epoxy shall be applied in accordance with AWWA C550 and be ANSI/NSF 61 certified.
- D. The flanges of valves may be raised or plain faced. Flanges of valves shall be faced and drilled to 125-lb American Standard template. Provide ASME Class 250 flanges for valves located on the high pressure discharge side piping.
- E. All valves shall be furnished with pressure classes equal to or better than the pressure class of the pipe with which the valves are to be used. Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- F. Valves shall be manufactured by **Mueller Co., Clow Valve Co.**, or approved equal.

2.2 BUTTERFLY VALVES

- A. Butterfly valves shall be AWWA C504 Standard Class 150B, NSF 61 certified and have a Flange by Flange, Flange by Mechanical Joint, Mechanical Joint, or wafer body style, as indicated on the drawings, rated for 250 psi working pressure. The valves shall have a heavy duty ductile iron body with flanges fully faced and drilled per ANSI B16.1 Class

150B. Shells shall be tested at a minimum of 400 psi. Maximum flow velocity shall be less than 16 fps for cold water service. The valve shall have a hand wheel operator, 2-inch Standard AWWA nut operator, or traveling nut actuators rated at 450 ft. lbs. torque, and integral disc position indicators, or connected to an electric motor operator as noted on the drawings. The valve shall have a polyamide cured epoxy or fusion bonded epoxy protective coating (10 mil minimum inside and out) system that is non-toxic and imparts no taste to water. The epoxy shall be applied in accordance with AWWA C550 and be ANSI/NSF 61 certified. The valve shall be manufactured by **Mueller Co., Clow Valve Co.**, or approved equal.

2.3 BUTTERFLY VALVES (High Pressure)

- A. Butterfly valves on the pump discharge piping shall be ANSI Class 300, NSF 61 certified and have a Flange by Flange or wafer body style, as indicated on the drawings, rated for 350 psi working pressure. The valves shall have a carbon steel body conforming to ASTM A 216 Grade WCB with flanges fully faced and drilled per ANSI B16.34 Class 300. Valve shall have a reinforced PTFE seat. Shells shall be tested at a minimum of 400 psi. Maximum flow velocity shall be less than 16 fps for cold water service. The valve shall have a hand wheel operator, 2-inch Standard AWWA nut operator, or traveling nut actuators rated at 450 ft. lbs. torque, and integral disc position indicators, or connected to an electric motor operator as noted on the drawings. The valve shall have a polyamide cured epoxy or fusion bonded epoxy protective coating (10 mil minimum inside and out) system that is non-toxic and imparts no taste to water. The epoxy shall be applied in accordance with AWWA C550 and be ANSI/NSF 61 certified. The valve shall be by **Mueller Co., Clow Valve Co.**, or approved equal.

2.4 BALL VALVES

- A. Valves shall be rated for the working pressure of the system.
- B. **Stainless Steel Ball Valves** shall be full port opening stainless steel and have adjustable stem packing gland. Body and ball shall be stainless steel in accordance with ASTM A351. Seats shall be reinforced PTFE and packing stem shall be PTFE. The handle shall be Type 304 stainless steel with vinyl insulator. The valves shall conform to MSS-SP-100 and be **Apollo 76F-100, NIBCO T-585-S6-R-66-LL, Watts Series S-FBV-1**, or approved equal.
- C. **Bronze Ball Valves** shall be full port opening bronze body, hard chrome plated brass ball and have adjustable stem packing gland. Seat and seals shall be PTFE. Handle shall be heavy, duty, zinc-plated steel with vinyl insulator. They shall be **Watts Series B6080, NIBCO T585-70, Apollo 70-100 Series**, or approved equal.
- D. **PVC Ball Valves** shall be full port opening with all wetted materials composed of Schedule 80 PVC. Valve shall have true union ends or flanged ends to mate with ANSI B16.5 Class 150 flanges. PVC ball valves shall be **NIBCO Chemtrol Series, Spears Mfg. Co. TU-2-2025**, or approved equal. PVC Ball valves are not allowed to be connected to any pump discharge piping.
- E. Segmented Ball Valves shall be v-ported ball quarter turn valves. Valves shall be Neles R-Series Segment Valve, flanged RE, with low flow Q trim for cavitation/noise abatement as manufactured by Metso Automation. Flanges and body shall be ASME 150 rated. Valves shall be connected to a 3 phase electric motor operator.

2.5 SERVICE SADDLES

- A. Shall consist of a 2-piece bronze body and strap, meeting applicable sections of AWWA C800.
- B. Outlet shall be tapped with AWWA I.P. thread (F.I.P.T.). Outlet shall be o ring sealed. Saddles shall be ANSI/NSF 61 certified.
- C. Shall be **Mueller H-13000 Series, Romac Style 202B**, or approved equal.

2.6 WATER SERVICE CONNECTIONS AND FITTINGS

- A. Water service pipe shall be polyethylene tubing (PE 3408 IPS, 200 psi) for buried service lines. Poly piping shall be 3/4-inch, 1-inch or 2-inch minimum as indicated on the Contract Drawings. Replacement service pipes shall be the same diameter as existing pipes.
- B. All water service connections, except 2-inch, shall be made using **Mueller Insta-Tite Connections, Ford Ultra-Tite**, or approved equal, fittings and shall conform to AWWA C800. All 2-inch water service connections shall be made using **Mueller Pack Joint, Ford Pack Joint**, or approved equal.
- C. If the existing service is poly pipe, a coupling can be used to extend the poly service to the new waterline.
- D. New water service lines shall be bored, jacked or augered under the existing pavement, gutters or sidewalks.
- E. Where the new service line will pass under an existing gas line, in order to prevent damage, the gas line shall be potholed and shall remain exposed until the service line is installed.

2.7 CORP STOPS

- A. Corp Stops shall be Brass Alloy 85-5-5-5 ASTM B62 and conform to the requirements of AWWA C800.
- B. Corp Stops for 3/4-inch and 1-inch sizes shall be **Mueller H-15026, Ford F1100 Ultra-Tite joint**, or approved equal.
- C. Corp Stops for 2-inch size shall be **Mueller E-25029, Ford F1100 Pack Joint**, or approved equal.

2.8 FIRE HYDRANTS

- A. Fire hydrants shall the dry-barrel type that meet or exceed ANSI/AWWA C502, latest revision. Rated working pressure shall be 250 psig, test pressure shall be 500 psig.
- B. The nozzle section, upper and lower stand pipes and hydrant base shall be ductile iron.
- C. External surfaces above grade shall be factory coated with an epoxy primer and a two-part polyurethane top coating.

- D. The main valve closure shall be of the compression type, opening against the pressure and closing with the pressure. Nozzle section to be designed for easy 360° rotation by the loosening of no more than four bolts.
- E. The valve opening diameter shall be 5-1/4". Hydrant must be designed so that removal of all working parts can be accomplished without excavating. The bronze seat shall be threaded into mating threads of bronze for easy field repair.
- F. Bolting below-grade shall be stainless steel.
- G. The draining system of the hydrant shall be bronze and be positively activated by the main operating rod. Hydrant to be furnished with a sliding bronze drain valve. Sliding drain valves made of rubber, plastic or leather will not be allowed.
- H. Hydrant must have an internal travel stop nut located in the top housing of the hydrant.
- I. Hydrant operating threads to be factory lubricated. O-rings shall be furnished to help keep operating threads lubricated and protected from line fluid and from the weather.
- J. Hydrant must have a traffic flange design allowing for quick and economical repair of damage resulting from a vehicle's impact. Hydrants shall be **AMERICAN Flow Control's Waterous Pacer Model WB67-250** (NO EQUAL ALLOWED).

2.9 VALVE BOXES AND LIDS

- A. All buried valves shall be installed complete with 6-inch diameter slide type, two-piece cast iron valve box. Manufacturer be **Tyler 562 Series**, or approved equal. The valve box lid shall be designated "WATER" unless noted otherwise on the Contract Drawings.
- B. Concrete Collars shall be 10" thick x 2'- 6" in diameter centered on the valve box. They shall have two circumscribing #4 bars, one at three inches from the outside edge and a second bar nine inches from the outside edge each centered in the concrete. Concrete shall be 3000 psi.

2.10 PRESSURE GAUGES

- A. Pressure gauges shall be provided where shown on the drawings. Gauges shall meet the requirements of ASME B40.1 Grade 2A and be industrial type with stainless steel movement, liquid filled, and stainless steel, Polypropylene, or Phenolic case. Gauges shall have a rear blowout disc or panel. Unless noted otherwise on the drawings, pressure gauges shall have a 4-1/2-inch dial with white face and black lettering, a 1/2-inch threaded connection, and shut-off valve. Measuring element shall be a stainless steel Bourdon Tube. Gauges shall be calibrated to read in applicable units, with an accuracy of ± 0.5 percent to 150 percent of the working pressure. Gauges shall be manufactured be **Ashcroft Model 1279 Duragauge, 1900 Series SOLFRUNT by Ametek (U.S. Gauge), Process Gauge by Marsh Bellofram**, or approved equal.
- B. Pressure gauges that connect to lines other than potable water shall have gauge guards to prevent corrosion and clogging. Gauge guards shall have a durable flexible diaphragm which serves as a protective barrier between the process fluid and instrument. The diaphragm shall be either elastomer or Teflon and rated for the pressure of the gauge.

- C. Pressure gauges for chemical service lines shall be 2-1/2-inch diameter with integral diaphragm seal. These gauges shall be manufactured by **Plast-o-matic**, or approved equal.

2.11 BOOSTER PUMP CONTROL VALVES

- A. Booster Pump Control Valves shall be designed to eliminate starting and stopping surges caused by the pump. The valve shall be equipped with a built in check valve. The valve shall be hydraulically operated, single diaphragm actuated, globe type valve. Valve stem shall be stainless steel and the valve body shall be steel conforming to ASTM A 216, Grade WCB. Flanges shall be Class 300 and shall be rated for a working pressure of 350 psi. The valve manufacturer shall provide a 3 year warranty on the valve and 1 year warranty on the electrical components. The booster pump control valves shall be **Model 60-11 by Cla-Val Company**, or approved equal.
- B. The booster pump control valve shall be controlled by an externally mounted pilot control system with a four-way solenoid operated pilot. The solenoid shall be designed to operate on 120 Volt AC current and have a manual operator installed. The pilot system shall include a four-way solenoid pilot valve, opening and closing speed controls, shut off valves, strainers, and CVS-1 shuttle valve to provide the highest available operating pressure to the pilot system.
- C. The booster pump control valve shall have an adjustable limit switch assembly mounted on the main valve and connected to the main valve stem. It shall be actuated by opening or closing of the valve and easily adjusted to operate at any point of the valve's travel. The limit switch shall be used to complete the pump off cycle. The actuating point of the limit switch shall be adjustable.
- D. A direct factory representative shall provide start-up assistance, inspection and adjustments. The representative shall provide 2 to 4 hours of assistance for each valve installed on the project.

2.12 PRESSURE REDUCING VALVES

- A. Pressure reducing valves 1/2-inch to 2-1/2-inch shall have a bronze ASTM B62 body and cover with stainless steel trim. Diaphragm shall be reinforced EPDM and the disc EPDM. Valves shall be balanced, direct acting type **Model 990 by Cla-Val Co.**, or approved equal. Valves shall be installed at the location(s) shown on the drawings. The pressure class shall be 150 lb, and the valve shall be set to operate at the pressure indicated on the drawings.
- B. Pressure reducing valves 1/8-inch to 1/4-inch shall be brass with stainless steel stem and spring. Valves shall be provided with a gauge and be **Model #560G by Watts**, or approved equal. Valves shall be installed at the location shown on the drawings. The valve shall be set to operate at the pressure indicated on the drawings.

2.13 PRESSURE RELIEF/PRESSURE SUSTAINING VALVES

- A. Pressure Relief/Pressure Sustaining Valves shall be hydraulically operated, pilot-controlled, modulating valve designed to maintain constant upstream pressure within close limits. The valve can also be used for pressure relief in a by-pass system. If upstream pressure decreases below the spring setting, the valve shall close. The valve

shall be hydraulically operated, single diaphragm actuated, globe type valve. Valve stem and trim shall be stainless steel and the valve body shall be steel conforming to ASTM A 216, Grade WCB. Ends shall be threaded or Class 300 grooves and shall be rated for a working pressure of 350 psi. The valve manufacturer shall provide a 3 year warranty on the valve and 1 year warranty on the electrical components. The pressure relief/pressure sustaining valves shall be **Model 50-01 by Cla-Val Company**, or approved equal.

- B. The pressure relief pilot shall be a direct-acting, adjustable, spring-loaded, diaphragm valve designed to permit flow when controlling pressure exceeds the adjustable spring setting. Pilot control sensing shall be upstream of the pilot system strainer so accurate control may be maintained if the strainer is partially blocked. A full range of spring settings shall be available from 0 to 450 psi.
- C. A direct factory representative shall provide start-up assistance, inspection and adjustments. The representative shall provide 2 to 4 hours of assistance for each valve installed on the project.

2.14 SLANTING DISK CHECK VALVES

- A. Slanting disc check valves shall be ductile iron with two body halves and body seat with o-ring seal. Pivot pins and bushings shall be stainless steel of differing hardness. The area through the seat section shall be at least 40% larger than the inlet and outlet of the valve to achieve low head loss. The check valve shall have a ductile iron disc with disc position indicator. The check valve shall be **Series 800 by APCO (DeZURIK)**, or approved equal.

2.15 AIR VALVE SURGE SUPPRESSION SWING CHECK VALVE

- A. The check valve shall be of the full flow body type, with a domed access cover and only two moving parts, the flexible disc and the Disc Accelerator. Valves 2" through 12" diameter shall be suitable for pressures up to 250 psi water service and valves 14" through 66" shall be suitable for up to 500 psi water service.
- B. The valve shall be designed, manufactured, and tested in accordance with AWWA C 508. Valves used in potable water service shall be certified to NSF/ANSI 61 Drinking Water System Components – Health Effects, and certified to be Lead-Free in accordance with NSF/ANSI 372.
- C. The valve shall be certified to be lead free in accordance with NSF 61, Annex G.
- D. Joints: Provide the type of joint as specified on the Contract Drawings. Unless noted otherwise, provide wafer style valves for installation between ANSI B16.1 Class 125 flanges. Grooved end valves shall be provided in 2" through 12" diameters for installation on pipe with cut grooves per AWWA C606 for steel IPS pipe.
- E. Materials: The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 class B gray iron for 30 in. (800mm) and larger. Optional body materials include ASTM A-351 Grade CF8M, stainless steel for sizes 3" (80 mm) through 12" (300 mm). The disc shall be precision molded Buna-N (NBR), ASTM D2000-BG. Optional disc material includes Viton, EPDM, Hypalon. The disc accelerator shall be Type 302 stainless steel.

- F. Valve interior and exterior shall be coated with an NSF 61 certified fusion bonded epoxy in accordance with AWWA C 550.
- G. Swing check valves shall be **SURGEBUSTER by Val-Matic**, or approved equal.

2.16 DUAL DISC CHECK VALVE

- A. The check valve shall be dual disc, flanged style with torsion spring induced closure. Valves 2" through 12" diameter shall be suitable for pressures up to 250 psi water service and valves 14" through 66" shall be suitable for up to 500 psi water service.
- B. The valve shall be designed, manufactured, and tested in accordance with AWWA C 518. Valves for use in fire protection systems shall be UL listed and FM approved in sizes 2-1/2" to 16".
- C. The valve shall be certified to be lead free in accordance with NSF 61, Annex G.
- D. Joints: Provide the type of joint as specified on the Contract Drawings. Unless noted otherwise, provide wafer style valves for installation between ANSI B16.1 Class 125 flanges. Grooved end valves shall be provided in 2" through 12" diameters for installation on pipe with cut grooves per AWWA C606 for steel IPS pipe.
- E. Materials: The valve body shall be constructed of ASTM A 536 Grade 65-45-12 ductile iron carbon steel per ASTM A 216. The disc shall be constructed of ASTM B 584, Alloy C83600 cast bronze, or ASTM B 148, Alloy C95200 cast aluminum bronze, or ASTM A 351 Grade CF8M Stainless Steel. The pivot pins, stop pins, and torsion spring shall be Type 316 Stainless Steel for sizes up to 16-inch diameter and ASTM A 313 Type 17-7 PH on 18-inch diameter and larger. The seal shall be EPDM, Buna-N per ASTM D 2000-BG Viton per D2000-HK.
- F. Valve interior and exterior shall be coated with an NSF 61 certified fusion bonded epoxy in accordance with AWWA C 550.
- G. Dual-disc check valves shall be **Series #8800 by Val-Matic, CDD 9000T by DeZurik**, or approved equal.

2.17 DRAIN LINE CHECK VALVE

- A. Drain line check valves shall be the low-head "duck bill" type installed at the locations shown on the drawings. Valves shall be constructed of pure gum rubber and be **Tideflex Model TF-1 by Red Valve**, (no approved equal).

2.18 CHECK VALVES

- A. The globe style check valves shall be **APCO Globe Style Series 600 Silent Check Valves**, or approved equal, and shall be rated at 150 psi.
- B. The 1-inch and 2-inch brass check valves shall be **Watts CVY Series**, or approved equal, with rating 125 WSP/200 WOG.
- C. The 1-inch PVC check valves shall be **Spears Industrial Ball Check Valve Model 4521**, or approved equal, with a pressure rating of 235 psi.

2.19 HOSE BIBBS and SAMPLING TAPS

- A. Hose bibbs shall be as-manufactured by Watts, or approved equal, and shall include an integral vacuum breaker or built-in backflow protection devices and cast iron wheel handle. Sampling Taps shall be smooth nose type. Valves shall be stainless steel.

2.20 COMBINATION AIR/VACUUM VALVES

- A. Combination Air/Vacuum valves shall be single body, double orifice valves conforming to the requirements of AWWA C 512. Valve float shall be stainless steel. Valves shall be the size indicated on the drawings and shall be **Series 140C by APCO (DeZURIK)**, or approved equal.

2.21 AIR RELEASE VALVES

- A. Air release valves shall be provided where shown. Valve body shall be ductile iron and float shall be stainless steel and shall conform to the requirements of AWWA C 512. Air release valves on the discharge piping shall be designed for a working pressure of 350 psi. Valves shall be the size indicated on the drawings and shall be **Series 200 by APCO (DeZURIK)**, or approved equal.

2.22 FLOW METER

- A. See Section 40 91 23 – Miscellaneous Properties Measurement Devices.

2.23 PRESSURE TRANSMITTERS

- A. See Section 40 91 23 – Miscellaneous Properties Measurement Devices.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Valves, valve-operating units, stem extensions and other accessories shall be installed by CONTRACTOR where shown, or where required in the opinion of ENGINEER, to provide for convenience in operation. Where buried valves are indicated, CONTRACTOR shall furnish and install valve boxes at grade with concrete collars. All valves and boxes shall be new and recently manufactured.
- B. Install mechanical appurtenances as indicated on the plans and in accordance with the manufacturer's written instructions.

- END OF SECTION -

SECTION 33 12 16

GATE VALVES (Resilient Wedge Type)

PART 1 -- GENERAL

1.01 GENERAL

- A. The CONTRACTOR shall provide all tools, supplies, materials, equipment and all labor necessary for furnishing, epoxy coating, installing, adjusting, and testing of all valves and appurtenant work, complete and operable, all in accordance with the requirements of the Contract Documents. Where buried valves are indicated, the CONTRACTOR shall furnish and install valve boxes to grade.
- B. The provisions of this Section shall apply to all valves and valve operators specified in the various Sections of these Specifications except where otherwise specified in the Contract Documents. Valves and operators in particular locations may require a combination of units, operators, sensors, limit switches, and controls specified in other sections of these Specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Installation shall conform to the requirements of Section 33 11 00, "Water Distribution and Transmission," and the requirements herein.

1.03 REFERENCE DOCUMENTS

- A. Commercial Standards.
 - AWWA C509 Resilient Wedge Gate Valve
 - AWWA C550-81 Protective Interior Coatings for Valves and Hydrants
 - ASTM D424 Rubber Seats
 - ASTM B16.1 Cast Iron Flanges

1.04 CONTRACTOR SUBMITTALS

- A. Prior to procurement of valves, the Contractor shall submit to the Owner for approval manufacture information and shop drawings of the valves as required in Section 01 33 00 "Contractor Submittals". Required drawings shall include complete outline drawings showing overall dimensions, assembly drawings showing the general assembly of the valves and operators. Materials of component parts shall be identified by referring to standards of ASTM.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Gate valves shall be resilient wedge type valves and shall be cast or ductile iron body, with non-rising stem and 2" square operating nut. The wedge shall be of cast or ductile iron with guide bars or channels. Valves above ground shall have handwheels or other operators as shown. Buried valves shall include valve boxes and covers with valve stem extensions where indicated.

- B. Resilient wedge gate valves shall comply with AWWA C509, except as specifically modified or supplemented by these specifications.

2.01 MATERIALS AND EQUIPMENT

- A. Materials. All internal working parts (excluding wedge) shall be all bronze containing not more than 11 percent aluminum or more than 5 percent zinc. Valve stems shall be cast or forged from bronze having a tensile strength of not less than 60,000 psi, a yield point of not less than 30,000 psi and an elongation of not less than 10 percent in 2 inches. Stem nuts shall be of bronze having a tensile strength of not less than 30,000 psi and a yield point of not less than 14,000 psi. Stem seals shall be of the "O" ring type, providing at least two "O" rings in grooves; at least one above the thrust collar and one below in such a manner that the valve may be repacked under pressure in the full open position. Rubber for the resilient seat shall be new, natural or synthetic of a compound designed for water service application, and shall be resistant to microbiological attack, copper poisoning, and ozone attack. Rubber seats shall be bonded to the wedge and fully encapsulated in accordance with ASTM D429 with a peel strength of not less than 75 pounds per inch.
- B. End Fittings and Operators. The end flanges for valves shall be flat-faced and shall conform in dimensions and drilling to ANSI B16.1 for cast-iron flanges and flanged fittings, Class 125. Flanges shall be back-faced or spot-faced at the bolt holes. Faces of flanges shall have a serrated finish of approximately 32 serrations per inch and approximately 1/64 inch deep. Serrations may be either spiral or concentric.

2.01 VALVES

- A. General: The CONTRACTOR shall furnish all valves, valve-operating units, stem extensions and other accessories as shown and specified. All valves and gates shall be new and of current manufacture. Shut-off valves, 6-inch and larger, shall have operators with position indicators. Where buried, valves shall be provided with valve boxes and covers, and shall include position indicators and valve extensions where indicated.
- B. Valve Flanges: The flanges of valves may be raised or plain faced. Flanges of valves for design pressures of 150 psi or less shall be faced and drilled to ANSI B16.1 125-lb. class or ANSI B16.5 150-lb. class. Flanges of valves for design pressures greater than 150 psi, up to 275 psi, shall be faced and drilled to ANSI B16.1 250-lb. class or ANSI B 16.5 150-lb. class. For design pressures greater than 275 psi up to a maximum of 700 psi, flanges of valves shall be faced and drilled to ANSI B16.1 800-lb. class or ANSI B 16.5 300-lb. class.
- C. Gate Valve Stems; Gate valve stems shall be of bronze containing not more than 5 percent of zinc nor more than 2 percent of aluminum, and shall have a minimum tensile strength of 60,000 psi, a yield strength of 40,000 psi, and an elongation of at least 10 percent in 2 inches, as determined by a test coupon poured from the same ladle from which the valve stems to be furnished are poured.
- D. Painting and Protective Coating. All inside ferrous surfaces, except stainless alloys, in the water passage of valves 4-inch and larger, as well as the exterior surfaces of all submerged valves, shall be coated with an epoxy resin coating.

PART 3 -- EXECUTION

3.01 INSTALLATION AND PROTECTIVE COATING

- A. Installation of valve shall be in accordance with the manufacturer's recommendations, details shown on the drawings, and Section 33 11 00, "Water Distribution and Transmission." Valves shall be firmly supported to avoid undue stress on the pipe.
- B. For buried valves all valve boxes, and stem extensions where required, shall be carefully installed centered over valve operator nut and shall be installed vertically to allow for ease of valve key for valve operation.

*** END OF SECTION ***

SECTION 33 13 00
PIPELINE TESTING AND DISINFECTION

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers testing and disinfection to remove bacteriological contamination of the pipeline. Disinfection is only required if the pipeline is used for potable water.
- B. The CONTRACTOR shall be responsible for obtaining permits for discharging excess testing water and de-chlorination of such water, if required.

1.2 RELATED SECTIONS

- A. Including but not limited to the following:
 - 1. Section 01 33 00 Submittals
 - 2. Section 33 05 05 Ductile Iron Fittings
 - 3. Section 33 05 07 Polyvinyl Chloride (PVC) Pipe (AWWA C900 and C905)
 - 4. Section 33 92 10 Steel Pipe, Specials, and Fittings (AWWA C200, Modified)

1.3 REFERENCES

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
 - 1. AWWA C-651 - Disinfecting Water Mains
 - 2. Utah Public Drinking Water Regulations
 - 3. Section 6 of the City of West Jordan Water Policies and Design Criteria Manual.

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittals.
- B. Furnish a written testing plan and schedule, including water source and methods for conveyance to the project, sequence, control, and disposal. Include the name of the certified bacteriological testing laboratory.
- C. Disinfection Report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Name of person collecting samples.
 - 5. Initial and 24 hour disinfectant residuals in treated water in parts per million (ppm) for each outlet tested.
 - 6. Date and time of flushing start and completion.
 - 7. Disinfectant residual after flushing in ppm for each outlet tested.

PART 2 MATERIALS

2.1 DESCRIPTION

- A. All test equipment, temporary valves, bulkheads, and other water control equipment, shall be as determined by the CONTRACTOR. No materials shall be used which damage the project pipelines for future conveyance of potable water.
- B. Disinfecting materials shall consist of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.
- C. De-chlorination agents may be sodium bisulfate, sodium sulfite, or sodium thiosulfate.

PART 3 EXECUTION

3.1 GENERAL

- A. Source of Water
 - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water for testing and disinfection of the water line system. All testing water used in the pipeline shall be potable water from a State approved drinking water system.
 - 2. All pressure pipelines shall be tested.
 - 3. Disposal of flushing water and water containing chlorine shall be by methods acceptable to the State of Utah, Division of Water Quality.
- B. West Jordan City Policies:
 - 1. Section 6 of the City water policies is applicable. If there is a conflict between the City's standard and this section the City's standard shall apply.

3.2 HYDROSTATIC TESTING OF PIPELINES PROCEDURE

- A. Prior to hydrostatic testing, pipelines 24-inches diameter and larger shall be swept free of debris and visually inspected that all debris has been removed prior to filling.
- B. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. The CONTRACTOR may test pipelines in sections. Sections to be tested shall be defined by isolation valves in the pipeline. Where such valves are not present, the CONTRACTOR shall install temporary bulkheads or plugs for the purpose of testing. Sections that do not have isolation valves shall be tested in approximate one-mile segments. Sections that have a zero leakage allowance may be tested as a unit. No section of the pipeline shall be tested until field-placed concrete or mortar has attained an age of 14 Days. The test shall be made by closing valves when available or by placing bulkheads and filling the line slowly with water (maximum filling velocity shall not exceed 0.25 foot per second, calculation based on the full area of the pipe). The CONTRACTOR shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment. Remove or

protect any pipeline-mounted devices that may be damaged by the test pressure. The CONTRACTOR shall provide sufficient temporary tapings in the pipelines to allow for trapped air to exit or for water to be drained. After completion of the tests, such taps shall be permanently plugged. Care shall be taken that air relief valves are open during filling.

- C. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the release valves at a reasonable velocity. The air within the pipeline shall be allowed to escape completely. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb water and to allow the escape of air from air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the ENGINEER shall be taken. Additional water shall be added to the pipeline to replace any water absorbed by the cement mortar lining.
- D. The hydrostatic test shall consist of holding 125% of the design operating pressure on the pipeline segment for a period of 2 hours. Visible leaks that appear during testing shall be repaired. Add water to restore the test pressure if the pressure decreases 5 psi below test pressure during the test period.
- E. Pipe with welded joints shall have no leakage. In the case of pipelines that fail to pass the leakage test, the CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.
- F. Exposed piping and valves shall show no visible leaks and no pressure loss during the test.
- G. Blowoff isolation gate valves and plug valves (throttling valves) shall be operated and tested during a simulated blow down operation to demonstrate functionality of the valves to the satisfaction of the ENGINEER. Isolation valves (gate valves) shall not be used for throttling.

3.3 DISINFECTING OF PIPELINES PROCEDURE

- A. Leakage and pressure testing must be completed prior to disinfection procedures.
- B. All water and solution piping installed under this Contract shall be disinfected using an approved disinfection method in accordance with the "American Water Works Association Standard for Disinfecting Water Mains" (AWWA C651).
- C. The CONTRACTOR may use one of the three chlorination methods – tablet, continuous feed, and slug, as outlined in AWWA C651 that is acceptable to the OWNER. Care must be taken to prevent the strong chlorine solution in the line being disinfected from flowing back into the line supplying the water.
- D. The CONTRACTOR shall provide sampling ports along the pipeline as defined in AWWA C651. Taps may be at manways and air valves to help facilitate the spacing requirement.
- E. Heavily chlorinated water shall not be discharged onto the ground. Upon completion of disinfection, Sodium Bisulfate (NaHSO₄), or other approved de-chlorination agent, shall

be applied to the heavily chlorinated water to neutralize thoroughly the chlorine residual remaining. Water shall be neutralized to less than 1 ppm total chlorine residual.

- F. After approval of disinfection, CONTRACTOR shall flush the new system until the chlorine residual is a maximum of 0.3 ppm.
- G. After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the pipeline being tested. Sampling and testing will be completed by CONTRACTOR. Contractor shall collect at least one set of samples from every 1,200 feet of pipeline, plus one set from the end of the line and at least one set from each branch. All samples shall be tested for bacteriological (chemical and physical) quality in accordance with "Standard Methods for Examination of Water and Wastewater" and shall show the absence of coliform organisms. If the initial disinfection fails to provide satisfactory bacteriological results, or shows the presence of coliform, then the line shall be re-chlorinated, flushed, and retested until satisfactory results are obtained at the expense of the CONTRACTOR.

3.4 CONNECTIONS TO EXISTING SYSTEM

- A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before installation. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.
- B. Final Fill: After a successful pressure and disinfection tests, the pipeline(s) shall be filled with fresh potable water and shall remain filled.

- END OF SECTION -

SECTION 33 92 10
STEEL PIPE, SPECIALS, AND FITTINGS (AWWA C 200, MODIFIED)

PART 1 GENERAL

1.1 DESCRIPTION

- A. The CONTRACTOR shall provide fabrication and installation of steel pipe, specials, and fittings, complete and in place, in accordance with AWWA C200 and as modified herein.
- B. A single pipe manufacturer shall be made responsible for furnishing steel pipe, specials, fittings, and appurtenances such as bolts and gaskets.
- C. A special is defined as any piece of pipe other than a normal full length of straight pipe. This includes, but is not limited to, elbows, manhole sections, short pieces of straight pipe, reducers, tees, and bulk heads.

1.2 RELATED WORK

- A. Related work specified in other sections:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 01 50 30 Protection of Existing Facilities
 - 3. Section 31 23 15 Excavation and Backfill for Pipelines
 - 4. Section 33 12 00 Mechanical Appurtenances
 - 5. Section 33 13 00 Pipeline Testing and Disinfection

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
 - 1. ANSI B16.1 Cast-Iron Pipe Flanges and Flanged Fittings Class 25, 125, and 250
 - 2. ANSI B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
 - 3. ANSI/AWS B2.1 Specification for Welding Procedure and Performance Qualification
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 20 Standard Specification for General Requirements for Steel Plates for Pressure Vessels
 - 2. ASTM A 193 Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
 - 3. ASTM A 194 Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
 - 4. ASTM A 234 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

5. ASTM A 283 Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
6. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
7. ASTM A 370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products
8. ASTM A 563 Standard Specification for Carbon and Alloy Steel Nuts
9. ASTM A 572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
10. ASTM A 578 Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
11. ASTM A 1011 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
12. ASTM A 1018 Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
13. ASTM E 165 Standard Practice for Liquid Penetrant Examination for General Industry

D. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 200 Steel Water Pipe 6-inch and Larger
2. AWWA C 205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4-inch and Larger-Shop Applied
3. AWWA C 206 Field Welding of Steel Water Pipe
4. AWWA C 207 Steel Pipe Flanges for Waterworks Service - Sizes 4-inch Through 144-inch
5. AWWA C 208 Dimensions for Fabricated Steel Water Pipe Fittings
6. AWWA C 209 Cold-Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings
7. (AWWA C210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines)
8. AWWA C 214 Tape Coating Systems for the Exterior of Steel Water Pipelines
9. AWWA C 216 Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings
10. AWWA C 219 Bolted, Sleeve-Type Couplings for Plain-End Pipe
11. AWWA C 606 Standard for Grooved and Shouldered Joints
12. AWWA C 651 Standard for Disinfecting Water Mains
13. AWWA M 11 Manual of Water Supply Practices – Steel Pipe – A Guide for Design and Installation

1.4 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings
 1. Prepare and submit certified dimensional drawings consistent with the pipeline alignment and grade on the Drawings, including all fittings and appurtenances, and

- with the size, location, elevation and slope information of existing utilities, pipelines, and encasements obtained by the CONTRACTOR in accordance with Section 01 50 30 - Protection of Existing.
2. Joint and pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; coating and lining holdbacks, manufacturing tolerances; and other pertinent information required for the manufacture of the product. Standard joint details shall be submitted where deep bell or butt strap joints are required for control of temperature stresses.
 3. Details for elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials that indicate amount and position of reinforcement. Fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions as indicated in the drawings. Provide design calculations for all fittings and specials, including all reinforcement requirements.
 4. Material lists and steel reinforcement schedules that describe materials to be utilized.
 5. Line layout and marking diagrams which indicate the specific number of each pipe and fitting, the location of each pipe, and the direction of each fitting in the completed line compatible with requirements of AWWA Manual 11 (M-11). In addition, the line layouts shall include:
 - a. The pipe station and invert elevation at every change in grade or horizontal alignment.
 - b. The station and invert elevation to which the bell end of each pipe will be laid.
 - c. Elements of curves and bends, both in horizontal and vertical alignment.
 - d. Pipe joint type.
 - e. The limits within each reach of each type of field-welded joint and of concrete encasement.
 - f. Location of mitered pipe sections, beveled ends, butt straps and deep bell lap joints for temperature stress control.
 - g. Location and details for each valve, meter, pump, fitting, and other equipment as shown on the drawings used to determine pipe dimensions. Include location of closures, cut-off sections for length adjustment, temporary access manways, vents, and weld lead outlets for construction convenience.
 - h. Location of bulkheads, including those shown and as required, for hydrostatic testing of pipeline.
 6. Welding Information
 - a. The Shop Drawings shall define the weld type and distinguish between shop and field welds. Shop Drawings shall indicate by welding symbols or sketches the details of the welded joints and the preparation of parent metal required to make them. Joints or groups of joints in which welding sequence or technique are especially important and shall be carefully controlled to minimize shrinkage stresses and distortion.
 - b. Written welding procedures for shop and field welds, including Welding Procedures Specifications (WPS's) and Procedure Qualification Records (PQR's) shall be submitted.
 - c. Written nondestructive testing procedure specifications and nondestructive testing personal qualifications for shop and field welds shall be submitted.
 - d. Current (within the last 6 months) Welder Performance Qualifications (WPQ's) shall be submitted for each welder used prior to their performing any Work either in the shop or field. Qualification testing shall be as specified in paragraph 1.3 – Quality Assurance.

- e. Submit the credentials of the CONTRACTOR's Certified Welding Inspectors (CWI's) and quality control specialist for review prior to starting any welding in the shop or field. The credentials shall include, but not be limited to, American Welding Society (AWS), QC-1 Certification. Other nondestructive testing (NDT) quality control personnel shall be certified as required by AWS D1.1.
 - f. Submit NDT data for each shop-welded and field-welded joint. This data shall include all testing on each weld joint, including re-examination of repaired welds, using radiographic testing (RT), magnetic particle testing (MT), dye penetrant testing (PT), ultrasonic testing (UT), or air test examination methods as specified. Test data shall be reviewed and signed by the CWI.
 - g. Submit a welder log for field and shop welding. Log shall list all welders to be used for the Work and the types of welds each welder is qualified to perform.
 - h. Submit a written weld repair procedure for each type of shop and field weld proposed for use on the project.
 - i. Submit a written rod control procedure for shop and field operations demonstrating how the CONTRACTOR intends to maintain rods in good condition throughout the Work. The rod control procedure shall also demonstrate how the rods are used for each weld.
7. Drawings showing the location, design, and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining.
 8. Details and locations of closures for length adjustment and for construction convenience. Submit proposed sequencing of events to control temperature stresses in the pipe wall during installation prior to starting any field welding. Submit the proposed sequencing of events or special techniques to minimize distortion of the steel as may result from shop welding procedures. Submit plan for monitoring pipeline temperatures.
 9. Detail drawings indicating the type, number, and other pertinent details of the slings, strutting, and other methods proposed for pipe handling during manufacturing, transport, and installation.
 10. Manufacturer's written Quality Assurance/Control Program.
- C. Certifications: The CONTRACTOR shall furnish a certified affidavit of compliance for pipe and other products or materials in AWWA C200, AWWA C205, AWWA C206, AWWA C207, AWWA C208, AWWA C209, AWWA C214, AWWA C216, AWWA C219, and the following supplemental requirements:
1. Certified copies of mill test reports on each heat from which steel is rolled. Test shall include physical and chemical properties. Submit certified copies of mill test reports for flanges.
 2. Hydrostatic test reports.
 3. Results of production weld tests.
 4. Sand, cement, and mortar tests.
 5. Records of coating application, including technical data sheets, manufacturer name, product name and thickness.
- D. Performing and paying for sampling and testing necessary for certification are the CONTRACTOR's responsibility.
- E. Manufacturer's Qualifications: Furnish a copy of manufacturer's certification to ISO 9000, SPFA, or LRQA, and documentation of manufacturer's experience in fabricating AWWA

C200 pipe. Credentials shall include reference names, telephone numbers, and descriptions of projects for pipe conforming to AWWA C200 that is of similar diameter, length, and wall thickness to the pipe for this project.

- F. Design Calculations of Fittings and Specials: Furnish a copy of design calculations for fittings and specials including miters, welds, and reinforcement, prior to manufacture of pipe, fittings, and specials.

1.5 QUALITY ASSURANCE

- A. Pipe Manufacturer Qualifications: The pipe manufacturer shall be certified to ISO 9000, the Steel Plate Fabricator's Association (SPFA), or Lloyd's Register Quality Assurance (LRQA) and shall be experienced in fabrication of AWWA C200 pipe of similar diameters, lengths, and wall thickness to this project. The manufacturer shall have the capability of meeting the schedule requirements of this project. Experience shall be in the production facilities and personnel, not the name of the company that owns the production facility or employs the personnel. Verification of experience and production capability will be conducted as part of the initial submittal review process for steel pipe and the CONTRACTOR's progress schedule.
- B. Inspection: Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200, C205, C206, C208, and C214 as supplemented by the requirements herein. The CONTRACTOR shall notify the ENGINEER in writing of the manufacturing start date not less than 14 Days prior to the start of any phase of the pipe manufacture.
- C. Tests: Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200, C205, C206, C208, and C214 as applicable.
 - 1. After the joint configuration is completed and prior to lining with cement mortar, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 75 percent of the yield strength of the steel. The test pressure shall be held for 2 minutes and the pipe visually inspected to confirm that welds are sound and leak-free.
 - 2. In addition to the tests required in AWWA C200, weld tests shall be conducted on each 5,000-feet of production welds and at any other times there is a change in the grade of steel, welding procedure, or welding equipment. One set of tests per operator per work shift shall be performed.
 - 3. Fittings fabricated from straight pipe previously passing a hydrostatic test need not have an additional hydrostatic test provided welds are tested by nondestructive means and demonstrated to be sound.
 - 4. Material tests shall be performed at no additional cost to the OWNER. The ENGINEER and OWNER shall have the right to witness testing conducted by the CONTRACTOR or pipe manufacturer/fabricator; provided that the CONTRACTOR's schedule is not delayed for the convenience of the ENGINEER or OWNER.
- D. Welding Procedure Specifications: Welding procedures used to fabricate and install pipe shall be in accordance with the ASME Boiler and Pressure Vessel Code (BPVC) for shop welds and ANSI/AWS D1.1 for field welds. Written welding procedures shall be required for welds in the shop or the field. Welds qualified per the ASME BPVC shall include

supplementary Essential Variables for notch-tough welding. Provisions of ANSI/AWS D1.1 qualified welds pertaining to notch-tough welding shall apply.

- E. Welder Performance Qualifications: Welding shall be performed by skilled welders, welding operators, and tackers who have had experience in the methods and materials to be used. Welders shall be qualified per the provisions of ASME BPVC for shop welds and ANSI/AWS D1.1 for field welds.
- F. Shop Testing of Steel Plate Specials:
1. If any special has been fabricated from straight pipe not previously tested and is of the type listed below, the special shall be hydrostatically tested with a pressure equal to 1-1/2 times the design working pressure: This applies to bends, wyes, crosses, tees with side outlet diameter greater than 30 percent of the main pipe diameter, and manifolds.
 2. Specials not required to be hydrostatically tested shall be tested by liquid dye penetrant inspection method in accordance with ASTM E 165, Method A or the magnetic particle method in ASME Section VIII, Division 1, Appendix VI.
 3. Reinforcing plates shall be tested by the solution method using approximately 40 psi air pressure introduced between the plates through a threaded test hole. Test hole shall be properly plugged following successful testing.
 4. Any weld defects, cracks, leaks, distortion, or signs of distress during testing shall require corrective measures. Weld defects shall be gouged out and re-welded. After corrections, the special shall be retested.
 5. Where welded test heads or bulkheads are used, extra length shall be provided to each opening of the special. After removal of each test head, the special shall be trimmed back to the design points with finished plate edges ground smooth, straight, and prepared for the field joint.
 6. Testing shall be performed before joints have been coated or lined.
 7. Ultrasonic examination shall be performed in accordance with the following:
 - a. Steel plate that will be in welded joints or welded stiffener elements shall be examined ultrasonically for laminar discontinuities where both of the following conditions exist:
 - 1) Any plate in the welded joint has a thickness exceeding 1/2-inch.
 - 2) Any plate in the welded joint is subject to transverse tensile stress through its thickness during the welding or service.
 - b. Ultrasonic examination may be waived where joints are designated to minimize potential laminar tearing.
 - c. The ultrasonic examination shall be in accordance with ASTM A578 with a Level I acceptance standard.
 8. Plates that are not in conformance with the acceptance criteria in ASTM A578 may be used in the WORK if the areas that contain the discontinuities are a distance at least 4 times the greatest dimension of the discontinuity away from the weld joint.
- G. Shop Nondestructive Testing: Nondestructive testing shall be performed for various weld categories as indicated below. Testing shall include submitting written documentation of procedures per Section V of the ASME Boiler and Pressure Vessel Code, and acceptance criteria shall be in accordance with Section VIII of the ASME BPVC.

1. Field Butt Joint Welds: Spot radiographically examine pipe in accordance with Paragraph UW-52 of the ASME BPVC Section VIII Division 1. If in the opinion of the ENGINEER, the welds cannot readily be radiographed, they shall be 100 percent ultrasonically examined.
 2. Fillet Welds: 100 percent examine every fillet weld using the magnetic particle inspection method.
 3. Groove Welds: 100 percent ultrasonically examine groove welds that cannot be readily radiographically spot examined.
 4. CONTRACTOR's certified welding inspector (CWI) shall 100 percent visually examine every weld as a minimum.
 5. In addition to weld tests indicated, doubler pads shall be air tested as stated in AWWA C206.
 6. CONTRACTOR shall be responsible for performing and paying for said tests and the ENGINEER has the right to witness testing conducted by the CONTRACTOR.
- H. Onsite Observation: The SUPPLIER shall provide an experienced staff member if requested by the CONTRACTOR to be onsite while the pipe and fittings are being installed. The staff member's duties shall include, but not be limited to the following:
1. Observe the installation and welding of the pipe and fittings.
 2. Report any concerns to the OWNER'S on-site observer.
 3. Answer questions and provide assistance to the OWNER and CONTRACTOR.
- I. Certified Welding Inspector: Furnish the services of a certified welding inspector(s) (CWI) for the shop and field welding as specified in AWWA C200 and C206. After receiving CWI qualification, the CWI shall have at least 3 years of professional work experience similar to the work being performed for the project. The CWI's shall be directed by a CWI supervisor with at least 5 years of professional work experience similar to the work being performed for the project. The certified welding inspector(s) shall submit written certification that all welds were performed in conformance with these documents. Shop weld tests shall be reviewed and signed by the certified welding inspector(s).
- J. Field Testing: Field testing shall conform to the requirements of Section 33 13 00 - Pipeline Testing and Disinfection.
- K. Welding Requirements: Welding procedures used to fabricate and install pipe shall be prequalified under the provisions of ANSI/AWS D1.1 - Structural Welding Code-Steel or the ASME Boiler and Pressure Vessel Code, Section 9. Welding procedures shall be required for longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- L. Welder Qualifications: Welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the project shall be used in qualification tests.

1.6 WARRANTY

- A. A one-year warranty for the pipe shall be included from the CONTRACTOR, and shall cover the cost of replacement pipe and freight to the project site, should the pipe have any defects in material or workmanship.
- B. In addition to the standard pipe warranty, the welding contractor shall provide in writing a warranty for a period of one year for all welded joints, including formation, installation, and pressure testing.
- C. Unless otherwise noted, the warranty periods shall begin when Substantial Completion is issued for the contract.

PART 2 PRODUCTS

2.1 GENERAL

- A. Manufacturers of steel pipe and steel fittings or specials shall be under the direction and management of one steel pipe manufacturer only. This does not prevent a separate fabricator from fabricating specials or fittings; however, WORK shall be directed by the Main Pipe Manufacturer. The responsibility of the Main Pipe Manufacturer shall include at a minimum:
 - 1. Verify pipe, fittings, and specials are being manufactured in full accordance with the drawings and specifications and applicable codes and standards.
 - 2. Manage the design, fabrication, testing and delivery of the pipe, fittings, and specials. Provide field support if requested to the CONTRACTOR during installation and testing.
 - 3. Prepare and submit submittal information and Shop Drawings.
 - 4. Make any corrections that may be required to the submittal information and Shop Drawings.
 - 5. Certify that the pipe and specials have been manufactured in accordance with the Drawings and Specifications.
- B. Lined and coated steel pipe and specials shall conform to AWWA C210 subject to the following supplemental requirements. The pipe, specials, and fittings shall be of the diameter and class indicated and shall be provided complete with welded joints as indicated on the Drawings. For pipe, specials, and fittings 14-inches diameter and larger, the nominal inside diameter after lining shall not be less than the diameter indicated on the Drawings, allowing for tolerances according to AWWA C200 and C205. Pipe, specials, and fittings smaller than 14-inches diameter may be furnished in standard outside diameters. When indicated as a minimum, wall thickness tolerance shall be as allowed by AWWA C200 or the ASTM nominal sheet or plate tolerance, whichever is less.
- C. Markings: The manufacturer shall legibly mark pipe, specials, and fittings in accordance with the laying schedule and marking diagram. Each pipe, special, and fitting shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. Each pipe, special, and fitting number shall be located on the inside and outside area of pipe, special, and fitting. Interior marking shall be in full conformance with NSF 61. Each pipe, fitting and special shall be marked at each end with top field centerline. The word "Top" shall be painted or marked on the outside top spigot of each pipe section or fitting. Mark "Top Match Point" for compound bends per AWWA C208.

- D. Handling and Storage: The pipe, specials, and fittings shall be handled by use of wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment that might injure the pipe coating/exterior will not be permitted. Stockpiled pipe, specials, and fittings shall be supported on padded skids, sand or earth berms free of rock exceeding 2-inches diameter, sand bags, or suitable means so that the pipe including coating and lining coating will not be damaged. Pipe, specials, and fittings shall not be rolled and shall be secured to prevent accidental rolling. The ends of pipes shall be securely bulkheaded or otherwise sealed during transportation and shall remain sealed until installation.
- E. The CONTRACTOR shall replace or repair any pipe, specials, and fittings damaged at no additional cost to the OWNER.
- F. Strutting: Adequate strutting shall be provided on specials, fittings, and straight pipe so as to avoid damage to the pipe, specials, and fittings during handling, storage, hauling, and installation. For mortar-lined steel pipe, specials, or fittings the following requirements shall apply:
 - 1. The strutting shall be placed as soon as practicable after the mortar lining has been applied and shall remain in place while the pipe, special, or fitting is loaded, transported, unloaded, installed, and backfilled at the Site.
 - 2. The strutting materials, size, and spacing shall be the responsibility of the CONTRACTOR and shall be adequate to support the earth backfill plus any greater loads that may be imposed by the backfilling and compaction equipment.
 - 3. Strutting on shop lined pipe shall consist of wood stulls and wedges. Strutting shall be installed in a manner that will not harm the lining.
 - 4. Any pipe, special, or fitting damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced at no additional cost to the OWNER.
- G. Laying Lengths: Maximum pipe laying lengths shall be 48-feet with shorter lengths provided as required to accommodate the CONTRACTOR's operation.
- H. Lining: The pipe, specials, and fittings shall have smooth, dense interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness.
- I. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing indicated. The locations of the correction pieces and closure assemblies shall be shown on the pipe layout diagrams.
- J. Backfill with CLSM: Where required, backfill with Controlled Low Strength Material (CLSM) shall be the full depth of the pipe zone from 6 inches below to 6 inches above the pipe as a minimum.

2.2 MATERIALS

- A. Mortar: Materials for mortar shall conform to the requirements of AWWA C205; provided, that cement for mortar coating shall be Type II modified or Type V and mortar lining shall be Type II modified or Type V. Cement in mortar lining and coating shall not originate

from kilns that burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement. Admixtures shall contain no calcium chloride.

B. Steel for Cylinder and Fittings: Pipe, specials, and fittings manufactured under AWWA C200 shall satisfy the following requirements:

1. Minimum yield strength of steel is 42,000 psi.
2. Be manufactured by a continuous casting process.
3. Be fully killed.
4. Be fine grain practice.
5. Maximum carbon content of 0.25 percent.
6. Maximum sulfur content of 0.015 percent.
7. Minimum elongation of 22 percent in a 2-inch gauge length.
8. Be in accordance with one of the following, ASTM A1011, ASTM A283, ASTM A572, or ASTM A1018.
9. Maximum carbon equivalent of 0.45, calculated as follows:

$$CE = C + \frac{(Mn+Si)}{6} + \frac{(Cr+Mo+V)}{5} + \frac{(Ni+Cu)}{15}$$

C. Pipe shall be manufactured as fabricated pipe per AWWA C200 as modified herein. ASTM pipe manufacturing standards referenced in AWWA C200 shall not be used. Pipe sections shall be fabricated by either of the following methods:

1. Pipe sections may be fabricated by spirally welded short cylindrical coils of steel, joined circumferentially by complete penetration butt joint welds.
2. Pipe sections may be rolled or pressed from no more than three (3) sheets the full length of the pipe and welded with no more than three (3) longitudinal seams.

D. Steel equal to or greater than 1/2-inch thick used in fabricating pipe shall be tested for notch toughness using the Charpy V-Notch test in accordance with ASTM A370. Test each heat of steel by taking one specimen from any two coils per heat number. The steel shall withstand a minimum impact of 25 ft-lb at a temperature of 30 deg F.

1. Plate: Charpy tests shall be conducted on each plate as required in ASTM A20.
2. Coils: Charpy tests shall be conducted on the first 500 tons of steel by testing each coil as follows:
 - a. Tests shall include representative sampling of steel thicknesses required for the Work.
 - b. Each coil shall be tested by taking coupons from the outer, middle, and inner wrap of the coil. Middle coil coupons may be taken from the ends of full-length pipes that are closest to the middle of the coil.
 - c. Coils that do not meet the above Charpy acceptance criteria shall not be used in the production of the pipe.

E. External Pipeline Coating: In accordance with Section 09 98 10 – Pipeline Coatings and Linings.

2.3 DESIGN OF PIPE

A. General: The pipe shall be suitable to transmit potable water under the conditions indicated on the Drawings. The steel pipe shall have field welded joints as indicated. The

pipe shall be epoxy lined as per Section 09 98 10. Field lining will only be allowed where specifically approved in advance by the ENGINEER.

- B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and, except as hereinafter modified, shall conform to AWWA C200.
- C. Pipe Dimensions: Pipe shall be of the diameter and minimum wall thickness indicated on the Drawings.
- D. Fitting Dimensions: Fittings shall be of the diameter and class to match the adjacent piping.
- E. Joint Design: Unless indicated otherwise, the standard field joint for steel pipe shall be as indicated in the following table. Butt-strap joints shall be used only where required for closures or where indicated. The joints furnished shall have the same, or higher, pressure rating as the abutting pipe as indicated on the Contract Drawings or in Section 33 13 00 - Pipeline Testing and Disinfection. Provide air test tapped holes with weld-o-lets for each double welded lap joint or butt strap joint.

Pipe Diameter	Application	Joint Type
60-inches and less	Non-Restrained Areas	Single Lap Welded Joint or Double Lap Welded Joint
	Restrained Areas	Butt Welded Joint or Flanged
	Closures; Restrained and/or Non-Restrained	Butt Strap Joint

- F. Lap joints prepared for field welding shall be in accordance with AWWA C200. The method used to form, shape, and size bell ends shall be such that the physical properties of the steel are not substantially altered. Bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. Faying surfaces of the bell and spigot shall be essentially parallel except for mitered bells, but the bell slope shall not vary more than 2 degrees from the longitudinal axis of the pipe.
- G. Spiral weld seams shall be tested by the visible penetrant method of ASTM E 165 or magnetic particle inspection method of ASME Section VIII, Division 1, Appendix VI, for a

minimum distance of 12-inches from each end of each joint after the spigot and bell are formed. Defects shall be repaired at no additional cost to the OWNER.

- H. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated. Holdback areas shall be coated as indicated in Section 09 98 10 – Pipeline Coatings and Linings.
- I. Joint Shop Coating: Holdback areas for welded joints and butt straps shall be thoroughly cleaned and given a shop coat of rust-inhibitive primer. The surface preparation and primer shall be compatible with the intended finish coating as specified in Section 09 98 10 - Pipeline Coatings and Linings and Section 09 90 00 Painting and Finishes.
- J. Shop Fit Test: Make certain that joints are correctly field assembled and that excessive annular space between spigots and bells and that the pipe meets the requirements of AWWA C200. The pipe fabricator shall perform dimensional measurements for all pipe joints to verify joints are within manufacturing tolerances prior to shipment. The pipe ends shall be match marked after shop assembly.
 - 1. The shop fit test shall join the pipe ends in the shop with proposed adjacent pipe end.
 - 2. Record the actual annular space with the data to include as a minimum:
 - a. Maximum/minimum space at any point.
 - b. Space at 90-degree intervals top, bottom, and at springline.
- K. Restrained Joints
 - 1. Located where indicated and where required to meet seismic requirements, restrained joints shall be field-welded joints, either single, or double lap-weld, or butt-weld, flanges, or butt-straps as indicated on the Contract Drawings. Designs shall include stresses created by the greater of:
 - a. Temperature differential of 50 degrees F plus Poisson's effect in combination with hoop stress, or;
 - b. Thrust due to bulkheads, bends, reducers, and line valves resulting from working pressure in combination with hoop stress.
 - 2. For field welded joints, design stresses shall not exceed 50 percent of the specified minimum yield strength of the grade of steel utilized, or 21,000 psi, whichever is less, for the part being examined when longitudinal thrust is assumed to be uniformly distributed around the circumference of the joint.
- L. Flanges
 - 1. Flanges shall be in accordance with AWWA C 207 Class D for operating pressures up to 175 psi on 4-inch through 12-inch diameter, and operating pressures to 150 psi on diameters over 12-inches.
 - 2. Flanges shall be AWWA C 207 Class E for operating pressures over 150 psi to 275 psi or shall be Class F for pressures to 300 psi (drilling matches ANSI B 16.5 Class 250).
 - 3. Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flanges shall be shop coated with a soluble rust preventive compound which is NSF 61 certified if used on potable water pipelines.
 - 4. Gaskets shall be full-face, 1/8-inch thick, cloth-inserted rubber, **Garlock 3000, John Crane Co. Style 777**, or approved equal.

M. Bolts and Nuts for Flanges

1. Bolts for flanges shall be carbon steel, ASTM A 307, Grade B for Class B and D flanges and nuts shall be ASTM A 563, Grade A heavy hex. Bolts for Class E and F flanges shall be ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex.

2.4 SPECIALS AND FITTINGS

- A. Design: Except as otherwise indicated, materials, fabrication and shop testing of Specials and fittings shall conform to the requirements stated above for pipe and shall conform to the dimensions of AWWA C208. (Specials consisting of access manways, outlets for air valves, blow-off valves, etc. are excluded from the criteria as follows and collar plates, wrapper plates or crotch plates shall be required for reinforcing the outlet connections in accordance with AWWA M-11 and AWWA C208 requirements.) The minimum thickness of plate for pipe from which specials are to be fabricated shall be the greatest of those determined by the following 3 criteria:

1. Working and Transient Pressure Design

$$T = \frac{P_w D / 2}{Y / S_w} \qquad T = \frac{P_t D / 2}{Y / S_t}$$

Where:

- T = Steel cylinder thickness in inches
- D = Outside diameter of steel cylinder in inches
- P_w = Design working pressure in psi
- P_t = Design transient pressure in psi
- Y = Specified minimum yield point of steel in psi
- S_w = Safety factor of 2.5 at design working pressure
- S_t = Safety factor at design transient pressure; for elbows 1.875 and 2.0 for other specials

2. Mainline Pipe Thickness: Plate thickness for specials shall not be less than for the adjacent mainline pipe.
3. Thickness Based on Pipe Diameter

Nominal Pipe Diameter, in	Pipe Manifolds Piping Above Ground Piping Structures
24 and under	3/16-in
25 to 48	1/4-in
over 48	5/16-in

- a. Minimum plate thickness shall be the greater of the adjacent mainline pipe, the thickness on the Drawings, the thickness calculated as indicated herein or as shown on the table above indicating the minimum thickness based on pipe diameter.
 - b. Refer to ASME B36.10M for dimensions of wall thickness for standard weight pipe and nominal pipe size.
- B. Specials installed on saddle supports shall be designed to limit the longitudinal bending stress to a maximum of 10,000 psi. Design shall be in accordance with the provisions of Chapter 7 of AWWA Manual M11.
- C. Reinforcement for wyes, tees, outlets, and nozzles shall be designed in accordance with AWWA Manual M11. Reinforcement shall be designed for the design pressure indicated and shall be in accordance with the Drawings. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe. Unless otherwise indicated, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11-1/4 degrees.
- D. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths of pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. Bevels shall be provided on the bell ends. Mitering of the spigot ends will not be permitted. The maximum allowable angle for pulled joints shall be in accordance with the manufacturer's recommendations or the angle which results from a 3/4-inch pull out from normal joint closure, whichever is less. Horizontal deflections or fabricated angles shall fall on the alignment. In congested city streets or at other locations where underground obstructions may be encountered, the chord produced by deflecting the pipe shall be no further than 6-inches from the alignment indicated.
- E. Vertical deflections shall fall on the alignment and be at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures. The pipe angle points shall match the angle points indicated.
- F. Outlets, Tees, Wyes, and Crosses
 1. Outlets 12-inches and smaller may be fabricated from Schedule 30 or heavier steel pipe in the standard outside diameters. Minimum plate thickness for reinforcements shall be 10-gauge.
 2. The design of outlet reinforcement shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M -11 and the design pressures and factors of safety above.
 3. In lieu of saddle or wrapper reinforcement as provided by the design procedure in Manual M -11, pipe or specials with outlets may be fabricated entirely of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.
 4. Where Manual M-11 requires the design procedure for crotch plate reinforcement, such reinforcement shall be provided.
 5. Outlets shall be fabricated so that there is always at least a 12-inch distance between the outer edge of the reinforcing plate and any field welded joints. For outlets without

reinforcing plates, outlets shall penetrate the steel cylinders so that there is at least a 12-inch clearance between the outlet and any field-welded joints.

6. Tees, wyes, crosses, elbows, and manifolds shall be fabricated so that the outlet clearances and reinforcing plates from any weld joints are a minimum of 5 times cylinder thickness or 2-inches, whichever is greater. Longitudinal weld joints in adjacent cylinder sections shall be oriented so that there is a minimum offset of 5 times cylinder thickness or 2-inches, whichever is greater.

G. Steel Welding Fittings: Steel welding fittings shall conform to ASTM A 234.

H. Ends for Mechanical-Type Couplings: Except as otherwise indicated, where mechanical-type couplings are indicated, the ends of pipe shall be banded with Type C collared ends using double fillet welds. The collared ends shall be grooved for the fitting. Where pipe 12-inches and smaller is furnished in standard schedule thickness and where the wall thickness after grooving equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.

2.5 INTERIOR AND EXTERIOR COATING OF PIPE

A. Coating of Exposed Piping: The exterior surfaces of pipe, specials, and fittings that will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of primer compatible with the finish coating required by Section 09 98 10 - Pipeline Coatings and Linings.

B. Coating of Buried Piping: Pipe for buried service, including bumped heads, shall be coated per Section 09 98 10 – Pipeline Coatings and Linings.

C. Flexible coatings shall conform to Section 09 98 10 - Pipeline Coatings and Linings.

2.6 PIPELINE MARKING TAPE

A. Metallic Tape: Tape shall be minimum 5.5-mils thick aluminum foil imprinted on one side, encased in high visibility inert polyethylene jacket. Tape shall be 12-inches wide. Imprinted lettering shall be one-inch tall, permanent black, and shall read: "CAUTION – WATER LINE BURIED BELOW" or similar. Joining clips shall be manufacturer's standard tin or nickel coated. Refer to Drawings for location of tape placement.

1. Tape shall be manufactured by **Reef Industries (Terra "D")**, **Allen (Detectatape)**, or equal.

B. Plastic Tape: Tape shall be minimum 4-mil thick polyethylene which is impervious to alkalis acids, and chemicals and solvents which are likely in the soil. Tape shall be 12-inches wide and lettering shall be one-inch tall permanent black on a blue background. Lettering shall read: "CAUTION – WATER LINE BURIED BELOW". Refer to Drawings for location of tape placement.

1. Tape shall be manufactured by **Reef Industries (Terra Tape)**, **Allen (Markline)**, or equal.

2.7 MARKERS

- A. Provide pipeline markers at the locations indicated. Markers in open fields shall be concrete post types and markers in areas beneath or adjacent to paved streets with curbs/gutters shall be brass cap type installed in the top of the curb.
- B. Concrete Posts: Posts shall be square reinforced concrete posts as indicated, provide above the centerline of pipeline. Concrete shall be 3000-psi concrete in accordance with ASTM C 94. The cement shall be Type V. Each of the four (4) sides shall have information painted above ground in 3-inch tall black letters. Paint shall conform to Federal Specification TT-P-24, Type IV.
 - 1. Side 1: Paint the OWNER's name.
 - 2. Side 2: Paint the lateral name, per the ENGINEER.
 - 3. Side 3: Paint the appurtenance designate, per the ENGINEER.
 - 4. Side 4: Paint the station number.
- C. Carsonite Survivor: Carsonite survivor series markers may be substituted where shown for the concrete post markings as required for the concrete posts except that all information shall be on a single decal surface.
- D. Brass Caps: Caps shall be 2-1/2-inch diameter brass caps with posts set by epoxy into holes drilled into the curb adjacent to the pipeline. Caps shall be **Sokkia 813406**, or equal, stamped with the following information:
 - 1. Owner's name
 - 2. Station number.
 - 3. Lateral name, per the ENGINEER.
 - 4. Distance and direction to appurtenance or lateral centerline.

2.8 PIPE APPURTENANCES

- A. Pipe appurtenances shall be in accordance with the requirements of the Specifications and Drawings. Access manholes with covers shall be as indicated, installed during fabrication, not in the field. Threaded outlets shall be forged steel suitable for 3000 psi service.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Handling and Storage: Pipe, specials, and fittings shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, and impact shocks and free fall. Pipe, specials, and fittings shall not be placed directly on rough ground but shall be supported in a manner that will protect the pipe against injury whenever stored at the Site or elsewhere. Pipe, specials, and fittings shall be handled and stored at the Site in accordance with the requirements stated in Part 2, above. No pipe shall be installed when the lining or coating/interior or exterior surfaces show cracks that may be harmful as determined by the ENGINEER. Such damaged lining and coating/interior and exterior surfaces shall be repaired or a new undamaged pipe, special, or fitting shall be provided at no additional cost to the OWNER.

- B. Pipe damaged prior to Substantial Completion shall be repaired or replaced at no additional cost to the OWNER.
- C. Repair of Defects: Patching inserts, overlays, or pounding out defects shall not be permitted. Repair of notches or laminations on second ends shall not be permitted. Deformation of pipe ends through mechanical means or other methods to achieve pipe fit up of defective pipe shall not be permitted. Damaged ends shall be removed to a point of uniform, non-damaged cylinder end and properly prepared. Distorted or flattened lengths shall be rejected. Buckled sections shall be removed and replaced with a full pipe cylinder. The CONTRACTOR shall submit a written repair plan and receive favorable review from the OWNER prior to the start of any repair work.
- D. The CONTRACTOR shall inspect each pipe, special, and fitting for damage. The CONTRACTOR shall remove or smooth out any burrs, gouges, weld splatter, or other small defects prior to laying the pipe, special, or fitting.
- E. Before placement of pipe, specials, or fittings in the trench, each shall be thoroughly cleaned of any foreign substance that may have collected thereon and shall be kept clean thereafter. For this purpose, the openings of pipes, specials, and fittings in the trench shall be closed during any interruption to the project.
- F. Pipe, specials, and fittings backfilled with CLSM shall be laid directly on moist sandbags or other suitable supports in preparation for the CLSM pipe zone material. Sandbags shall be placed to provide at least 6-inches of CLSM below the bottom of the pipe. Sandbags shall be spaced at a maximum interval of 8-feet and one set shall be placed within 3-feet on both sides of each joint. The CONTRACTOR shall provide additional sandbags as needed to support the pipe on line and grade. Excavation outside the normal trench section shall be made at field joints as needed to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- G. Installation Tolerances: Each section of pipe, special, or fitting shall be laid in the order and position on the laying diagram and in accordance with the following:
 - 1. Each section of pipe, special, or fitting having a nominal diameter less than 48-inches shall be laid to line and grade, within plus or minus 2-inches horizontal deviation and plus or minus 1-inch vertical deviation.
 - 2. Each section of pipe, special, or fitting having nominal diameter 48-inches and larger shall be laid to line and grade, within plus or minus 5 percent of diameter horizontal deviation and plus or minus 2.5 percent of diameter vertical deviation.
 - 3. In addition to the horizontal and vertical tolerances above, lay the pipe so that no high or low points other than those on the laying diagram are introduced.
 - 4. After installation, pipe, specials, and fittings shall not show deflection greater than 1.5 percent for mortar-lined and mortar-coated pipe, specials, and fittings; 2.25 percent for mortar-lined and flexible-coated pipe, specials, and fittings; and 3.75 percent for flexible-lined and flexible-coated or bare pipe, specials, and fittings. The allowable deflection shall be based on the design inside diameter.
 - 5. CONTRACTOR shall not permit the pipeline to experience a differential settlement after welding of more than 1.5" over 300 feet.
- H. Where necessary to raise or lower the pipe, specials, or fittings due to unforeseen obstructions or other causes, the CONTRACTOR may change the alignment and/or the grades in accordance with the requirements of the Specifications and Drawings. Such

change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in a joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer without prior approval from the ENGINEER. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint. In all cases the joint opening, before finishing with the protective mortar inside the pipe, shall be the controlling factor.

- I. Except for short runs, pipes shall be laid uphill if on grades exceeding 10 percent. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. Bends shall be installed as indicated.
- J. Struts in pipe 42-inches diameter and larger shall be left in place until backfilling operations have been completed. Struts in pipe smaller than 42-inches may be removed immediately after laying. CONTRACTOR shall monitor pipe deflection by measuring pipe inside diameter before struts are removed and 24 hours after struts are removed. Pipe deflection shall not exceed 3 percent 24 hours after the struts are removed. After the backfill has been placed, the struts shall be removed and shall remain the property of the CONTRACTOR. For pipe backfilled with CLSM, struts shall be left in place until the CLSM backfill has obtained a minimum 7 day cure.
- K. Cold Weather Protection: No pipe, special, or fitting shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe, special, or fitting shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.
- L. Pipe, Specials, and Fitting Protection: The openings of pipe, specials, and fittings with shop-applied mortar lining shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water, or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe, specials, and fittings. The CONTRACTOR shall introduce water into the pipe to keep the mortar moist if moisture has been lost due to damaged bulkheads.
- M. Flotation: At all times, means shall be provided to prevent the pipe from floating. Take necessary precautions to prevent the pipe from floating due to water entering the trench or from backfilling with CLSM. The CONTRACTOR shall assume full responsibility for any damage due to this cause and shall at its own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating. Maintain the inside of the pipe free from materials and in a clean and sanitary condition.
- N. Pipe Cleanup: As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of debris. The CONTRACTOR shall completely clean the interior of the pipe of sand, dirt, mortar splatter, and any other debris following completion of pipe laying, pointing of joints, and any necessary interior repairs prior to testing and disinfecting the completed pipeline. When pipe laying is not in progress and at the end of each day, the CONTRACTOR shall cover the exposed ends of all pipes to prevent animals, dust, dirt and other debris from entering the pipe.

3.2 WELDED JOINTS

- A. General: Field welded joints shall be in accordance with AWWA C206.

B. Welding Procedures, Welding Qualifications and Testing:

1. Field welding procedures, welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and as defined in Section 3 of ANSI/AWWA C206 or ANSI/AWWA C200, as applicable. Qualifications shall be in accordance with all position pipe tests as defined in Section 5 of AWS D1.1.
2. For field welding, the welder qualification testing shall be performed at the Site. Previous qualifications will not be accepted. CONTRACTOR shall obtain the services of an independent testing laboratory to perform the welder qualification on-Site. Copies of test data and certifications shall be provided to the ENGINEER. Costs for welder qualification testing shall be paid by the CONTRACTOR at no increased cost to the OWNER.
3. Upon completion of each field-welded joint the CONTRACTOR shall provide a record system that traces a welder's work completion to a specific joint as it relates to the pipeline stationing.
4. Field lap welds shall be inspected by magnetic particle or dye penetration methods. Field butt welds shall be inspected in accordance with the requirements of API 1104 by the radiographic method and the acceptance criteria of API 1104. Magnetic particle testing is not required for seal welds.
5. Double welded lap joints and butt strap joints shall be air tested. Repairs and retesting shall be required if any loss of pressure occurs and shall be at no increased cost to the OWNER.
6. Personnel performing the visual inspection of welds shall be qualified and currently certified as Certified Welding Inspector (CWI) in accordance with AWS QC1, Standard for Qualification and Certification of Welding Inspectors. Personnel performing nondestructive tests shall be qualified and certified to meet the requirements of SNT-TC-1A.

C. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.

D. Butt straps shall be as indicated. When fitting up the ends of pipe to be welded or fitting butt-strap pieces, jacking or clamping shall not be allowed. Cold working the metal with sledges or localized application of heat and working the metal with sledges shall not be allowed. If field displacement of joints, where butt strap joints are indicated, does not allow proper fit up with the tolerances indicated, special closure butt straps or mitered pieces shall be shop fabricated and installed.

E. A heat resistant shield shall be draped over at least 24-inches of coating beyond the holdback on both sides of the weld during welding to avoid damage to the coating by hot weld splatter. Welding grounds shall not be attached to the coated part of the pipe.

F. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint.

G. To control temperature stresses, the unbackfilled joint areas of the pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hours prior to the beginning of the welding operation and until the weld has been completed. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow

air circulation around the pipe. Shading of the pipe joints need not be performed when the ambient air temperature is below 50 deg F as measured in the trench.

- H. Temperature Control Joints: At intervals not exceeding 250-feet along welded reaches of the pipeline and at the first regular lap-welded field joints outside concrete encasements and structures, the pipe shall be laid with an initial lap of not less than 1-inch greater than the typical lap dimension. The welding of each such temperature control joint shall be performed when the temperature is approximately the lowest during the 24 hour day, after at least 250-feet of pipe have been laid and the joints have been welded ahead of and in back of the shrinkage control joint, and after backfill has been completed to at least 1-foot above the top of the pipe ahead of and in back of the shrinkage control joint. Where temperature control joints occur in a traveled roadway or other inconvenient location, the location of the temperature control joint may be adjusted, as necessary.
- I. Prior to the beginning of the welding procedure, any tack welds used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with AWWA C206. Where more than one pass is required, each pass except the first and final ones shall be peened to relieve temperature stresses, and dirt, slag, and flux shall be removed before the succeeding bead is applied.
- J. Prior to butt welding, the pipe and joint shall be properly positioned in the trench using line up clamps so that, in the finished joint, the abutting pipe sections shall not be misaligned more than 1/16-inch.
- K. Unless double fillet welds are indicated, field welded lap joints may, at the CONTRACTOR'S option, be made on either the inside or the outside of the pipe.
- L. Inspection of Field Welded Joints: An independent testing laboratory shall inspect the joints. Inspection shall be as soon as practicable after the welds are completed.
 - 1. Fillet welds shall be tested by the Magnetic Particle Inspection Method in accordance with ASME Section VIII, Division 1, Appendix VI.
 - 2. In addition double fillet welds on butt strap joints or double welded lap joints shall be air tested by shop drilling and tapping for 1/4-inch national pipe thread in the lap or bell end of the pipe. Apply 40 psi of air or other satisfactory gas into the connection between the 2 fillet welds. Test pressure shall be measured with a 4-inch diameter, minimum, pressure gauge with a range no greater than 0 to 100 psi. The air test shall consist of holding the test pressure undiminished for 5 minutes. If the air test fails, paint the welds with a soap solution and mark any leaks indicated by the escaping gas bubbles. Leaking portions of the welds or defective welds shall be removed and rewelded. The amount of material removed shall be limited to that required to correct the defect. After the repair is made, the joint shall be checked by repeating the original test procedure to verify that there is no leakage at the inside weld. Close the threaded openings with pipe plugs or by welding them.
 - 3. Butt welds shall be inspected by radiographic methods in accordance with API Standard 1104.
- M. Following tests of the joint, the exterior joint spaces shall be coated in accordance with these specifications after which backfilling may be completed.

- N. Repair of Welds: Welds that are defective shall be repaired by the CONTRACTOR to meet the requirements of this Specification. Defects in welds or defective welds shall be removed, and that section of the joint shall then be re-welded. Only sufficient removal of defective material that is necessary to correct the defect is required. After the repair is made, the joint shall be checked by repeating the original test procedure. Welds deficient in size shall be repaired by adding weld metal.

3.3 JOINT COATING AND LINING

- A. General: The interior and exterior joint recesses shall be thoroughly wiped clean and water, loose scale, dirt, and other foreign material shall be removed from the inside surface of the pipe.
- B. Joint Coating of Shop-Applied Epoxy Pipe: Joints shall be coated in accordance with Section 09 98 10 – Pipeline Coatings and Linings.
- C. Every joint will be tested by the CONTRACTOR with an electrical detector capable of at least a 12,000 volt output, furnished by the SUPPLIER. Holiday tests will be conducted in accordance with NACE RP0274. Holidays shall be repaired by the CONTRACTOR at no additional cost to the OWNER.
- D. Coating Repair: Coating repair shall be in accordance with Section 09 98 10 – Pipeline Coatings and Linings.
- E. Coating of Fittings and Specials: Fittings and specials shall be coated in accordance with Section 09 98 10 – Pipeline Coatings and Linings.

3.4 INSTALLATION OF PIPE APPURTENANCES

- A. Protection of Appurtenances: Where the joining pipe is tape-coated, buried appurtenances shall be coated with cold-applied tape in accordance with Section 09 98 10 – Pipeline Coatings and Linings.
- B. Installation of Valves: Valves shall be handled in a manner to prevent any injury or damage to the valve or any part of it. Joints shall be thoroughly cleaned and prepared prior to installation. The CONTRACTOR shall adjust stem packing and operate each valve prior to installation to verify proper operation.
- C. Valves shall be installed so that the valve stems are plumb and in the location indicated.
- D. Buried valves and flanges shall be coated and protected in accordance with Section 09 98 10 - Pipeline Coatings and Linings.
- E. Installation of Flanged Joints: Before the joint is assembled, the flange faces shall be thoroughly cleaned of foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. Bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable calibrated torque wrench. Clamping torque shall be applied to the nuts only. Full face reinforced rubber gaskets shall be applied to the inside face of blind flanges with adhesive.

- F. Insulated Joints: Insulated joints and appurtenant features shall be provided as required. The CONTRACTOR shall exercise special care when installing these joints to prevent electrical conductivity across the joint. After the insulated joint is completed, an electrical resistance test shall be performed by the CONTRACTOR. If the resistance test indicates a short circuit, the CONTRACTOR shall remove the insulating units to inspect for damage, replace all damaged portions, and reassemble the insulating joint. The insulated joint shall then be retested to assure proper insulation.
- G. Flexible Coupled Joints: When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings, and gaskets are clean and free of dirt and foreign matter with special attention given to the contact surfaces of the pipe, gaskets, and couplings. The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer.
- H. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the follower rings and the body of the pipe. Bolts shall be tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable calibrated torque wrench set for the torque recommended by the coupling manufacturer. Clamping torque shall be applied to the nut only.

3.5 MARKING TAPE INSTALLATION

- A. Continuously install metallic marking tape along the pipe at the depth and location indicated.
- B. Continuously install plastic marking tape along the pipe at the depth and location indicated.

3.6 PRESSURE TESTING

- A. Pressure testing and disposal of test water shall be in accordance with Section 33 13 00 – Pipeline Testing and Disinfection.

- END OF SECTION -

SECTION 40 05 13.13
STEEL PROCESS PIPING

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall furnish and install all steel process piping and appurtenances as shown and specified, and as required for a complete and workable piping system.
- B. This Section includes schedule 40 and 80 steel process pipe in accordance with ASTM A53 and ASTM A106 with welded, flanged, grooved, or threaded joints. Fabricated steel pipe in accordance with AWWA C200 – Steel Water Pipe, 6-inch and Larger, is included in Section 33 92 10 – Steel Pipe, Specials, and Fittings (AWWA C200, modified).

1.2 RELATED WORK

- A. Related work specified in other sections:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 31 23 15 Excavation and Backfill for Pipelines
 - 3. Section 33 92 10 Steel Pipe, Specials, and Fittings (AWWA C200, modified)
 - 4. Section 33 12 00 Mechanical Appurtenances
 - 5. Section 33 13 00 Pipeline Disinfection

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
 - 1. ASME B 16.1 Gray Iron Flanges and Fittings, Classes 25, 125, and 250
 - 2. ASME B 16.3 Malleable Iron Threaded Fittings, Classes 150 and 300
 - 3. ASME B 16.4 Gray Iron Threaded Fittings, Classes 125 and 250
 - 4. ASME B 16.5 Pipe Flanges and Flanged Fittings
 - 5. ASME B 16.9 Factory-Made Wrought Butt Welded Fittings
 - 6. ASME B 16.11 Forged Fittings, Socket-Welding and Threaded
 - 7. ASME B 16.12 Cast Iron Threaded Drainage Fittings
 - 8. ASME B 31.1 Power Piping
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. ASTM A 106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
- D. AMERICAN WELDING SOCIETY (AWS)
 - 1. AWS D1.1 Structural Welding Code

E. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 207 Steel Pipe Flanges for Waterworks Services
2. AWWA C 606 Grooved and Shouldered Joints
3. AWWA C 651 Standard for Disinfecting Water Mains

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's affidavit certifying product was manufactured, tested and supplied in accordance with applicable references in this section together with a report of the test results and the date each test was completed.
- C. Submit shop drawings of pipe, fittings, supports and appurtenances showing compliance with this Section including necessary dimensions, details, pipe joints and material lists.
- D. Submit gasket material data including manufacturer's catalog indicating that the proposed product is suitable for each fluid of service application.
- E. Submit welders' qualifications in accordance with AWS D1.1.

PART 2 PRODUCTS

2.1 STEEL PIPE

- A. Galvanized and black steel process pipe shall be fabricated in accordance with ASTM A 53 or ASTM A 106, Grade B, and shall be Schedule 40 or 80 as indicated on the Drawings. Unless noted otherwise, galvanized steel pipe shall not be cement mortar lined.

2.2 PIPE JOINTS

- A. Black steel pipe joints shall be screwed ends with NPT threads, welded, or flanged. Screwed joints shall be made up with Teflon tape. Welded joints may have butt-weld or socket weld fittings or flanges. Where indicated on the Drawings, provide grooved ends for rigid or flexible mechanical couplings or plain ends for sleeve-type couplings.
- B. Galvanized steel pipe shall have screwed ends with NPT threads. Screwed joints shall be made up with Teflon tape. Where indicated on the Drawings, provide grooved ends for rigid or flexible mechanical couplings or plain ends for sleeve-type couplings.
- C. Flanged joints shall be in accordance with ASME B16.5 or AWWA C207 flanges for the pressure class required for the project conditions or as indicated on the Drawings. The CONTRACTOR is responsible for providing the appropriate flanges required to connect steel pipe to equipment and other appurtenances. The CONTRACTOR shall replace flanges that do not match the mating equipment or appurtenance at no additional cost to the OWNER. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene for water or wastewater service. Gasket material for chemicals shall be suitable for the chemical service.

2.3 FITTINGS

- A. Threaded fittings shall be in accordance with ASME B 16.3 or ASME B 16.4 for pressure pipe. Threaded fittings for gravity pipe systems shall be in accordance with ASME B 16.12.
- B. Welded fittings shall be in accordance with ASME B 16.11 or ASME B 16.9.
- C. Flanged fittings shall be in accordance with ASME B 16.1 or ASME B 16.5.
- D. Grooved fittings shall conform to AWWA C 606.

PART 3 EXECUTION

3.1 INSTALLATION

- A. For buried pipelines, excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. Above ground steel process piping shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.
- C. Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 05 45 00 – Mechanical Metal Supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.
- D. Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Low points shall be provided with a drain valve.

3.2 PIPE PREPARATION

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly

3.3 PIPE JOINTS

- A. Pipe threads shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape.
- B. Welded joints shall conform to the requirements of this Section and the recommendations of ASME B 31.1. Welding shall be done by skilled and qualified welders. Welders shall be qualified under the provisions of AWS D1.1. Machines and electrodes similar to those used in the work shall be used in qualification tests.

- C. Grooved couplings shall be installed per the manufacturer's recommendations and shall conform to AWWA C 606.

3.4 INSPECTION AND TESTING OF PIPELINE

- A. Completed steel process piping systems shall be inspected for proper supports, anchorage, and damage to pipe, fittings, and coatings. Any damage shall be repaired by the CONTRACTOR at no additional cost to the OWNER.
- B. CONTRACTOR shall provide temporary blow-off valves and fittings as required to flush and disinfect new pipelines. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.
- C. Source of Water
 - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection and/or pressure testing of the pipeline.
- D. Testing Procedure
 - 1. Prior to enclosure or burying, piping systems shall be pressure tested as required on the Drawings, for a period of not less than one hour, without exceeding the tolerances listed on the Drawings. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish test equipment, labor, materials, and devices
 - 2. Leakage shall be determined by loss of pressure, soap solution, or other positive and accurate method. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures.
 - 3. Leaks shall be repaired, and the piping shall be re-tested until no leaks are found.
 - 4. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that the ENGINEER may be present during the test.

3.5 DISINFECTING

- A. Disinfection shall be in accordance AWWA C 651 and the requirements of Section 33 13 00 - Pipeline Disinfection.

- END OF SECTION -

SECTION 40 05 13.19
STAINLESS STEEL PROCESS PIPING

PART 1 GENERAL

1.1 DESCRIPTION

- A. CONTRACTOR shall furnish and install all stainless steel process piping and appurtenances as shown and specified, and as required for a complete and workable piping system.

1.2 RELATED WORK

- A. Related work specified in other sections:
1. Section 01 33 00 Submittal Procedures
 2. Section 33 12 00 Mechanical Appurtenances

1.3 REFERENCES

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
1. ASME B 16.5 Pipe Flanges and Flanged Fittings
 2. ASME B 16.9 Factory-Made Wrought Butt Welded Fittings
 3. ASME B 16.11 Forged Fittings, Socket-Welding and Threaded
 4. ASME B 31.1 Power Piping
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM A 312 Standard Specification for Seamless, Welded, and Heavy Cold Worked Austenitic Stainless Steel Pipes
 2. ASTM A 403 Standard Specification for Wrought Austenitic Stainless Steel Piping and Fittings
 3. ASTM A 409 Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
 4. ASTM A 778 Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
- D. AMERICAN WELDING SOCIETY (AWS)
1. AWS D1.1 Structural Welding Code
- E. AMERICAN WATER WORKS ASSOCIATION (AWWA)
1. AWWA C 606 Grooved and Shouldered Joints
 2. AWWA C 651 Standard for Disinfecting Water Mains

1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's affidavit certifying product was manufactured, tested and supplied in accordance with applicable references in this section together with a report of the test results and the date each test was completed.
- C. Submit shop drawings of pipe, fittings, supports and appurtenances showing compliance with this Section including necessary dimensions, details, pipe joints and material lists.
- D. Submit gasket material data including manufacturer's catalog indicating that the proposed product is suitable for each fluid of service application.
- E. Submit welders' qualifications in accordance with AWS D1.1.

PART 2 PRODUCTS

2.1 STAINLESS STEEL PIPE

- A. Stainless steel process pipe shall be in accordance with ASTM A 312, Type 316, seamless, Schedule 40S, with screwed fittings for sizes up to and including 3-inches and welded fittings for sizes 3-inches and larger. Flange fittings may be used for pipe diameters 2-inches and larger. Stainless steel process piping 12-inches and larger shall be in accordance with ASTM A 409 or ASTM A 778, Type 316, Schedule 40S, with welded or flanged joints.

2.2 PIPE JOINTS

- A. Stainless steel pipe 3-inches and smaller shall have screwed ends with NPT threads. Screwed joints shall be up with Teflon tape. Stainless steel pipe 3-inches and larger shall have welded joints or flanges. Flanges shall have stainless steel nuts and bolts the same material type as the pipe. Where indicated on the Drawings, provide grooved ends for rigid or flexible mechanical couplings. Pipe grooving is only allowed for Schedule 40S or 80S pipe. For plain end stainless steel pipe use sleeve-type couplings where noted on the Drawings.
- B. Flanged joints shall be in accordance with ASME B16.5 for the pressure class required for the project conditions or as indicated on the Drawings. The CONTRACTOR is responsible for providing the appropriate flanges required to connect stainless steel process pipe to equipment and other appurtenances. The CONTRACTOR shall replace flanges that do not match the mating equipment or appurtenance at no additional cost to the OWNER. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene for water or wastewater service. Gasket material for chemicals shall be suitable for the chemical service.

2.3 FITTINGS

- A. Threaded fittings shall be forged stainless steel fittings in accordance with ASME B 16.11.
- B. Socket welded fittings shall be forged stainless steel fittings in accordance with ASME B 16.11.

- C. Butt-welded fittings shall be wrought stainless steel fittings in accordance with ASTM A 403 and ASME B 16.9.
- D. Flanged fittings shall be in accordance with ASME B 16.5.
- E. Grooved fittings shall be wrought stainless steel conforming to ASTM A 403 and ASME B 16.9 and to AWWA C 606. Gasket material shall be suitable for the intended service.
- F. Fittings shall be in accordance with the pressure class shown on the Drawings or have the same pressure rating as the pipe.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Stainless steel process piping shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.
- B. Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with the project drawings. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.
- C. Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Low points shall be provided with a drain valve.

3.2 PIPE PREPARATION

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly

3.3 PIPE JOINTS

- A. Pipe threads shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape.
- B. Welded joints shall conform to the requirements of this Section and the recommendations of ASME B 31.1. Welding shall be done by skilled and qualified welders. Welders shall be qualified under the provisions of AWS D1.1. Machines and electrodes similar to those used in the work shall be used in qualification tests. Field welds shall be kept to a minimum by using couplings or shop fabrication as much as possible. Weld residue, oxide, and heat stain shall be removed by stainless steel wire brushes followed by cleaning with an agent, followed by complete removal of the agent. Cleaning agent shall be **BlueOne Pickling Paste 130 by Avesta Finishing Chemicals, STAR Gel by Krystal Surface Solution**, or approved equal. Passivation must following the cleaning process

using **FinishOne Passivator 630 by Avesta Finishing Chemicals, STAR Pass 1 by Krystal Surface Solution**, or approved equal. Following the manufacturer's instruction for the cleaning/pickling and passivation process.

- C. Grooved couplings shall be installed per the manufacturer's recommendations and shall conform to AWWA C 606.

3.4 INSPECTION AND TESTING OF PIPELINE

- A. Completed stainless steel process piping systems shall be inspected for proper supports, anchorage, and damage to pipe, fittings, and coatings. Any damage shall be repaired by the CONTRACTOR at no additional cost to the OWNER.
- B. CONTRACTOR shall provide temporary blow-off valves and fittings as required to flush and disinfect new pipelines. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.
- C. Source of Water
 - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection and/or pressure testing of the pipeline.
- D. Testing Procedure
 - 1. Prior to enclosure or burying, piping systems shall be pressure tested as required on the Drawings, for a period of not less than one hour, without exceeding the tolerances listed on the Drawings. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish test equipment, labor, materials, and devices
 - 2. Leakage shall be determined by loss of pressure, soap solution, or other positive and accurate method. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures.
 - 3. Leaks shall be repaired, and the piping shall be re-tested until no leaks are found.
 - 4. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that the ENGINEER may be present during the test.

3.5 DISINFECTING

- A. Disinfection shall be in accordance AWWA C 651 and the requirements of Section 33 13 00 - Pipeline Disinfection.

- END OF SECTION -

SECTION 40 91 23
MISCELLANEOUS PROPERTIES MEASUREMENT DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers the work necessary to install a ready to use and tested process and analysis system. CONTRACTOR shall provide all components required for a complete and functional system.

1.2 RELATED WORK

- A. Related work in other sections includes but is not limited to:
 - 1. Section 01 33 00 Submittal Procedures

1.3 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit catalog cuts on all process equipment including: switches, meters, sensors, or other items shown on Drawings referencing each item by mark number. Information shall indicate manufacturer specification compliance and dimensional data.
- C. Contractor shall supply operation and maintenance manuals for all process equipment.

1.4 WARRANTY

- A. Manufacturer shall provide to Owner written guarantee against defects in material or workmanship for a period of one (1) year.

1.5 DELIVERY AND STORAGE

- A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants. Each system shall be factory calibrated and certified prior to delivery.

1.6 MEASUREMENT AND PAYMENT

- A. There shall be no separate measurement and payment for any systems. Full compensation for the system shall be considered as included in the contract unit or lump sum bid prices for the various items of the contract to which it relates.

1.7 QUALITY ASSURANCE

- A. Equipment to be furnished under this section shall be the product of manufacturers regularly engaged in the design and manufacturing of this type of equipment. The manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving CONTRACTOR from responsibility for the proper installation and functionality of the work.

PART 2 PRODUCTS

2.1 GENERAL

- A. Each process measurement system shall typically consist of a sensor and analyzer/transmitter. Where shown on the Drawings, the analyzer/transmitter may be utilized for multiple sensors. When an analyzer/transmitter is used for multiple sensors, it shall be capable of displaying simultaneously each process measurement.
- B. Each analyzer/transmitter shall be equipped with a means to transmit process measurement data to the plant SCADA system.
 - 1. For hardwired signals, unless indicated otherwise on Drawings, provide the following:
 - a. 4-20 mA output signals for each process measurement (for up to 500 Ohm loads).
 - b. Two programmable SPDT relay outputs, rated at 5A up to 230 VAC, for each process measurement.
 - 2. Where shown on the Drawings, provide the following digital communications to the plant SCADA system:
 - a. HART Protocol
 - b. PROFIBUS
 - c. MODBUS
- C. Each analyzer/transmitter shall be powered by 115VAC (+/- 10%) at 60 Hz unless shown on Drawings as being powered by 24 VDC (+/- 15%). Each analyzer/transmitter shall retain its programmable settings in non-volatile memory.
- D. Each sensor and corresponding analyzer/transmitter shall be supplied as a complete and operable system. This includes all cabling, mounting hardware and fasteners. When installed outdoors, the analyzer/transmitter shall be protected from the sun such that direct sunlight will not shine on the display.
- E. All analyzers/transmitters shall be waterproof and made from corrosion resistant materials.
- F. All sensors to be immersed in liquids shall be rated for permanent submersion and shall be corrosion resistant.

2.2 MAGNETIC FLOW METERS

- A. Magnetic flow meters shall be the low the low frequency induction type which produces a DC pulsed signal directly proportional to and linear with the flow rate. Liners shall be polyurethane. Flow meters shall be rated at 250 psi. Standard output shall be an analog 4-20 mA signal with a local indication from a liquid crystal display (LCD) reading in gallons per minute flow. The meter shall also have a totalizer (with pulsed output), and non-full pipe detection. Meters shall have a minimum of 2 self-cleaning electrodes. CONTRACTOR shall field verify length of cable for connection.
- B. Flanged connections shall be constructed of Type 304 or Type 316 stainless steel with pressure ratings to match the connecting pipe.

- C. Liner shall be polyurethane or PTFE and electrodes stainless steel suitable for potable water service. Liners and electrodes for service other than potable water shall be constructed of materials conforming to the manufacturer's recommendation for the intended service.
- D. Meter housing shall be rated for NEMA 6 for submersible operation.
- E. Meters shall include grounding rings.
- F. The sensor shall house four measuring electrodes (1"-2.5") and six measuring electrodes (3"-120"), plus a grounding electrode, and one empty pipe detection electrode with no exceptions. The electrodes shall be bullet-nosed shaped and made of 316L SS, Alloy C22, or Tantalum (listed by the application and instrument schedule).
- G. The transmitter shall have six digit LCD displays for flow rate, percent of span, and totalization; be capable of measuring flow in both directions; automatic range change; capability to convert DC pulse signal from the tube to a standardized 4 to 20 mA DC signal into a minimum of 700 ohms; self-diagnostics and automatic data checking, and a scaleable frequency output, 0 to 100 Hz.
- H. The flow measuring system shall conform to the following:
 1. Time constant: 0.5 to 1000 seconds; galvanic or optic isolation
 2. Accuracy: 0.50 percent of flow rate from 10 to 100 percent full scale velocities over 3 feet per second.
 3. Repeatability: 0.25 percent of full scale
 4. Power consumption: 30 watts or less
 5. Power requirements: 120 VAC, plus or minus 10 percent
- I. Magnetic flow meters shall be **Proline Promag W400 by Endress+Hauser** or approved equal.

2.3 PRESSURE SWITCH

- A. A high pressure cutoff switch shall be installed as shown on Drawings, and shall be as specified in the Electrical Drawings. The switch setting shall be adjustable as specified on the drawings. The switch shall be rated for the pressure of the system where it is installed with a safety factor of 1.5.

2.4 PRESSURE TRANSMITTER

- A. The pressure transmitter shall be an electronic pressure transducer tailored to the installation as shown on the drawings and suitable for the planned application. The system shall include a pressure transducer with integral diaphragm seal. The pressure transmitter shall operate on 24 VDC, and shall provide a 4-20 mA DC signal to the RTU panel. The loop signal shall measure the water pressure and have a 4-20 mA signal output. The pressure transmitter shall have a LCD display showing the pressure in "psi". The pressure transmitter shall be coded "DW" for NSF drinking water certification. Pressure transmitters shall be Rosemount Series 3051, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All equipment shall be mounted and installed as per manufacturer recommendations. Coordinate final location with ENGINEER.

3.2 TESTING

- A. After installation of the equipment is complete, operating tests shall be carried out to assure that the equipment operates properly. All piping shall be tested hydrostatically and for leaks. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

3.3 METER CALIBRATION

- A. Meters shall be field calibrated to verify proper operation within the expected flow ranges for the project.

- END OF SECTION -

PART IV

APPENDICES



**GEOTECHNICAL INVESTIGATION
PROPOSED WELL PUMP HOUSE
RON WOOD PARK WELL
8600 SOUTH AND DUCK RIDGE WAY
WEST JORDAN, UTAH**

PREPARED FOR:

**HANSEN ALLEN AND LUCE
859 WEST SOUTH JORDAN PARKWAY, #200
SOUTH JORDAN, UTAH 84095**

ATTENTION: MARK ATENCIO

PROJECT NO. 1200102

APRIL 23, 2020

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APPENDIX

LEAD AND ARSENIC TEST RESULTS

EXECUTIVE SUMMARY

1. Subsurface soils encountered in the test pits consist of approximately 1 foot of fill overlying lean clay. Gravel and sand were encountered below the clay at depths of approximately 11 and 10 feet below the ground surface in Test Pits TP-1 and TP-2, respectively. The gravel and sand are approximately 2 feet thick and underlain by lean clay extending the full depth investigated, approximately 14 feet.
2. No subsurface water was encountered in the test pits at the time of excavating.
3. The upper clay is moisture sensitive where it collapses and becomes more compressible when wetted. The proposed building may be supported on spread footings bearing on the undisturbed natural sand or gravel below the moisture-sensitive soil or on compacted structural fill that extends down to the undisturbed natural sand or gravel. The sand and gravel were encountered at depths of approximately 10 to 11 feet in the test pits.
4. Spread footings bearing on the undisturbed natural soil below the moisture-sensitive soil or on compacted structural fill extending down to the undisturbed natural sand or gravel may be designed using an allowable net bearing pressure of 2,000 psf. Spread footings bearing on at least 2 feet of compacted structural fill meeting the imported structural fill criteria given for footing support may be designed for an allowable net bearing pressure of 3,500 psf.
5. The upper soil consists of clay and will be easily disturbed by construction equipment when it is very moist to wet. Placement of approximately 1 to 2 feet of granular borrow consisting predominantly of gravel with less than 15 percent passing the No. 200 sieve may be needed to provide access for rubber-tired equipment and to facilitate pavement construction when the subgrade is very moist to wet. Consideration may be given to placing a support fabric above the subgrade prior to placing granular borrow.
6. Geotechnical information related to foundations, subgrade preparation and materials is included in the report.

SCOPE

This report presents the results of a geotechnical investigation for the proposed well pump house for the Ron Wood Park well at 8600 South and Duck Ridge Way in West Jordan, Utah. The report presents the subsurface conditions encountered, laboratory test results and recommendations for foundations and pavement. The study was conducted in general accordance with our proposal dated February 12, 2020.

Field exploration was conducted to obtain information on the subsurface conditions. Samples obtained from the field investigation were tested in the laboratory to determine physical and engineering characteristics of the on-site soil. Information obtained from the field and laboratory was used to define conditions at the site for our engineering analysis and to develop recommendations for the proposed foundations and pavement.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to construction are included in the report.

SITE CONDITIONS

The site consists of an undeveloped field. A well has been installed at the site.

The site is relatively flat with a gentle slope down to the east. The north end of the site along 8600 South Street appears to have been raised with about 1 to 2 feet of fill.

There is some gravel on the surface of the site. Vegetation consists of sparse grass and weeds.

There are undeveloped fields to the south and east and a park in the distance to the southeast. There are homes to the north and west.

FIELD STUDY

The field study was conducted on April 8, 2020. Two test pits were excavated at the approximate locations indicated on Figure 1. The test pits were excavated with a rubber-tired backhoe. The test pits were logged and soil samples obtained by an engineer from AGECE. Logs of the subsurface conditions encountered in the test pits are presented on Figure 2.

The test pits were backfilled without significant compaction. The backfill in the test pits should be removed and replaced with properly compacted fill where the backfill will support proposed buildings, slabs or pavement.

SUBSURFACE CONDITIONS

Subsurface soils encountered in the test pits consist of approximately 1 foot of fill overlying lean clay. Gravel and sand were encountered below the clay at depths of approximately 11 and 10 feet below the ground surface in Test Pits TP-1 and TP-2, respectively. The gravel and sand are approximately 2 feet thick and underlain by lean clay extending the full depth investigated, approximately 14 feet.

A description of the soils encountered in the test pits follows:

Fill - The fill consists of lean clay with sand and occasional gravel. It is moist to very moist, brown and contains roots.

Lean Clay - The clay contains small to moderate amounts of sand and occasional silty sand layers. It is soft to stiff, very moist and brown to grayish brown.

Laboratory tests conducted on samples of the clay indicate it has natural moisture contents ranging from 20 to 30 percent and natural dry densities of 77 to 88 pounds per cubic foot (pcf). Consolidation tests conducted on samples of the clay indicate that the soil is moisture sensitive where it collapses and becomes more compressible when wetted. Results of the consolidation tests are presented on Figures 3 and 4.

Poorly-graded Sand with Silt and Gravel - The sand is medium dense, moist and brown with black and orange staining.

Poorly-graded Gravel with Silt and Sand - The gravel is medium dense, moist and brown.

Results of the laboratory tests are summarized on Table I and are included on the test pit logs.

SUBSURFACE WATER

No subsurface water was encountered in the test pits to the maximum depth investigated, approximately 14 feet.

PROPOSED CONSTRUCTION

We understand that the proposed pump house will consist of a single-story, masonry structure with a slab-on-grade floor.

We have assumed building loads consisting of wall loads up to 4 kips per lineal foot.

We anticipate that pavement may be constructed in the areas surrounding the building. We have assumed traffic for the pavement consisting predominantly of car traffic with occasional trucks such as maintenance vehicles.

If the proposed construction, building loads or traffic is significantly different from what is described above, we should be notified so that we can reevaluate the recommendations given.

RECOMMENDATIONS

Based on the subsoil conditions encountered, laboratory test results and the proposed construction, the following recommendations are given:

A. Site Grading

We anticipate that there will be relatively small amounts of cut and fill for site grading. We have assumed that the grade in the building area will be within approximately 3 feet of the existing grade.

1. Subgrade Preparation

Unsuitable fill, topsoil, organics, debris and other deleterious material should be removed from the area of the proposed building and other improvements sensitive to differential settlement.

The upper soil consists of clay and will be easily disturbed by construction equipment when it is very moist to wet. Placement of approximately 1 to 2 feet of granular borrow consisting predominantly of gravel with less than

15 percent passing the No. 200 sieve may be needed to provide access for rubber-tired equipment and to facilitate pavement construction when the subgrade is very moist to wet. Consideration may be given to placing a support fabric above the subgrade prior to placing granular borrow.

2. Excavation

Excavation at the site can be accomplished with typical excavation equipment.

3. Compaction

Compaction of materials placed at the site should equal or exceed the minimum densities as indicated below when compared to the maximum dry density as determined by ASTM D 1557.

Fill To Support	Compaction
Foundations	≥ 95%
Concrete Flatwork	≥ 90%
Pavement	
Base Course	≥ 95%
Fill Placed Below Base Course	≥ 90%
Landscaping	≥ 85%
Retaining Wall Backfill	85 - 90%

To facilitate the compaction process, the fill should be compacted at a moisture content within 2 percent of the optimum moisture content.

Fill and pavement materials placed for the project should be frequently tested for compaction.

4. Materials

Listed below are materials recommended for imported structural fill.

Fill to Support	Recommendations
Footings	Non-expansive granular soil Passing No. 200 Sieve < 35% Liquid Limit < 30% Maximum size 4 inches
Floor Slab (Upper 4 inches)	Sand and/or Gravel Passing No. 200 Sieve < 5% Maximum size 2 inches
Slab Support	Non-expansive granular soil Passing No. 200 Sieve < 50% Liquid Limit < 30% Maximum size 6 inches

The on-site soil, which is predominantly clay, may be considered for use as site grading fill below pavement areas or as utility trench or wall backfill, if the topsoil, organics, debris and other deleterious materials are removed or it may be used in landscape areas.

Consideration may be given to using the on-site soil as fill below the proposed building if its placement is observed and compaction tested on a full-time basis by a representative of AGECE. Organics, debris and other deleterious materials should be removed. The moisture of the clay should be adjusted to within 2 percent of optimum. Drying of the soil may not be practical during cold or wet periods of the year. Thus, use of clay as fill below the building may not be practical during such times. The clay should be placed in lifts thin enough to allow for proper compaction.

5. Drainage

The ground surface surrounding the proposed building should be sloped away from the building in all directions. Roof downspouts and drains should discharge beyond the limits of backfill.

The collection and diversion of drainage away from the pavement surface is important to the satisfactory performance of the pavement section. Proper drainage should be provided.

B. Foundations

1. Bearing Material

The upper clay is moisture sensitive where it collapses and becomes more compressible when wetted. The proposed building may be supported on spread footings bearing on the undisturbed natural sand or gravel below the moisture-sensitive soil or on compacted structural fill that extends down to the undisturbed natural sand or gravel. The sand and gravel were encountered at depths of approximately 10 to 11 feet in the test pits. If structural fill is placed below footings, the structural fill should extend out away from the edge of the footings a distance at least equal to the depth of fill beneath footings.

Topsoil, unsuitable fill, debris and other deleterious materials should be removed from below proposed foundations.

2. Bearing Pressure

Spread footings bearing on the undisturbed natural soil below the moisture-sensitive soil or on compacted structural fill extending down to the undisturbed natural sand or gravel may be designed using an allowable net bearing pressure of 2,000 psf. Spread footings bearing on at least 2 feet of compacted structural fill meeting the imported structural fill criteria given for footing support may be designed for an allowable net bearing pressure of 3,500 psf. Footings should have a width of at least 2 feet and a depth of embedment of at least 1 foot.

3. Temporary Loading Conditions

The allowable bearing pressure may be increased by one-half for temporary loading conditions such as wind or seismic loads.

4. Settlement

Based on the subsurface soil conditions encountered and the assumed building loads, we estimate that total and differential settlement will be less than ½ inch for foundations designed as indicated above.

Care will be required to not disturb the natural soil at the base of foundation excavations to maintain settlement within tolerable limits.

5. Frost Depth

Exterior footings and footings beneath unheated areas should be placed at least 30 inches below grade for frost protection.

6. Foundation Base

The base of all footing excavations should be cleared of loose or deleterious material prior to structural fill or concrete placement.

7. Construction Observation

A representative of the geotechnical engineer should observe footing excavations prior to structural fill or concrete placement.

C. Concrete Slab-on-Grade

1. Slab Support

Concrete slabs may be supported on the undisturbed non-moisture-sensitive natural soil or on compacted structural fill extending down to the non-moisture-sensitive undisturbed natural soil. Topsoil, moisture-sensitive soil, unsuitable fill, organics and other deleterious materials should be removed from below proposed floor slabs.

2. Underslab Sand and/or Gravel

A 4-inch layer of free draining sand and/or gravel (less than 5 percent passing the No. 200 sieve) should be placed below the concrete slabs for ease of construction and to promote even curing of the slab concrete.

D. Lateral Earth Pressures

1. Lateral Resistance for Footings

Lateral resistance for footings placed on the undisturbed, natural soil or on compacted structural fill is controlled by sliding resistance between the footing and the foundation soils. A friction value of 0.35 may be used in design for ultimate lateral resistance.

2. Subgrade Walls and Retaining Structures

The following equivalent fluid weights are given for design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move. The values listed below assume a horizontal surface adjacent the wall.

Soil Type	Active	At-Rest	Passive
Clay & Silt	50 pcf	65 pcf	250 pcf
Sand & Gravel	40 pcf	55 pcf	300 pcf

3. Seismic Conditions

Under seismic conditions, the equivalent fluid weight should be increased by 29 pcf and 14 pcf for active and at-rest conditions, respectively, and decreased by 29 pcf for the passive condition. This assumes a peak horizontal ground acceleration of 0.49g for a 2 percent probability of exceedance in a 50-year period.

4. Safety Factors

The values recommended above assume mobilization of the soil to achieve the assumed soil strength. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

E. Seismicity, Faulting and Liquefaction

1. Seismicity

Listed below is a summary of the site parameters that may be used with the 2018 International Building Code.

Description	Value ¹
Site Class	D ²
S _s - MCE _R ground motion (period = 0.2s)	0.94g
S ₁ - MCE _R ground motion (period = 1.0s)	0.33g
F _a - Site amplification factor at 0.2s	1.13
F _v - Site amplification factor at 1.0s	1.97
PGA - MCE _G peak ground acceleration	0.41g
PGA _M - Site modified peak ground acceleration	0.49g

¹Values obtained from information provided by the Applied Technology Council at <https://hazards.atcouncil.org>

²Site Class D was determined based on the subsurface conditions encountered at the site to the depth investigated and our understanding of geologic conditions.

2. Faulting

The closest mapped active fault to the site is the Granger fault located approximately 6.3 miles to the northeast (Utah Geological Survey, 2020).

3. Liquefaction

The site is located within an area mapped as having a "very low" potential for liquefaction (Salt Lake County, 2002).

Based on the liquefaction hazard map and our understanding of the geologic conditions in the area, liquefaction is not a hazard at this site.

F. Water Soluble Sulfates

One sample of the natural soil was tested in the laboratory for water soluble sulfate content. The test results indicate there is less than 0.1 percent water soluble sulfate in the sample tested. Based on the results of the test and published literature, the natural soil possesses negligible sulfate attack potential on concrete. The concentration of water soluble sulfates present in the soil at the site indicates that sulfate resistant cement is not needed for concrete placed in contact with the natural soil. Other conditions may dictate the type of cement to be used in concrete for the project.

G. Corrosion

One sample of the clay was tested for the following parameters:

Parameter	Value
Resistivity	910 ohm-cm
pH	9.4
Redox	409 mV
Sulfides	0.923 mg/kg-dry

The above information should be considered in selecting the appropriate level of corrosion protection for metal placed in contact with the soil.

H. Lead and Arsenic Testing

Soil samples from Test Pit TP-1 at depths of ½, 1 and 1½ feet were submitted to Western Analytical Laboratories for lead and arsenic tests. The results of the tests are included in the appendix.

I. Pavement

Based on the subsoil conditions encountered, laboratory test results and the assumed traffic as indicated in the Proposed Construction section of the report, the following recommendations are given:

1. Subgrade Support

The near surface soil consists of lean clay. We have assumed a California Bearing Ratio (CBR) value of 3 percent which represents a clay subgrade.

2. Pavement Thickness

Based on the subsoil conditions, assumed traffic, a design life of 20 years for flexible pavement and 30 years for rigid pavement and methods presented by AASHTO, a pavement section consisting of 3 inches of asphaltic concrete overlying 6 inches of base course is calculated. Alternatively, a rigid pavement section consisting of 5 inches of Portland cement concrete placed on a prepared subgrade may be considered.

Approximately 1 to 2 feet of granular borrow may be needed for construction equipment access and to facilitate pavement construction when the subgrade is very moist to wet clay.

3. Pavement Materials and Construction

a. Flexible Pavement (Asphaltic Concrete)

The pavement materials should meet the specifications for the applicable jurisdiction. The use of other materials may result in the need for different pavement material thicknesses.

b. Rigid Pavement (Portland Cement Concrete)

The pavement thickness assumes that the pavement will have aggregate interlock joints and that a concrete shoulder or curb will be provided.

Pavement materials should meet the specifications for the applicable jurisdiction. The pavement thickness indicated above assumes that the concrete will have a 28-day compressive strength of 5,000 pounds per square inch. Concrete should be air entrained with approximately 6 percent air. Maximum allowable slump will depend on the method of placement but should not exceed 4 inches.

4. Jointing

Joints for concrete pavement should be laid out in a square or rectangular pattern. Joint spacings should not exceed 30 times the thickness of the slab. The joint spacings indicated should accommodate the contraction of the concrete and under these conditions steel reinforcing will not be required. The depth of joints should be approximately one-fourth of the slab thickness.

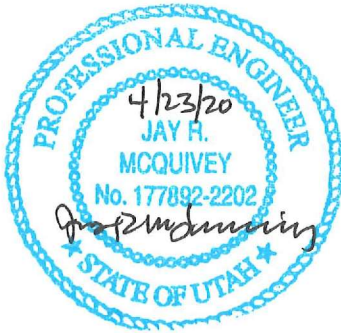
J. Preconstruction Meeting

A preconstruction meeting should be held with representatives of the owner, project architect, geotechnical engineer, general contractor, earthwork contractor and other design team members to view construction plans, specifications, methods and schedule.

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the test pits excavated at the approximate location indicated on Figure 1 and the data obtained from laboratory testing. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface conditions or groundwater level is found to be significantly different from what is described above, we should be notified to reevaluate the recommendations given.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Jay R. McQuivey, P.E.


Reviewed by Douglas R. Hawkes, P.E.

JRM/bw

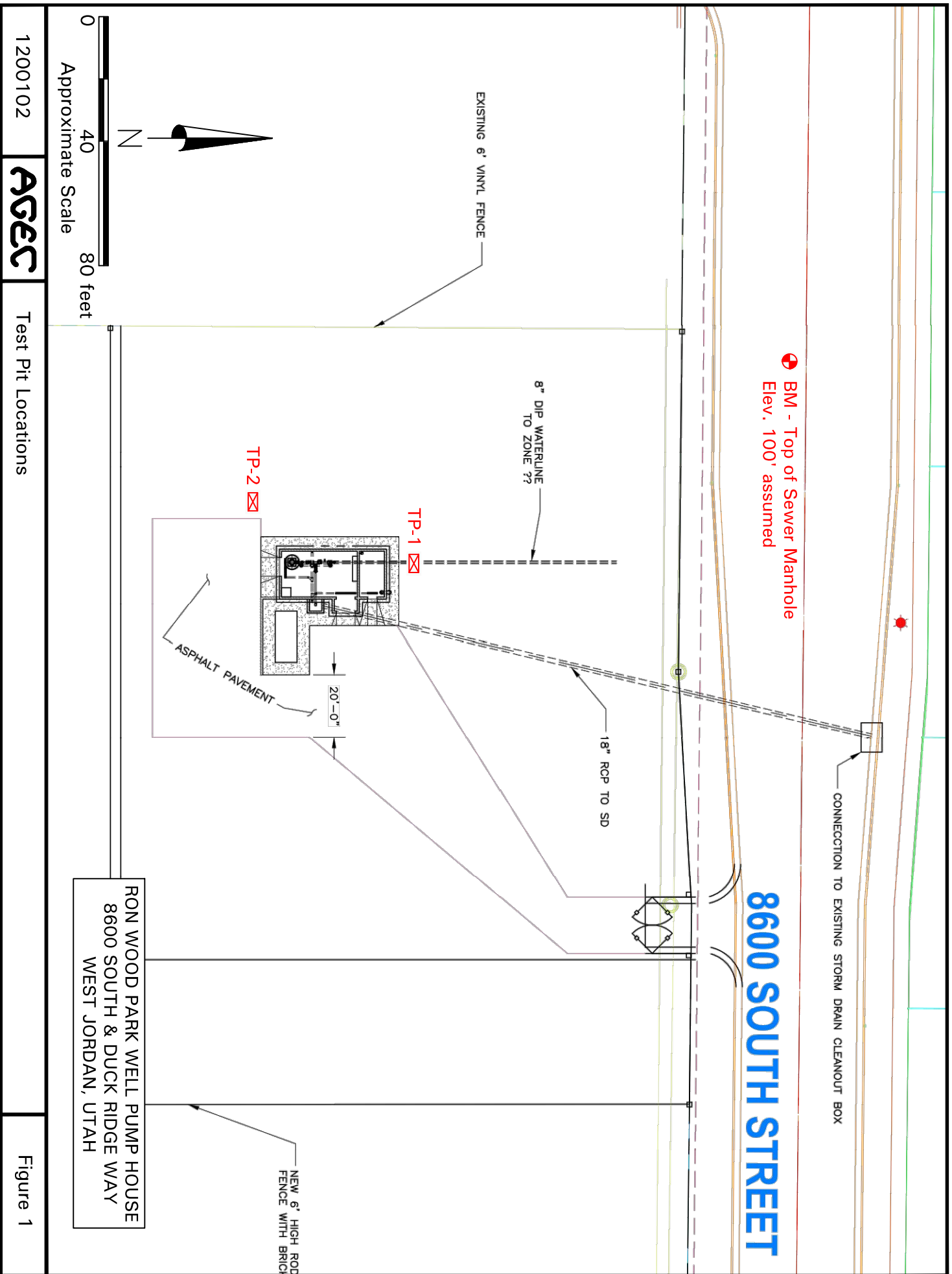
REFERENCES

American Society of Civil Engineers, 2017; Minimum design loads and associated criteria for buildings and other structures: ASCE/SEI 7-16, Reston, Virginia.

International Code Council, 2017; 2018 International Building Code, Falls Church, Virginia.

Salt Lake County, 2002; Surface Rupture and Liquefaction Potential Special Study Areas Map, Salt Lake County, Utah, adopted March 31, 1989, revised March 2002, Salt Lake County Public Works - Planning Division, 2001 South State Street, Salt Lake City, Utah.

Utah Geological Survey, 2020; Utah Quaternary Fault and Fold Database, <http://geology.utah.gov/resources/data-databases/qfaults/> Accessed April 13, 2020.



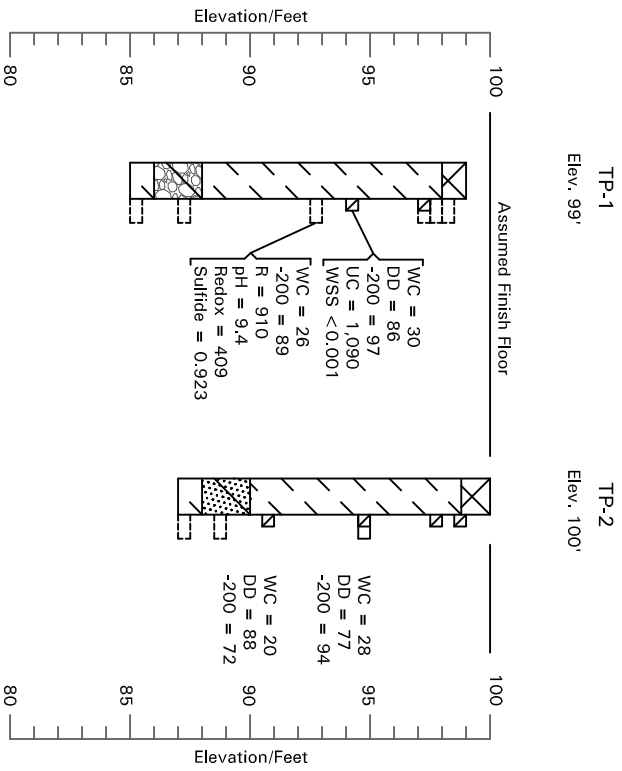
1200102

ASSEC

Test Pit Locations

Figure 1

RON WOOD PARK WELL PUMP HOUSE
 8600 SOUTH & DUCK RIDGE WAY
 WEST JORDAN, UTAH



LEGEND:

- Fill; lean clay with sand, occasional gravel, moist to very moist, brown, roots.
- Lean Clay (CL); small to moderate amount of sand, occasional silty sand layers, soft to stiff, very moist, brown to grayish brown.
- Poorly-graded Sand with Silt and Gravel (SP-SM); medium dense, moist, brown with black and orange staining.
- Poorly-graded Gravel with Silt and Sand (GP-GM); medium dense, moist, brown.

- Indicates relatively undisturbed hand drive sample taken.
- Indicates disturbed sample taken.
- Indicates relatively undisturbed block sample taken.

NOTES:

1. The test pits were excavated on April 8, 2020 with a rubber-tired backhoe.
2. The locations of the test pits were measured by pacing from features shown on the site plan provided.
3. The elevations of the test pits were measured by automatic level and refer to the benchmark shown on Figure 1.
4. The test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between materials shown on the test pit logs represent the approximate boundaries between materials and the transitions may be gradual.
6. No free water was encountered in the test pits at the time of excavation.
7. WC = Water Content (%);
 DD = Dry Density (pcf);
 -200 = Percent Passing the No. 200 Sieve;
 UC = Unconfined Compressive Strength (psf);
 WSS = Water Soluble Sulfates (%);
 R = Resistivity (ohm-cm);
 pH = pH;
 Redox = Redox Potential (mV);
 Sulfide = Sulfides (mg/kg-dry).

Approximate Vertical Scale 1" = 8'

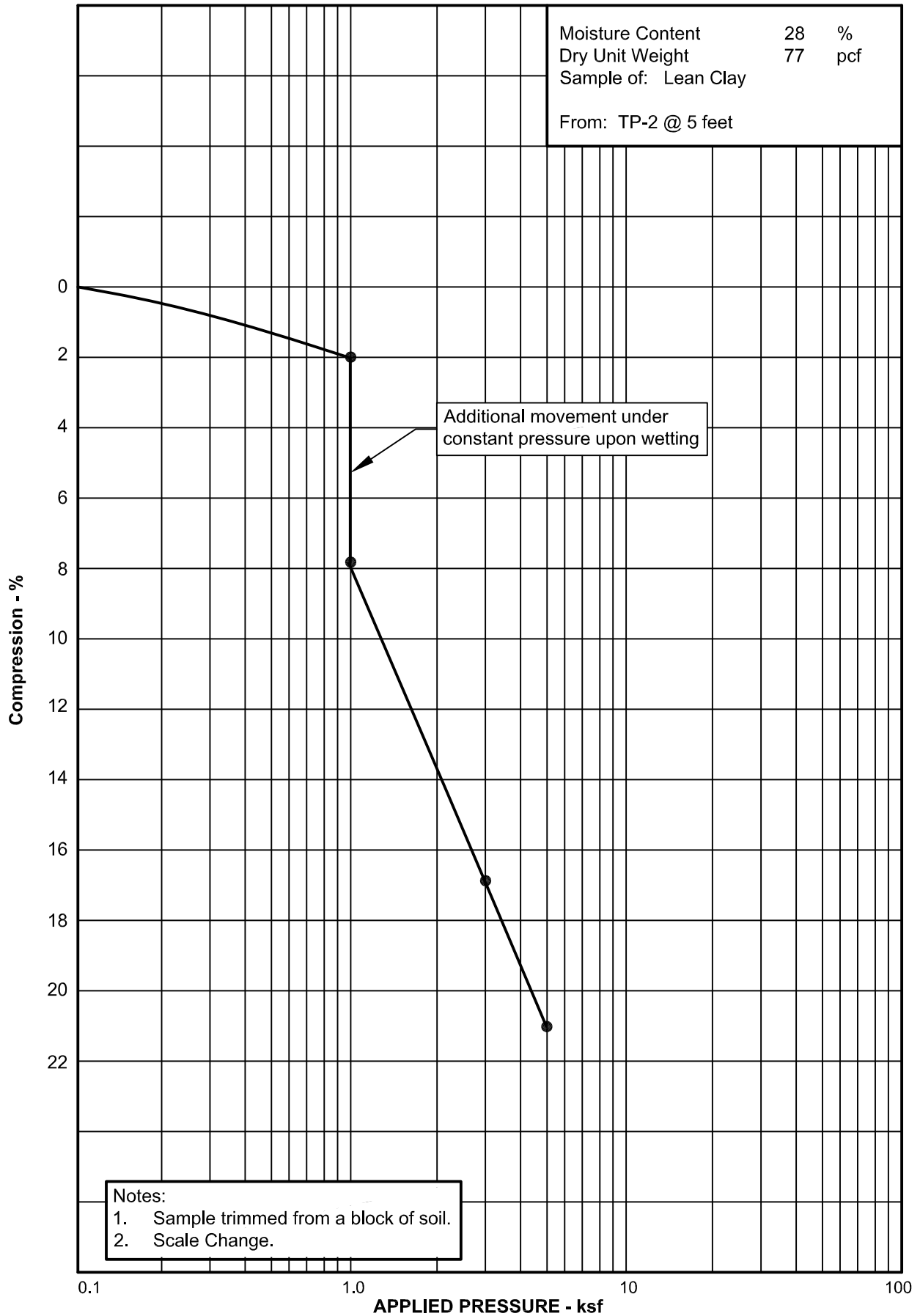
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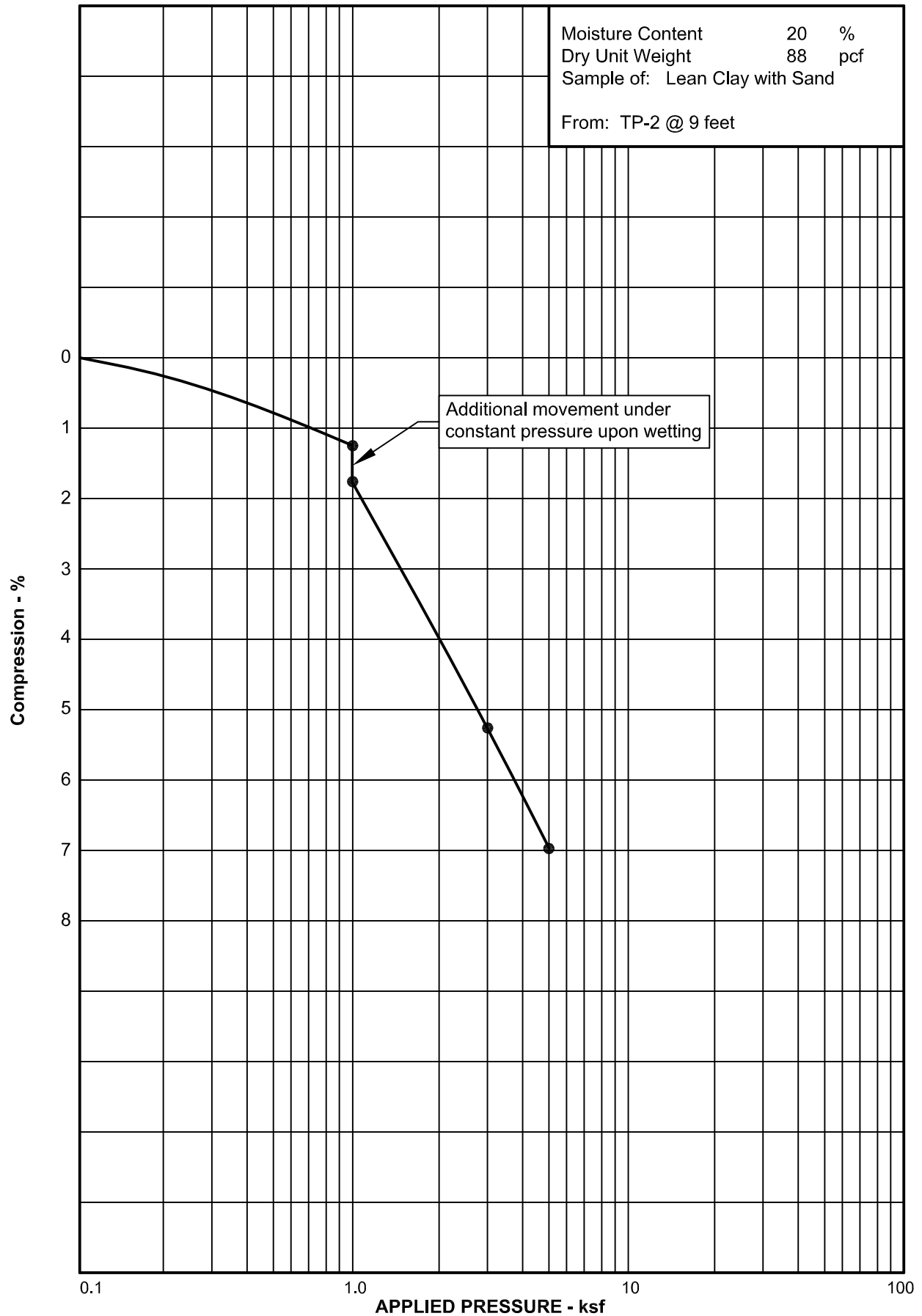
Test Pit Logs, Legend and Notes

Figure 2

Applied Geotechnical Engineering Consultants, Inc.



Applied Geotechnical Engineering Consultants, Inc.



APPENDIX

Lead and Arsenic Test Results



INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical **Contact:** Katrina Black
Project: Ronwood Park Well / 1200102
Lab Sample ID: 2004277-001
Client Sample ID: TP-1 @ 1/2
Collection Date:
Received Date: 4/9/2020 1646h

Analytical Results

TOTAL METALS

3440 South 700 West
Salt Lake City, UT 84119

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	4/14/2020 1145h	4/15/2020 1755h	SW6020B	0.612	19.3	
Lead	mg/kg-dry	4/14/2020 1145h	4/15/2020 1755h	SW6020B	3.67	42.4	

The date collected and expiration status of the sample is unknown as this information was not provided by the client.

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Kyle F. Gross
Laboratory Director

Jose Rocha
QA Officer



INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical **Contact:** Katrina Black
Project: Ronwood Park Well / 1200102
Lab Sample ID: 2004277-002
Client Sample ID: TP-1 @ 1
Collection Date:
Received Date: 4/9/2020 1646h

Analytical Results

TOTAL METALS

3440 South 700 West
Salt Lake City, UT 84119

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	4/14/2020 1145h	4/15/2020 1759h	SW6020B	0.624	13.6	
Lead	mg/kg-dry	4/14/2020 1145h	4/15/2020 1759h	SW6020B	3.74	18.0	

The date collected and expiration status of the sample is unknown as this information was not provided by the client.

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INORGANIC ANALYTICAL REPORT

Client: Applied Geotechnical **Contact:** Katrina Black
Project: Ronwood Park Well / 1200102
Lab Sample ID: 2004277-003
Client Sample ID: TP-1 @ 1 1/2
Collection Date:
Received Date: 4/9/2020 1646h

Analytical Results

TOTAL METALS

Compound	Units	Date Prepared	Date Analyzed	Method Used	Reporting Limit	Analytical Result	Qual
Arsenic	mg/kg-dry	4/14/2020 1145h	4/15/2020 1803h	SW6020B	0.640	14.7	
Lead	mg/kg-dry	4/14/2020 1145h	4/15/2020 1803h	SW6020B	3.84	18.2	

The date collected and expiration status of the sample is unknown as this information was not provided by the client.

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Salt Lake City, UT 84119

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