

**SPECIFICATIONS  
FOR  
ROUTE 66 INDUSTRIAL PARK – SITE DEVELOPMENT**

**Volume 4  
PERMIT SPECIFICATIONS**

**BID NO. COS \_\_\_\_\_**



**Department of Public Works  
425 East Dewey  
Sapulpa, Oklahoma 74067  
(918) 224-3040**

**CONSTRUCTION DOCUMENTS  
PREPARED BY:**

**Keithline Engineering Group  
8556 East 101<sup>st</sup> Street, Suite C  
Tulsa, Oklahoma 74133  
918.369.7911**

**JANUARY 2026**

# TABLE OF CONTENTS

## VOLUME 3 SPECIFICATIONS

001100 - Table of Contents

### GENERAL SPECIFICATIONS

SAPULPA GENERAL SPECIFICATIONS – DIVISION 1

SAPULPA MATERIAL SPECIFICATIONS – DIVISION 2

SAPULPA CONSTRUCTION SPECIFICATIONS – DIVISION 3

### SPECIAL SPECIFICATIONS

#### DIVISION 1 – GENERAL REQUIREMENTS

- 01 11 00 – Special Specifications
- 01 11 00 – Summary of Work
- 01 31 00 - Coordination and Meetings
- 01 32 50 – Progress Schedule
- 01 33 00 - Submittals
- 01 42 00 - References
- 01 45 00 - Quality Control
- 01 50 00 - Construction Facilities
- 01 71 00 - Lines and Grades
- 01 73 20 – Cutting and Patching
- 01 74 00 - Cleaning
- 01 78 90 - Contract Closeout
- 02 23 10 – Clearing and Grubbing

#### DIVISION 3 – CONCRETE

- 03 10 00 – Concrete Formwork
- 03 20 00 – Concrete Reinforcement
- 03 30 00 - Cast-in-Place Concrete

#### DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

- 46 00 01 – Duplex Lift Station

### EXTERNAL REFERENCES – SEE CONSTRUCTION PLANS TITLE SHEET

# **GENERAL SAPULPA SPECIFICATIONS**

**City of Sapulpa, Public Works Department, General Specifications are incorporated herein as if fully set forth and are on file with the Public Works Department**

## **DIVISION I**

### **GENERAL SPECIFICATIONS**

#### **PART 101 SCOPE AND LOCATION**

- 101.1 The location of the project is in or near the City of Sapulpa, Oklahoma, hereafter referred to as "The City". The character and exact location of the project are shown on the Drawings on file in the office of the City Auditor. Said Drawings clearly show the general work involved, but are not intended to show all details of the work.
- 101.2 The site and/or rights-of-way upon which the work is to be performed is shown on the Drawings. The Contractor agrees that the site and/or rights-of-way provided is adequate for the performance of the work. If any additional working area is required, the Contractor shall, at his expense, make arrangements for such working area. The City will not be liable for additional compensation as a result of any delay in obtaining rights-of-way.

#### **PART 102 SCOPE, NATURE, AND INTENT OF SPECIFICATIONS AND DRAWINGS**

- 102.1 The Specifications and Drawings are intended to supplement, but not necessarily duplicate each other; and together constitute one complete set of Specifications and Drawings, so that any work exhibited in the one and not in the other shall be executed just as if it had been set forth in both, in order that the work shall be completed according to the complete design or designs as decided and determined by the Engineer.
- 102.2 The Drawings are not intended to be scaled for dimensions, and if dimensions not shown on the Drawings are required, the Contractor shall request them from the Engineer. Where existing utility lines or other sub-surface obstructions are shown on the Drawings, the same have been located as nearly as practicable from information furnished by owners of such, and from such surface indications as may exist at the work site. Such obstructions are shown for the purpose of advising the Contractor that they may interfere with the work to be done hereunder, but not for the purpose of indicating that the work can be performed without such interference.
- 102.3 Where soundings are shown on the drawings, the depths are determined by driving a drill rod, using the churn method with water lubrication, to a maximum depth of nine feet or to refusal, whichever is lesser in depth. By showing soundings on the drawings, the City represents only that material of hardness and character which could be penetrated by a drill rod found above the depth of sounding as shown at the point where the drill rod was driven.
- 102.4 Where exploratory drilling is indicated to have been performed on the plans, boring logs will be available for review at the office of the Engineer. The logs will be furnished for information purposes only, and are not to be construed as a true representation of actual subsurface conditions.

- 102.5 Should anything be omitted from the Specifications and Drawings which is necessary to a clear understanding of the work, or should it appear various instructions are in conflict, the Contractor shall request written instructions from the Engineer before proceeding with the construction affected by such omissions or discrepancies.
- 102.6 The Contractor's responsibility for construction covered by conflicting requirements, not provided for by addendums prior to the time of opening bids for the work represented thereby, shall not extend beyond the construction in conformity with the cheaper of the said conflicting requirements. Any increase in cost of work requested to be done in excess of the cheaper of the conflicting requirements will be paid for as Extra Work as provided for herein.

### **PART 103 - LINES AND GRADES**

- 103.1 All work done under this Contract shall be done to the lines, grades, and elevations shown on the Drawings. All lines and grades shall be furnished by the Engineer, but the Contractor shall provide all batterboards, straight edges, and other materials for lines, levels, and measurements; and shall set all batterboards under direction of the Engineer. The Contractor shall give the Engineer at least forty-eight (48) hours notice as to the location where stakes are required.

### **PART 104 - SATURDAY, SUNDAY, HOLIDAY AND NIGHT WORK**

- 104.1 No work shall be done between the hours of 6:00 p.m. and 8:00 a.m., nor on Saturday, Sunday, or legal holidays without the written approval or permission of the Engineer in each case, except such work as may be necessary for the proper care, maintenance, and protection of work already done, or of equipment, or in the case of an emergency.

### **PART 105 - PROTECTION OF PROPERTY**

- 105.1 The protection of City, State and Government monuments, street signs, and other City property is of prime importance, and if the same be damaged, destroyed or removed, they shall be repaired, replaced or paid for by the Contractor. Disturbance to this property must first be approved by the agency that controls it.
- 105.2 No valve or other control on any utility main or building service line shall be operated for any purpose by the Contractor.
- 105.3 At places where the Contractor's operations are adjacent to, or crossing, the path of railway, telegraph, telephone, cable, electric, and gas lines, or water lines, sanitary sewers, and storm sewers, damage to which might result in expense, loss or inconvenience, work shall not be commenced until all arrangements necessary for the protection thereof have been made. Contractor shall notify the Notification Center of Oklahoma One-Call System, Inc. of any excavation or

demolition prior to the commencement of such work. Notification shall be made no sooner than ten (10) days, nor later than forty-eight (48) hours prior to start of work, excluding Saturdays, Sundays, and legal holidays.

105.4

The City has attempted to locate all storm sewers, culverts, buried telephone or electrical conduits, sanitary sewers, water mains, and gas mains that might interfere with the construction of this project. The Contractor shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a reasonable manner and duplication or rearrangement work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted. The revision and crossings of the various types of lines shall be made as follows:

- a) Storm sewers and culverts may be removed at the time of crossing or may be adequately braced and held in position while the pipe is placed beneath them. If the storm sewer or culvert is removed, it shall be replaced with pipe of the same type and size as that removed, and it shall be re-joined to the undisturbed line with a joint satisfactory to the Engineer. Backfill over the main, up to and around the storm sewer, shall be thoroughly compacted in order that no settlement will occur. The revision and crossing shown on the Drawing shall be at the expense of the Contractor. In the event lines, other than those shown on the Drawings, are encountered and fall within the standard trench limit and, in the opinion of the Engineer, revision of the line is necessary for the construction of the project, the Contractor will be reimbursed for the extra cost of the crossing or revision under the "Extra Work" clause of the Contract.
- b) All overhead and buried telephone cable and electrical conduits, and gas mains to be revised or crossed by the construction of this project shall be protected in accordance with the directions of the utility company owning the conduits and/or mains. The Contractor shall notify the companies and obtain their permission before making any crossing or revisions. The revision and crossing shown on the Drawing shall be at the expense of the Contractor. In the event lines other than those shown on the Drawing are encountered and fall within the standard trench limit and, in the opinion of the Engineer, revision of the line is necessary for the construction of the project, the Contractor will be reimbursed for the extra cost of the crossings or revision under the "Extra Work" clause of the Contract. Any overhead cables or buried cables or conduits or gas mains damaged by the Contractor shall be repaired at his expense to the satisfaction of the Engineer and of the owner.
- c) The Contractor shall not remove any water or sanitary sewer lines except as directed by the Engineer or as required by the Drawings and Specifications, and shall adequately brace and protect them from any damage during construction. Any existing water main or sewer main or lateral damaged by the Contractor's operation will be repaired by the City's maintenance forces. The Contractor shall notify the City immediately after damaging any pipe. The repairs will be made at the Contractor's expense.

- 105.5 The location of utility service lines serving individual properties may or may not be shown on the Drawings, but the Contractor shall assume that such service lines exist whether or not they are shown on the Drawings, and it shall be the responsibility of the Contractor to make any necessary changes in the line and/or grade of such services, or to secure the necessary changes therein to be made by the particular utility company involved or other owner thereof, or by an agent or individual contractor approved by such utility company or other owner. Contractor shall pay the cost of all such revisions whether performed by contractor, the utility company, or other owner, or an approved contractor. In the event of interruption of a utility service as a result of accidental breakage, Contractor shall promptly notify the Engineer and the owner of the utility, and shall repair or cause the same to be repaired, in the same manner as necessary changes above provided for, and the Contractor shall do all things necessary to see to the restoration of services as promptly as may be reasonably done. All sanitary sewer service lines damaged shall be replaced with cast iron pipe, regardless of type or kind damaged.
- 105.6 In the event the Contractor in any way fails to comply with the requirements of protecting, repairing, and restoring of any utility or utility service, the Engineer may, upon forty-eight (48) hours' written notice, proceed to protect, repair, rebuild or otherwise restore such utility or utility service as may be deemed necessary, and the cost thereof will be deducted from any money due or which may become due the Contractor pursuant to the terms of his contract.

## **PART 106 - CONNECTIONS**

- 106.1 All connections to existing water mains shall be made by the Contractor, unless noted otherwise. The Contractor shall perform his work so that these connections may be readily made. All transfer of building service line connections from the existing to the new main shall be made by the Contractor after the main has been backfilled, tested, and chlorinated, but before any sidewalks, driveways, curbs, and/or paved roadways, are replaced.
- 106.2 The Contractor shall not make any unauthorized connections to a sewer, nor shall he permit any such connections to be made. If the Contractor is properly authorized by the Engineer to make connections by installing tees in the sewer under construction, such installation shall conform to the regulation of the City.

## **PART 107 - REFERENCES TO OTHER SPECIFICATIONS**

- 107.1 Where a standard such as American Society for Testing Materials, American Concrete Institute, American Standards Association, American Water Works Association, or other agency designation is specified for a material, that designation shall be the current revision, either tentative or adopted. If a referenced specification is in conflict with these specifications, the City specifications shall govern.

## PART 108 - PROTECTION OF MATERIALS

- 108.1 All materials delivered to the site of the work shall be adequately housed and protected against deterioration according to the standard accepted procedures. The Contractor shall keep his storage yards in good order, pile his materials neatly, and protect them from damage.

## PART 109 - TESTING

- 109.1 **Materials:** All materials required to be tested shall be tested by a laboratory of good reputation, previously approved by the City. No material shall be accepted for construction unless it bears the approval of the laboratory. Reports of tests shall be forwarded to the City. Before final acceptance of the project, all materials shall be tested and shall be found in good and proper condition, or shall be placed in such condition.
- 109.2 **Testing of Manholes:** All manholes will be tested using the vacuum test method, following the manufacturer's recommendations for proper and safe procedures. The vacuum tester shall be as manufactured by Cherne Industries or equal.

All pipes for vacuum testing entering the manhole shall be installed at the top access point of the manhole.

A vacuum of 10 inches of mercury (Hg)(5.0 psi) shall be drawn on the manhole and the time shall be measured for the vacuum to drop to 9 inches of mercury (Hg)(4.5 psi). The manhole shall pass the test if the time measurement exceeds the values indicated in the following table:

Vacuum Test Timetable  
Manhole Diameter – Inches

<u>Depth-feet</u>	<u>48 Inches</u>	<u>60 Inches</u>	<u>72 Inches</u>	<u>96 Inches</u>	<u>144 Inches</u>
4	10 sec.	13 sec.	16 sec.	19 sec.	21 sec.
8	20 sec.	26 sec.	32 sec.	38 sec.	44 sec.
12	30 sec.	39 sec.	48 sec.	57 sec.	65 sec.
16	40 sec.	52 sec.	64 sec.	76 sec.	88 sec.
20	50 sec.	65 sec.	80 sec.	95 sec.	110 sec.
24	60 sec.	78 sec.	96 sec.	114 sec.	132 sec.
+Each 2'	+5 sec.	+6.5 sec.	+8.0 sec.	+9.5 sec.	+11 sec.

Manhole depth shall be rounded to the nearest foot. Intermediate values shall be interpolated. For depths above 24 feet, add the values listed on the last line of the table for each 2 feet of additional depth.

If the manhole fails the vacuum test, the contractor shall perform additional repairs and repeat the test procedures until satisfactory results are obtained.

All repairs and testing are the responsibility of the Contractor and will be performed at no additional cost to the City.

No payment will be made for any manholes which have not passed the vacuum test.

- 109.3 Testing and Chlorinating Water Mains: Testing and chlorinating water mains will be performed by the City, but the Contractor shall lend such assistance as may be required. Water mains shall be testing in accordance with the Standard Specifications for "Installation of Ductile Iron Water Mains and Their Appurtenances," AWWA Designation C-600. The pressure test of 150 psi shall be for thirty minutes' duration. If the line passes the test without significant pressure drop, a leakage test shall be made at the normal operating pressures under which the line is to operate for two hours' duration. Before being placed in service, all mains shall be chlorinated in accordance with "AWWA Standard for Disinfecting Water Mains," AWWA Designation C-651. Where temporary plugs are required for pressure testing, the contractor shall furnish and install the plug and temporary blocking, and remove after testing is complete. The cost shall be included in the unit price bid for pipe. No additional payment will be made.

#### **PART 110 - "OR APPROVED EQUAL" CLAUSE**

- 110.1 When a material is specified or shown on the Drawings by brand or manufacturer's name, any other material that will adequately perform the same function, in the opinion of the City, may be accepted for use.

#### **PART 111 - DEWATERING**

- 111.1 The Contractor shall provide all necessary pumps, drains, dams, well points, and other means for removing water from, or preventing water from entering the trench or other excavation until the project is completed. Sufficient pumps or other works shall be made available at all times to hold the water at a safe level as determined by the Engineer. Water from the excavation shall be properly disposed of so that no damage or interference results to public health, public or private property, completed or uncompleted work, other projects, or streets.

#### **PART 112 - SAFETY**

- 112.1 Excavations: The Contractor shall adequately shore, or sheet, and brace the excavation, or shall slope the sides of the trench in accordance with the State of Oklahoma Department of Labor requirements.
- 112.2 Explosives: In handling explosives used during the construction of the project, the Contractor shall adhere to all Federal and State Laws and City Ordinances regulating the purchase, transportation, storage, handling, and use of such explosives. All blasting shall be done in strict accordance with City Ordinance

#19947. No blasting shall be done without obtaining a "Blasting Permit" from the City and presence of the Inspector. All equipment, tools, and materials used shall be of the correct type and in good conditions for the operation. The Contractor shall take all necessary precautions to avoid damage to property resulting from the transportation, storage, handling and use of explosives. Before blasting, the Contractor shall cover the area to be blasted with steel mesh mat or other suitable material, reinforced with timbers of sufficient weight so that rock and debris will be confined to the excavation. Any blasting within ten feet of a water, sewer, gas, or pipe line shall be done with very light charges, and utmost care should be taken to avoid disturbance to these lines. All locations for blasting shall be subject to approval of the Engineer.

- 112.3 Danger Signals and Protection: When the Contractor is performing any type of construction or excavation work, or is stockpiling or storing any materials or equipment upon or adjacent to any street, alley, sidewalk, residence, public ground, or other location that is likely to be subject to pedestrian or vehicular traffic, he shall furnish, erect, and maintain substantial guard rails, safety fencing, lights, and traffic control devices around the project to protect pedestrians, animals, and vehicles from injury or damage. All traffic control shall be in accordance with \_\_\_Sapulpa's\_\_\_ Traffic Engineering Division's Standards and Procedures for Street Use and Temporary Traffic Control. Safety and traffic control devices shall be installed and removed only at the direction of the Engineer. The Contractor shall provide sufficient proper signals and flagmen for warning during construction, excavation, and blasting operations.
- 112.4 Power Lines: No person, materials, or equipment shall come within six feet of any power line carrying more than 440 volts unless the electric power services has been first discontinued.
- 112.5 Fire Prevention and Protection: The Contractor shall take all necessary measures to prevent fire, and shall provide satisfactory fire fighting means at the location of work.
- 112.6 Interference with Traffic: The Contractor shall construct and maintain adequate and safe bridges or crosswalks over excavations, where required. When a roadway or sidewalk is not closed, the Contractor shall provide a safe substitute route for any portion obstructed by his operations. If a roadway or sidewalk is closed to traffic, the Contractor shall provide and mark detours. As directed by the Engineer, construction across roadways or sidewalks may be done by open excavation.
- 112.7 Condition of Equipment and Materials: All equipment, tools, appliances, and materials used in connection with the project shall be handled and operated only when they are in safe operating condition and in accordance with a standard safety procedure.

## **PART 113 - REMOVAL OF CONDEMNED MATERIALS AND STRUCTURES**

- 113.1 The Contractor shall remove from the site of the work, without delay, all rejected and condemned materials or structures of any kind brought to or incorporated in the work. Upon his failure to do so, or to make satisfactory progress in so doing, within forty-eight (48) hours after the service of a written notice from the Engineer ordering such removal, the condemned material or structure may be removed by the City and the cost of such removal will be taken out of the money that may be due or may become due the Contractor. No such rejected or condemned material shall again be offered for use by the Contractor.

## **PART 114 - CLEAN-UP**

- 114.1 Immediately upon installation of any portion of the work, the Contractor shall restore all fills, topsoil, and utilities to their location and condition prior to construction.
- 114.2 Immediately upon installation of any block in length of the work herein contemplated, the Contractor shall remove all materials, tools, debris, excess excavated material, and equipment; and restore the site in a manner satisfactory to the Engineer.
- 114.3 Clean-up and restoration of service line transfers shall be made immediately following each transfer installation.

## **PART 115 - PLACING WORK IN SERVICE**

- 115.1 If desired by the City, portions of the work may be placed in service when completed and the Contractor shall give prior access to the work for this purpose, but such use and operation shall not constitute an acceptance of the work.

## **PART 116 - SUBMITTALS**

- 116.1 The Contractor shall submit to the Engineer, six (6) copies of material submittals for all material he proposes to use. Construction shall not begin until the Engineer has approved the submittals in writing.
- 116.2 Submittals for pipe shall consist of notarized certifications, from the manufacturer, that the pipe was manufactured and tested in accordance with the applicable specifications. The certifications shall indicate the pipe diameter, the pressure rating, and the batch number from which the pipe was manufactured. For concrete and steel pipelines 16-inches and larger, a detailed laying schedule prepared by the manufacturer shall be submitted, along with the detail design calculations.
- 116.3 Submittals for material other than pipe shall consist of manufacturer's product literature or shop drawings, indicating dimensions and material specifications.

Submittals shall include reference to compliance with AWWA, ASTM, NSF, and other applicable standards.

- 116.4 All delivery tickets, including factory certification of ductile iron pipe, shall be surrendered to City Inspector or their representative.

**SECTION END**

**DIVISION II  
MATERIAL SPECIFICATIONS  
APPROVED FITTINGS MANUFACTURERS**

**Tapping Saddles and Valves**

Mueller (DIP)  
Clow (DIP)  
American (DIP)  
Tyler (DIP)  
PowerSeal (DIP)  
Smith-Blair (DIP)  
Hanson Concrete (Conc)  
Price Bros(Conc)  
TD Williamson(Conc)  
Baker Series 428 (Steel)  
Rockwell 622 (Steel)  
Dresser (DIP)

**Restrained Joint Systems**

American Flex Ring (DIP)  
EBAA Megalug (DIP,PVC)  
Ford Meter Box Uni-Flange(DIP,PVC)  
Star StarGrip (DIP,PVC)  
Price Snap Ring & Harness Joint (Conc)  
Hanson Snap Ring & Harness Joint (Conc)  
Northwest weld (Steel)  
Hanson weld (Steel)  
USPipe TR Flex (DIP gravity sanitary only)  
Griffin SNAP-LOK (DIPgravity sanitary only)  
McWane THURSTLOCK (DIPgravity sanitary only)

**Resilient Wedged Gate Valves**

American  
Mueller (Aquagrip allowed)  
M&H  
Clow  
Kennedy  
US Pipe  
AVK

**Ball Valves**

Pratt

**Couplings for Out-of-Round CI Pipe**

Viking-Johnson  
Smith-Blair  
Straub

**Check Valves**

M&H  
American Flow Control  
Mueller  
US Pipe  
Clow  
Kennedy  
Watts

**4-Way Fire Hydrants**

American Darling  
Mueller (Aquagrip allowed)

**3-Way Hydrants**

American Darling B84B  
Kennedy Guardian  
Mueller Centurian (Aquagrip allowed)

**Valve Boxes**

(Includes Debris Cap)

Tyler 6850 Series 562-S  
East Jordan 85502737 (562-S)  
SIGMA VB 262-35  
Star VB 562SHD

**4" Reversible Rim & 23 ¼" Lids (Water)**

Neenah 1797-4R-TUL-WAT  
Deeter 1155-TUL-WAT  
East Jordan 2132R-TUL-WAT  
Sigma MH121WV-35

**Uniflanges**

EBAA Series 2100 Megaflange

### **1 ½" & 2" Meter Setters**

Ford B-C10046-011 (1 ½"), B-C10046-013(2")

Mueller 1 ½"x15"B2423, 2"x15"B2423  
AYMcDonald 20C615WFFF6654 (1 ½")  
AYMcDonald 20C715WGFF7766x22.75 (2")

### **Air Relief Valves**

APCO  
Crispin  
ValMatic

### **Butterfly Valves**

Pratt  
Mueller

### **Manhole Grade Adjustment Rings**

East Jordan V-1901 series (CI only)  
Deeter 1856 (CI only)

### **Chimney Adjustment Rings**

GNC Concrete Products (Concrete)  
Ladtech (HDPE)

### **Fittings**

American  
Griffin  
McWane  
Clow  
Star  
Sigma  
US Pipe  
Tyler  
East Jordan  
Pipeline Components (PCI)

### **4" Reversible Rim & 23 ¼" Lids (Stm)**

(Only McGard system allowed for sealed lids)

Neenah 1797-4R-TUL-STM  
Deeter 1155-TUL-STM  
East Jordan 2132R-TUL-STM  
Sigma MH121TW-35

### **4" Reversible Rim & 23 ¼" Lids (San)**

(Only McGard system allowed for sealed lids)

Neenah 1797-4R-TUL-SAN  
Deeter 1155-TUL-SAN  
East Jordan 2132R-TUL-SAN  
Sigma MH121N-35

### **8" Non-Reversible Rim & 23 1/4" Lid (San)**

(Only McGard system allowed for sealed lids)

Deeter 1265-TUL-SAN  
Neenah 1797-TUL-SAN  
East Jordan 2132-TUL-SAN  
Sigma MH122N-35

### **4" Reversible Rim & 31 ½" Lid (San)**

(Only McGard system allowed for sealed lids)

Deeter 1296-R-TUL-SAN  
East Jordan 2230-R-TUL-SAN  
Sigma MH123N-35

### **8" Non-Rev Rim & 23 ¼" Lid (Stm)**

(Only McGard system allowed for sealed lids)

Deeter 1265-TUL-STM  
Neenah 1797-TUL-STM  
East Jordan 2132-TUL-STM  
Sigma MH122T-35

### **4" Reversible Rim & 31 ½" Lid (Stm)**

(Only McGard system allowed for sealed lids)

Deeter 1296-R-TUL-STM  
East Jordan 2230-R-TUL-STM  
Sigma MH123T-35

### **Cast Iron Curb Inlet – 6" Barrier**

Deeter 2445  
East Jordan 00760065  
Neenah R-3076-6BOK

### **Lampholes (with closed pickhole)**

East Jordan 3312800lid/3342800frame  
Deeter 1828  
Deeter 1828-B (Bolted Ring & Cover)

**Vane Grates—"Drain to River" with "COT"**

Neenah 3076-3000  
East Jordan 00760033

**Type "D" 27 7/8" Circular Grate**

Deeter 1950  
East Jordan 00210032

**Bicycle Safe 17 3/4"x29 3/4" Grate**

Neenah 3076-0015  
EJ 44230231grate/FA1833032G0frame

**Bolted Bicycle Safe Trench Grate**

Neenah 3076-0019  
East Jordan 00697033

**Solid Knobby Frame/ 27 7/8" Circular Lid**

Deeter 1159 Frame /1159 Lid  
Neenah 1682-0001 Frame/R1682 Solid Lid  
East Jordan 00210002

**Vertical Standard Stormwater Grate**

Neenah R5050

**Cast Iron Curb Inlet – 8" Barrier**

Neenah R-3076-8BOK  
East Jordan 00760067

**Cast Iron Curb Inlet – 6" Mountable**

Neenah R-3076-6M  
East Jordan 00760063

**Single Inlet Frame**

Neenah 3076-0001  
East Jordan 00760011

**Center Inlet Frame**

Neenah 3078-0001  
East Jordan 00760017

**Left Inlet Frame**

Neenah 3077-0001  
East Jordan 00760013

**Right Inlet Frame**

Neenah 3077-0002  
East Jordan 00760015

**Water Meter Cans, Rims, Lids (non lockable)**

East Jordan 18 x 18 assembly 32534019 (3/4" x 5/8")  
East Jordan 18 x 24 assembly 32535019 (1")  
East Jordan 28 x 36 Assembly 32535539 (1 1/2")  
East Jordan 36 x 36 Assembly 00842801 (2")  
Sigma 18 x 18 MB-161TT-35 (3/4" x 5/8")  
Sigma 18 x 24 MB-163TT-35 (1")  
Sigma 28 x 36 MB-162TT-35 (1-1/2")  
Sigma 36 x 36 MB-147TT-35 (2")

**PART 201 - CONCRETE**

201.1 CEMENT

- 201.1.1 All cement used in the work shall be a well-known brand of true Portland Cement and shall conform to the Standard Specifications for Portland Cement, ANSI/A.S.T.M. Designation C150. Unless otherwise permitted, the Contractor shall use only one brand of cement in the work and under no condition shall he use more than one brand of cement in the same structure. Cement, which for any reason has become partially set or contains lumps or cakes will be rejected and shall be removed from the site.
- 201.1.2 The acceptance or rejection of cement shall rest with the Engineer. All rejected cement shall be plainly marked for identification, shall be immediately removed from the work, and shall not be offered for inspection again.

Cement kept in storage for several months may be subject to repeated tests, as directed by the Engineer.

201.1.3 The cement shall be delivered in strong cloth or paper bags. No cement shall be used or inspected unless delivered in the original package with the brand and name of the manufacturer plainly marked thereon. Each bag of cement shall contain approximately ninety-four pounds of cement, net weight, and four bags shall be the equivalent of one barrel. Packages received in broken or damaged condition will be rejected or accepted only as fractional packages.

201.1.4 The Contractor shall provide, at the site of the work, a suitable weather tight building, or buildings, having a tight floor properly blocked or raised from the ground, for the storage of cement. The building shall be large enough to permit keeping on hand a supply of cement in quantity sufficient to prevent delays or interruptions to the work, which might be due to the lack of cement. The cement shall be stored in such manner to permit easy access for the proper inspection and identification of each shipment. Cement in bags shall not be piled to a height in excess of seven feet. Suitable accurate scales shall be provided by the Contractor for weighing the cement. After it has been delivered to the job, the Contractor will not be permitted to remove or dispose of the cement in any way without the consent of the Engineer.

201.1.5 At the beginning of operations and at all other times while cement is required, the Contractor shall have, at the site of the work, an ample supply of acceptable cement and shall carefully guard against possible shortage on account of rejection, irregular deliveries, or any other cause.

## 201.2 WATER

201.2.1 All water used in mixing mortar or concrete shall be free from acid, alkali, oil, salt, vegetable, or other matter in sufficient quantity to be injurious to the finished product, and shall be from an approved source.

## 201.3 AGGREGATE

201.3.1 Fine aggregate for concrete shall be clean, hard, durable, uncoated grains of Arkansas River sand or other sand acceptable to the Engineer. It shall be free from injurious amounts of dust, clay balls, soft or flaky particles, shale, alkali, organic matter, loam, or other deleterious substances. It shall not contain more than three per cent, by weight, of material, which can be removed by standard decantation tests. If the color of the supernatant liquid is darker than that of the reference standard color solution when subjected to the Standard Test For Organic Impurities in Sands for Concrete ANSI/ASTM C40, the fine aggregate shall be rejected unless it passes the Standard Test for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar ANSI/ASTM C87.

201.3.2 Fine aggregate shall be graded approximately within the limits shown in the following table. If not enough fines are available in the natural sands, limestone dust, or other approved fines shall be added:

Per Cent Passing Standard Square Mesh Screens

No. 4	No. 20	No. 50	No. 100
95-100	45-80	10-30	5-10

201.3.3 Coarse aggregate shall consist of the best available crushed limestone or other approved material. River gravel or other material with smooth surfaces shall not be used without specific written approval of the Engineer. Coarse aggregate shall be clean, tough, sound, durable rock and shall not contain harmful quantities of foreign materials and must be satisfactory to the Engineer.

201.3.4 Coarse aggregate shall be graded approximately within the limits shown in the following table:

Percent Passing Standard Square Mesh Screens

Aggregate								
Max Size	2 1/2"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4
2"	100	95-100	60-95	50-83	40-70	20-40		0-5
1 1/2"		100	95-100		40-70		10-30	0-5
3/4"				100	95-100		40-75	0-5

201.3.5 Coarse aggregate shall conform to Standard Specifications for Concrete Aggregates, ANSI/ASTM C33, except as to gradation. The maximum size aggregate to be used in structures six inches thick and under shall be three-quarters inch; in structures from six inches to ten inches thick, the maximum size of aggregate shall be one and one-half inches. If required, the Contractor shall furnish test certificates showing the aggregates meet the above requirements.

201.3.6 In case the concrete resulting from the mixture of the aggregates is not of a workable character or does not make the proper finished surface, the Engineer may require a different grading in order to secure the desired results, or they may allow the use of inert admixtures to correct deficiencies, upon proper showing that such use will not materially lower the strength or increase the permeability of the concrete.

201.4 STEEL REINFORCEMENT

201.4.1 All reinforcing steel shall be deformed bars and shall conform to the requirements of the Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement, ANSI/ASTM A615, for grade 40 or grade 60. All steel shall be manufactured in the United States.

201.4.2 The Engineer reserves the right to require a test of three specimens of each size of bar from each carload received. These tests shall be made by a laboratory or testing firm approved by the Engineer and the cost of such testing shall be included in the price bid for steel reinforcement.

## 201.5 STRENGTH AND PROPORTION

201.5.1 The concrete shall have a compressive strength of not less than 3500 PSI, unless otherwise specified in the plans, as determined from test cylinders at twenty-eight days, made, cured, and broken, as hereinafter specified.

201.5.2 The concrete shall be mixed in the approximate proportion of 1:2-1/2:4-1/4 and shall contain not less than 6 sacks of cement per cubic yard of finished concrete. With the approval of the Engineer, admixtures may be added in order to increase workability.

## 201.6 TESTING OF CONCRETE

201.6.1 During the progress of the work, a reasonable number of compression tests shall be made when and if required by the Engineer. Each test shall consist of not less than three test cylinders. At least one test shall be made for each one hundred cubic yards of concrete placed. The test cylinders shall be made and stored in accordance with the Standard Method of Making and Curing Concrete Test Specimens in the Field, ANSI/ASTM C31, and shall be tested in accordance with the requirements relating to making compression tests on concrete test specimens as given in the Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens, ANSI/ASTM C39.

201.6.2 All test specimens shall be kept as near to the point of sampling as possible and yet receive the same protection from the elements as is given to the portions of the structure being built. Specimens shall be protected from injury. They shall be sent to a testing laboratory approved by the Engineer not more than seven days prior to the time of the test, and while in the laboratory shall be kept in the ordinary air at a temperature of approximately 70 degrees Fahrenheit until tested.

201.6.3 The Contractor shall furnish the Engineer certified reports on these tests and shall pay all the expense of making the tests and of furnishing the concrete for preparing and testing the cylinders.

## 201.7 RESPONSIBILITY OF CONTRACTOR FOR STRENGTH

201.7.1 It is the intent of these specifications that the Contractor shall guarantee that concrete of the specified compressive strength is incorporated in the structures and that the responsibility for producing the required grades of concrete is assumed by the Contractor.

201.7.2 Should the average strengths shown by test cylinders fall below the strengths required, the Engineer will require any or all of the following changes: amount

of cement, grading of aggregate, or ratio of the water to the cement used. If the tests disclose that the strength of the concrete is insufficient for the structure as built, the Engineer may condemn the part of any structure in which concrete of insufficient strength has been placed and the Contractor, at his cost, shall remove and replace such concrete with concrete meeting these specifications.

## 201.8 EXPERIMENTAL CONCRETE MIXES

201.8.1 The Contractor shall make experimental mixes prior to the placing of the concrete and at any time during the progress of the work when necessary to demonstrate that the concrete will meet these specifications. Materials for making experimental mixes shall be furnished by the Contractor and these materials shall be identical with those intended for use in the work. The cost of the materials, as well as the costs of crushing test specimens made from the experimental mix, shall be borne by the Contractor and shall be included in the price bid for concrete.

## 201.9 MIXING

201.9.1 The concrete shall be mixed in an approved batch machine or mixer. The ingredients shall be accurately measured by weight, unless measurement by volume is permitted by the Engineer, before being placed in the mixer. Measuring boxes or other approved measuring apparatus shall be such that the proportions can be accurately determined. The quantity of water to be added, which will vary with the degree of dryness of the material and with the weather conditions, shall be accurately measured for each batch of concrete. Means shall be provided by which a measured quantity of water can be introduced at any stage of the process. The mixing shall be done in a thorough and satisfactory manner and shall continue until every particle of aggregate is completely covered with mortar. The mixing time for each batch shall not be less than one minute after the materials are in the mixer. The entire contents of the drum shall be discharged before recharging. Retempering of concrete, which has partly hardened, will not be permitted.

## 201.10 CONSISTENCY

201.10.1 All reinforced concrete which is required to be spaded or puddled in forms or around reinforcing steel shall be of such consistency that: all aggregate will float uniformly throughout the mass without settling or segregation; when dropped directly from the discharge chute of the mixer, it will flatten out at the center of the pile but will stand up at the edges, the pile spreading from internal expansion and not by flowing; it will flow sluggishly when tamped or spaded; it can be readily puddled into corners and angles of forms and around reinforcing steel, it can be readily spaded to the bottom of the pour or to a depth of several feet any time within thirty minutes after placing.

201.10.2 A desirable consistency is one which results in a very slight accumulation of water at the top of a layer several feet in thickness, but not with segregation or accumulation of laitance.

201.10.3 If, through accident, intention, or error in mixing, any concrete shall, in the opinion of the Engineer, vary materially from the consistency specified, such concrete shall not be incorporated in the work but shall be discharged as waste material at a location approved by the Engineer.

## 201.11 PLACING CONCRETE

201.11.1 Before beginning a run of concrete, surfaces of the forms, reinforcing steel, and concrete previously placed, shall be thoroughly cleaned of hardened concrete and foreign materials. Forms shall be thoroughly wetted or oiled.

201.11.2 Concrete shall be placed in the forms immediately after mixing. It shall be deposited so that the aggregates are not separated. Dropping the concrete any considerable distance, generally in excess of five feet, depositing large quantities at any point and running or working it along the forms, or any other practice tending to cause segregation of the ingredients, will not be allowed. It shall be compacted by vibration or continuous tamping, spading, or slicing. Care shall be taken to fill every part of the forms, to work the coarser aggregate back from the face, and to force the concrete under and around the reinforcement without displacing it. All concrete shall be thoroughly vibrated, except where specifically excepted in the specifications. The concrete shall be deposited in continuous horizontal layers and, whenever practicable, concrete in structures shall be deposited continuously for each monolithic section of the work. Chutes and tremies used for conveying concrete shall be mortar-tight.

201.11.3 Work shall be arranged in order that each part of the work shall be poured as a unit, if this is possible. Where necessary to stop pouring concrete, the work shall be brought up in level courses and against a vertical stop board.

201.11.4 The placing of concrete under water, where permitted, must be done by special approved methods.

## 201.12 PLACING IN COLD WEATHER

201.12.1 No concrete shall be placed without the specific permission of the Engineer when the air temperature is at or below thirty-five degrees Fahrenheit.

201.12.2 If concreting in freezing weather is permitted by the Engineer, care shall be taken to prevent the use of any frozen material. In addition to adequate provision for protecting the concrete against chilling or freezing, the Contractor shall be required to heat the water and aggregate in order that when deposited in the forms, the concrete will have a temperature of not less than fifty degrees Fahrenheit, nor more than eighty degrees Fahrenheit. The concrete shall be adequately protected in order to maintain this temperature

for a minimum of seventy-two hours after it has been placed and a temperature above thirty-two degrees Fahrenheit for a period of two additional days. The work shall be done entirely at the Contractor's risk.

- 201.12.3 No chemicals or other foreign matter shall be added to the concrete for the purpose of preventing freezing.

#### 201.13 READY-MIXED CONCRETE

- 201.13.1 Ready-mixed concrete may be used on the work, with the approval of the Engineer, when the Contractor can demonstrate that the concrete can be furnished in accordance with the specifications hereinabove and that delivery can be made at such rate as will insure the continuity of any pour. Standard Specifications for Ready-Mix Concrete, ANSI/ASTM C94, when not in conflict with the specifications herein, shall control the furnishing of ready-mix concrete.

- 201.13.2 All mixer trucks shall be equipped with water meters. Additional water shall be added at the job site only with the specific approval of the Engineer.

#### 201.14 CONSTRUCTION JOINTS

- 201.14.1 Construction joints shall be located as shown on the drawings and at other points as may be necessary during the construction, provided that the location and nature of additional joints shall be approved by the Engineer. In general, joints shall be located at points of minimum shear, shall be perpendicular to the principal lines of stress, and shall have suitable keys having areas of approximately one-third of the area of the joints.

- 201.14.2 In resuming work, the surface of the concrete previously placed shall be thoroughly cleaned of dirt, scum, laitance, or other soft material, and shall be roughened. The surface shall then be thoroughly washed with clean water and covered with at least one-half inch of cement mortar, after which concreting may proceed. Mortar shall be placed in a manner in order not to splatter forms and reinforcing steel.

#### 201.15 FINISH OF CONCRETE SURFACES

- 201.15.1 All surfaces exposed to view shall be free from conspicuous lines, affects, or other irregularities caused by defects in the forms. If for any reason this requirement is not met, or if there are any conspicuous honeycombs, the Engineer may require the correction of the defects by rubbing with carborundum bricks and water until a satisfactory finish is obtained.

- 201.15.2 Immediately after removing the forms, all wires or other exposed metal shall be cut back of the concrete surface, and the depressions thus made and all honeycombs and other defects shall be pointed with mortar and then rubbed smooth. If the Engineer deems any honeycomb or other defect to require such treatment, the defective concrete shall be cut out to a depth sufficient to

expose the reinforcement and to afford a key for the concrete replacing that cut out.

## 201.16 CURING CONCRETE

- 201.16.1 Exposed surfaces of concrete shall be protected by approved methods from premature drying for a period of at least seven days. Curing compounds, when approved by the Engineer, shall be applied according to the manufacturer's recommendations. The Engineer may require the frequent wetting of the concrete and/or forms and the use of means to protect it from the direct rays of the sun.

## 201.17 PLACING REINFORCEMENT

- 201.17.1 All reinforcement, when placed, shall be free from mill scale, loose or thick rust, dirt, paint, oil or grease, and shall present a clean surface. Bends and splices shall be accurately and neatly done and shall conform to American Concrete Institute Manual of Standard Practice for Detailing Reinforced Concrete Structures.
- 201.17.2 All reinforcing shall be placed in the exact position shown on the drawings and shall be held firmly in position by means of approved metal spacers and supports, by wiring to the forms, and by wiring the bars together at intersections with approved wire ties in order that the reinforcement will not be displaced during the depositing and compacting of the concrete. The placing and fastening of reinforcement in each section of the work shall be approved by the Engineers before any concrete is deposited in the section. Care shall be taken not to disturb the reinforcement after the concrete has taken its initial set.

## 201.18 FORMS

- 201.18.1 Forms shall be so designed and constructed that they may be removed without injuring the concrete. The material to be used in the form for exposed surfaces shall be sized and dressed lumber or metal in which all bolt and rivet heads are countersunk. In either case, a plain, smooth surface of the desired contour must be obtained. Undressed lumber may be used for backing or other unexposed surfaces, except inside faces of conduit.
- 201.18.2 The forms shall be built true to line and braced in a substantial and unyielding manner. They shall be mortar-tight, and if necessary to close cracks due to shrinkage, shall be thoroughly soaked in water. Forms for re-entrant angles shall be filleted, and for corners shall be chamfered. Dimensions affecting the construction of subsequent portions of the work shall be carefully checked after the forms are erected and before any concrete is placed. The interior surfaces of the forms shall be adequately oiled with a non-staining mineral oil to insure the non-adhesion of mortar.

201.18.3 Form lumber, which is to be used a second time, shall be free from bulge or warp and shall be thoroughly cleaned. The forms shall be inspected immediately preceding the placing of concrete. Any bulging or warping shall be remedied, and all dirt, sawdust, shavings, or other debris within the forms shall be removed. No wood device of any kind used to separate forms will be permitted to remain in the finished work.

201.18.4 Temporary openings shall be placed at the bottom of the column and wall forms and at other points where necessary to facilitate cleaning and inspection immediately before depositing concrete.

## 201.19 REMOVAL OF FORMS

201.19.1 Forms shall be removed in such manner as to insure the complete safety of the structure. No forms shall be removed except with the express approval of the Engineer. In general, this approval will be based on the following:

201.19.2 Forms on ornamental work, railings, parapets, and vertical surfaces which do not carry loads and which will be exposed in the finished work shall be removed within twenty-four to forty-eight hours after placing, depending upon weather conditions.

201.19.3 Girder, beam, and joist sides only, column, pier, abutment, and wall forms may be removed within twenty-four to forty-eight hours after placing, depending upon weather conditions. No backfill shall be placed against walls, piers, or abutments, unless they are adequately supported or have reached the required strength.

201.19.4 Girder, beam, and joist soffit forms shall remain in place with adequate shoring underneath, and no construction load shall be supported upon, nor any shoring removed from any part of the structure under construction until that portion of the structure has attained sufficient strength to support safely its weight and the loads placed thereon.

## PART 202 - QUICK-SETTING FLOWABLE FILL

### 202.1 MATERIALS

202.1.1 Quick-setting flowable fill shall be a sand-cement slurry consisting of the following materials in a one cubic yard mixture:

Type I Cement	100 pounds
Sand	2,925 pounds
Water	585 pounds
Master Builders Pozzutec 20	80 ounces
(ASTM C494, Type C and E)	

- 202.1.2 NOTE: Can change somewhat due to type of sand used.
- 202.1.3 The combination of materials above shall be mixed in a ready-mix truck to produce the sand-cement slurry mixture.
- 202.1.4 Submittals shall be delivered to \_\_\_Sapulpa\_\_\_ at a date set by the Engineer. Submittals shall include the items outlined in ODOT Specification 701.03.

202.2 CONSTRUCTION METHODS

- 202.2.1 For each cubic yard of quick-setting flowable fill material required, the amount of the mix components in the MATERIALS section shall be used to produce the sand-cement slurry mixture. The slurry mixture shall be mixed between 70 to 100 revolutions of the ready-mix truck.
- 202.2.2 To minimize segregation, all flowable fill material shall be re-mixed at the project site at mixing speed in the ready-mix truck for approximately two minutes immediately prior to discharge of the sand-cement slurry mixture. Re-mixing of the flowable fill slurry shall be done under the direction of the Engineer.

202.3 TESTING

- 202.3.1 Special Provisions, "Flowable Fill Testing Procedures" identifies the Ohio Ready-Mixed Concrete Association (ORMCA) Standards FF1(94), and FF4(94) which shall be used in the performance of field testing.
- 202.3.2 The following are the testing requirements for the quick-setting flowable fill:

Flow	Minimum = 4 ½ inches
Compressive Strength (28 days)	Minimum = 25 pounds per square inch (psi)
	Maximum = 60 pounds per square inch (psi)

202.4 GENERAL

- 202.4.1 The time required before placing pavement over the cured quick-setting flowable fill is a minimum of six hours and/or whenever a minimum penetration value of 400 pounds per square inch (psi) is achieved. Penetrometer readings shall be taken with a Soiltest Mortar Penetrometer, Model CT-421A, or approved equal. The upper three inches of the area of the cured flowable fill mixture to be tested shall be removed prior to taking the penetrometer readings. The test value of record shall be the average of three tests.

**PART 203 - DUCTILE IRON PIPE, DUCTILE AND CAST IRON FITTINGS, AND VALVES**

203.1 PIPE AND FITTINGS

203.1.1 Where ductile iron pipe (DIP) three (3) inches in diameter and larger is specified or required, it shall conform to, and be tested in accordance with, the current American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids, ANSI/AWWA C151/A21.51.

203.1.2 Length of joints shall be either eighteen or twenty feet. The minimum standard thickness class of each size pipe shall be as follows:

Pipe Size	Thickness Class
4" thru 8"	51
10" and larger	50

203.1.3 For 16-inch and larger Water Ductile Iron Pipe, all bell and spigot joints shall be electrically bonded, using a #4 AWG bare copper wire of adequate length to braze, using a #15 cadweld cartridge, the copper wire to the bare metal at the bell and spigot. Cost shall be included in the unit price bid per lineal foot of Ductile Iron Pipe.

203.1.4 For 16-inch and larger Water Ductile Iron Pipe, junction box test stations shall be furnished and installed, EXCEPT, no magnesium anode banks shall be furnished or installed. Junction box test stations shall be installed in accordance with the stationing shown on the Schedule of Anode Spacing. Cost shall be included in the unit price bid per lineal foot of Ductile Iron Pipe.

203.1.5 Fittings for ductile iron pipe shall be cast or ductile iron. Cast iron and ductile iron fittings shall conform to the American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, ANSI/AWWA C110; or the American National Standard for Ductile-Iron Compact Fittings, 3-inch through 48-inch, ANSI/AWWA C153. The length of all solid sleeves (both AWWA C110 and C153) shall be the longest length listed in the AWWA C110 specification (12-inch length for 3-inch through 12-inch sleeves, 15-inch length for 14-inch through 24-inch sleeves, and 24-inch length for 30-inch through 48-inch sleeves).

203.1.6 Interior of all sanitary sewer 15-in and larger ductile iron pipe shall be lined with 40 mils of ceramic epoxy ("Protecto 401", or equal).

203.1.6.1 Condition of Ductile Iron Prior to Surface Preparation.  
All ductile pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. Because removal of old linings may not be possible, the intent of this specification is that the entire interior of the ductile iron pipe and fittings shall not have been lined with any substance prior to the application of the specified lining material and no coating shall

have been applied to the first six inches of the exterior of the spigot ends.

#### 203.1.6.2 Lining Material.

The Standard of Quality is Protecto 401 Ceramic Epoxy. The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the following properties, and a certification of the test results.

- A. A permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.
- B. The following test must be run on coupons from factory lined ductile iron pipe:
  - 1. ASTM B-117 Salt Spray (scribed panel) – Results to equal 9.0 undercutting after two years
  - 2. ASTM G-95 Cathodic Disbondment 1.5 volts @ 77°F. Results to equal no more than 0.5mm undercutting after 30 days.
  - 3. Immersion Testing rated using ASTM D-714-87.
    - a. 20% Sulfuric Acid – No effect after two years.
    - b. 140°F 25% Sodium Hydroxide – No effect after two years.
    - c. 160°F Distilled Water – No effect after two years.
    - d. 120°F Tap Water (scribed panel) 0.0 undercutting after two years with no effect.
- C. An abrasion resistance of no more than 3 mils (.075mm) loss after one million cycles using European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.

#### 203.1.6.3 Application

##### A. Applicator

The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.

##### B. Surface Preparation

Prior to abrasive blasting, the entire area to receive the protective compound shall be inspected for oil, grease, etc. Any areas with oil, grease, or any substance which can be removed by solvent, shall be solvent cleaned to remove those

substances. After the surface has been made free of grease, oil or other substances, all areas to receive the protective compounds shall be abrasive blasted using sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering oxide may be left on the surface. Any area where rust reappears before lining must be reblasted.

#### C. Lining

After the surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness of Protecto 401. No lining shall take place when the substrate or ambient temperature is below 40 degrees Fahrenheit. The surface also must be dry and dust free. If flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.

#### D. Coating of Bell Sockets and Spigot Ends

Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot end must be coated with 6 mils nominal, 10 mils maximum using Protecto Joint Compound. The Joint Compound shall be applied by brush to ensure coverage. Care should be taken that the Joint Compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the lining.

#### E. Number of Coats

The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. **To prevent delamination between coats, no material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.**

#### F. Touch-Up & Repair

Protecto Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.

#### 203.1.6.4 Inspection and certification

##### A. Inspection

1. All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating.
2. The interior lining of all pipe barrels and fittings shall be tested for pinholes with a nondestructive 2,500 volt test. Any defect found shall be repaired prior to shipment.
3. Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of his work.

##### B. Certification

The pipe or fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material used was as specified.

#### 203.1.6.5 Handling

Protecto 401 lined pipe and fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying.

### 203.2 JOINTS

- 203.2.1 Cast iron and ductile iron pipe and fittings shall be jointed with any of the end types as specified below, unless a particular end type is specified. Fittings shall have mechanical joints, unless otherwise specified. Flanged ends shall be used only where specifically noted on the Drawings except that the valve connection end of all tapping sleeves shall be flanged.
- 203.2.2 Mechanical joints and push-on joints shall conform to, and be tested in accordance with, the American National Standard for Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings, ANSI/AWWA C111/A21.11.
- 203.2.3 Flange joints shall conform to the American National Standard for Cast Iron Pipe Flanges and Flanged Fittings, ANSI B16.1.
- 203.2.4 Where ductile or cast iron pipe is to be tapped, a split case iron or a flexible stainless steel tapping sleeve may be used.

- 203.2.5 Split case iron tapping sleeves shall be of 150 psi working pressure. Sleeve body shall be cast iron conforming to ANSI/AWWA C110. Sleeve shall have mechanical joints conforming to AWWA C111 on the run and a flange branch conforming to ANSI B16.1, Class 125. End gaskets shall be natural rubber or neoprene material conforming to ANSI/AWWA C111.
- 203.2.6 Flexible stainless steel tapping sleeves shall be rated at 150 psi pressure, with flanges meeting AWWA C207. Assembly shall be NSF or UL rated. Bolts, nuts, and washers shall be stainless steel. Gaskets shall conform to ANSI/AWWA C111.
- 203.2.7 Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand working pressure of the line where no other provision is made for closing the openings. Blind flanges shall be fabricated from material as specified under ANSI/AWWA C200. All bolts shall be carbon steel ANSI/ASTM A307, Grade A only, in accordance with ANSI/AWWA C207.
- 203.2.8 Where restrained joints are specified or required, they shall be of a mechanical type or push-on type assembly easily removed in field once assembled without special equipment. Assemblies shall be ANSI/AWWA rated. Set screw type retainer glands will not be permitted.

### 203.3 COATING, LINING AND POLYETHYLENE WRAP

- 203.3.1 Cast iron and ductile iron pipe and fittings shall be bituminous coated outside and cement-mortar lined inside with seal coat in accordance with American National Standard for Cement Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water, ANSI/AWWA C104/A21.4.
- 203.3.2 All ductile iron and cast iron pipe and fittings shall be encased with polyethylene tube in accordance with AWWA C105, American National Standard for Polyethylene Encasement for Ductile Iron Piping for water and other liquids. Polyethylene film shall be manufactured of virgin polyethylene material conforming to ASTM D-1248, Type 1, Class A or C, Grade E. Thickness shall be not less than 8 mils (0.008 in.). Tensile strength shall be 1200 psi, minimum. Elongation shall be 300 percent, minimum. Tube length shall provide at least one (1) foot of overlap at each joint of pipe. Tape shall be a 2" width, plastic backed adhesive tape, Polykan #900, Scotch #50, or equal. Tube width for each pipe diameter shall be as follows:

NOMINAL	PUSH-ON JOINT FLAT	MECHANICAL JOINT FLAT
PIPE SIZES	TUBE WIDTH	TUBE WIDTH
4"	14"	16"
6"	17"	20"
8"	21"	24"
10"	25"	27"
12"	29"	30"
14"	33"	34"
16"	37"	37"
18"	41"	41"
20"	45"	45"
24"	53"	53"
30"	67"	67"
36"	81"	81"

#### 203.4 GATE VALVES

203.4.1 Where gate valves are specified, they shall be resilient-wedged.

203.4.2 Resilient-wedged gate valves shall conform to and be tested in accordance with ANSI/AWWA C509. The valve shall be bubble tight from either direction at the rated design pressure of 200 psi. The valve shall have a single disc gate with synthetic rubber seat bonded or mechanically attached to the disc; non-rising stem with 2-inch AWWA operating nut; counter clockwise opening, "O" ring stem seals, and corrosion resistant interior coating acceptable for potable water use.

203.4.3 Where specified, flanges shall be ANSI B16.1, Class 125, cast iron. Mechanical Joint, push-on, and bell and spigot joints are allowed.

#### 203.5 BALL VALVES

203.5.1 Ball valves shall conform to and be tested in accordance with the AWWA Standard for Ball Valves, ANSI/AWWA C507. Where ball valves are specified or required, they shall be: double-seated with natural or synthetic rubber located in the valve body. Ball seating surfaces shall be stainless steel; designed for 150 psi working pressure; flanged end; "O" ring rotor bearing seals; constructed of high-tensile strength cast iron; counter-clockwise opening; equipped with totally enclosed manual operators, and torque limiting control device. Valves shall be tested by, and shall withstand without leak, a hydrostatic pressure of: (1) 250 psi on the valve body with rotor in the open position; and (2) 150 psi on the side of the valve with the opposite side open to atmosphere. Six (6) copies of the test results and manufacturer's drawings shall be submitted for approval prior to delivery of the valve.

203.5.2 Valves shall be bubble tight at rated pressure with flow in either direction.

203.5.3 Where flanges are specified, they shall be ANSI B16.1, Class 125, cast iron flanges.

## 203.6 BUTTERFLY VALVES

203.6.1 Butterfly valves shall be of the tight-closing, rubber-seat type, shall have a rated pressure of 150 psig, and shall be bubble-tight at this pressure with flow in either direction. Valve opening shall be counter-clockwise. The valves shall conform to and be tested in accordance with the AWWA Standard for Rubber-Seated Butterfly Valves, ANSI/AWWA C504, Class 150B. The valve body shall be of the short-body flange type, constructed of cast iron conforming to either ASTM A126, Class B, or ANSI/ASTM A48, Class 40 or ductile iron ANSI/ASTM A536, Grade 65-45-12. Flanges shall be ANSI B 16.1, Class 125, cast iron flanges. Valve Discs shall be constructed of alloy cast iron conforming to ANSI/ASTM A436, Type 1, or cast iron conforming to ANSI/ASTM A48, Class 40, or ductile iron ANSI/ASTM A536, Grade 65-45-12. Valve shafts shall be constructed of 18-8, Type 304 or 316 stainless steel, ANSI/ASTM A296, Grade CF8, or monel. Valve seats shall be body mounted and shall be of natural or synthetic rubber compound with mating seat surfaces of 18-8, Type 304 or 316 stainless steel, or alloy cast iron conforming to ANSI/ASTM A436, Type 1, or bronze Grade A, D, or E. Valve bearings shall be corrosion resistant and self-lubricating.

203.6.2 Interior surfaces of the valve, except seating surfaces, shall be epoxy coated in accordance with AWWA Standard for Protective Interior Coatings for Valves and Hydrants, AWWA C550. Exterior surface of the valve shall be painted with two (2) coats of asphalt varnish conforming to Federal Specifications TT-V-51C. For non-buried service, exterior surface shall be coated with two (2) coats of epoxy, not zinc chromate.

203.6.3 Performance, hydrostatic and leakage tests shall be conducted in strict accordance with ANSI/AWWA C 504, except that the leakage tests as outlined in Section 5.3 are to be conducted on both faces of the disc.

203.6.4 Six (6) certified copies of the manufacturers detail drawings shall be submitted for approval prior to delivery of the valve.

203.6.5 Six (6) certified copies of the test results, signed by a registered professional engineer, are to be furnished to the Engineer.

## 203.7 MANUAL OPERATORS FOR BALL VALVES AND BUTTERFLY VALVES

203.7.1 Manual Operators for Ball and Butterfly valves shall be totally enclosed, permanently lubricated, counter-clockwise opening, and designed for buried or submerged service. Manual Operators shall be equipped with a 2" square AWWA operating nut with a removable handwheel complete with spinner and an open-closed indicator, suitable for one-man operation at 150 psi unbalanced across the valve. Manual Operators shall be either worm gear or

traveling-nut type, and shall conform to AWWA C507 for Ball Valves or AWWA C504 for Butterfly Valves.

203.7.2 Manual Operators for Ball and Butterfly Valves 16" and larger shall be equipped with a Torque Limiting Control Device. The device shall be mounted directly on the operating nut for valves in vaults and on top of the extension shaft for buried valves. The device shall be secured to the operating nut with two setscrews. The device shall declutch at 200 lb-ft of input torque in either direction of rotation. The device shall be designed for permanent buried or submerged service. Declutch and reset shall be automatic. Repeatability shall be within 5 percent of original rating for a minimum of 1000 cycles. Certified proof-of-design test reports shall be furnished for the device.

### 203.8 AIR RELIEF VALVES

203.8.1 Where air relief valves are specified or required, the valve shall be heavy-duty combination air release and vacuum type for 150 psi working pressure, tested to 300 psi, size shown on plans. Body, cover, and baffle shall be cast iron. All internal parts to be either highest quality stainless steel or bronze, and the inside of valve coated with rust inhibitor.

### 203.9 CHECK VALVES

203.9.1 Where check valves are specified or required, they shall conform to, and be tested in accordance with the AWWA Standard for Swing-Check Valves for Ordinary Water Works Service, AWWA C508. They shall be horizontally mounted, single disc, swing type with a full diameter passage providing minimum pressure loss. Valves shall be of the non-slamming type designed for the future installation of outside lever and weight. Unless otherwise specified, all check valves installed in pump or lift stations shall be equipped with position indicator. Disk shall be coated rubber and body shall be epoxy coated. Ends shall fit the pipe or fitting to which attached (push-on, mechanical, bell and spigot, or flanged).

### 203.10 3-WAY FIRE HYDRANTS

203.10.1 Where fire hydrants are specified, they shall conform to, and be tested in accordance with the AWWA Standard for Dry-Barrel Fire Hydrants, ANSI/AWWA C502. All hydrants shall have: breakable connection features and a breakable coupling on the stem immediately above the bury line which has a lower breaking point than the rest of the unit; 5¼-inch compression main valve; 6-inch inlet connection; standard bell or mechanical joint hub; four-foot six-inch bury length, or as specified on drawings; two 2½-inch hose nozzles with National Standard threads; one 4-inch pumper nozzle with Standard threads (refer to attached Standard Detail for Fire Hydrants); "O" ring seal; drain valve; left (counter-clockwise) opening; Federal yellow finish paint above ground line; and National Standard pentagon operating nut.

203.10.2 Where fire hydrant extensions are specified or required, they shall be of proper design to accommodate the make of fire hydrant installed.

#### 203.11 FOUR-WAY FIRE HYDRANT

203.11.1 Where four-way fire hydrants are specified or required, they shall conform to, and be tested in accordance with the AWWA Standard for Dry-Barrel Fire Hydrants, ANSI/AWWA C502. All hydrants shall have: breakable connection features and a breakable coupling on the stem immediately above the bury line which has a lower breaking point than the rest of the unit; 8-inch inlet connection; bell, flange, or mechanical joint inlet; four-foot six-inch bury length; two 2½-inch hose nozzles with National Standard threads; two 4-inch pumper nozzles with Standard threads; "O" ring seal; drain valve; left (counter-clockwise) opening; Federal yellow finish paint above ground line; and National Standard pentagon operating nut.

203.11.2 Where fire hydrant extensions are specified or required, they shall be of the proper design to accommodate the make of fire hydrant installed.

#### 203.12 BLOW-OFF HYDRANT

203.12.1 Where blow off hydrants are specified or required, they shall be constructed in accordance with Construction Standard Blow-off Hydrant.

### **PART 204 - STEEL PIPE AND FITTINGS**

#### 204.1 GENERAL

204.1.1 Where steel pipe is specified or required, it shall conform to the AWWA Standard for Steel Water Pipe, 6-Inches and Larger, AWWA C200. No steel less than 33,000 psi specified minimum yield strength shall be permitted. All pipe shall be hydrostatically tested in accordance with AWWA C200. Mill Test Reports shall be furnished and the hydrostatic test pressure shown on shop fabrication drawings. AWWA Designation C200 shall govern the testing. Pipe length shall be not less than 35 feet per joint, except for specials, unless otherwise noted. There shall be no more than one longitudinal or girth seam per section. Nominal pipe diameter and steel thickness shall be as specified on the drawings. The diameter shown is the required inside diameter of cement-mortar lining. All pipe shall be manufactured by an established manufacturer who has had at least three (3) years experience in successfully building this type of pipe. Openings for air valves, main connections, and blow-off connections shall be provided with suitable reinforcements around the opening, welded to the body of the pipe in accordance with AWWA Manual M11. Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand the working pressure of the line where no other provision is made for closing the openings. Blind flanges shall be fabricated from material listed above as specified under AWWA C200. All bolts shall be carbon steel ANSI/ASTM A307, Grade A

only, in accordance with ANSI/AWWA C207. For corrosion monitoring of steel pipe, junction box test stations shall be furnished and installed. Magnesium anode banks shall be furnished and installed where specified in the plans. Junction box test stations and anode banks shall be installed in accordance with the stationing as shown on the Schedule of Anode Spacing in the plans.

- 204.1.2 All steel pipe shall be manufactured with ends of true circular shape, free from indentations, projections, or roll marks for a distance of eight inches (8") from the end of the pipe. This shall be done by hydraulic expansion or some other method satisfactory to the Engineer. The outside diameter of the pipe shall be true enough in dimension to permit the passage for a distance of eight inches (8") from the end of the pipe a ring gauge with a bore three-thirty seconds of an inch larger than the outside diameter of the pipe.
- 204.1.3 Where steel fittings or specials are specified or required, they shall conform to all of the steel pipe specification requirements and to the AWWA Standard for Dimensions for Steel Water Pipe Fittings AWWA C208. Where fittings and specials are fabricated from mill pipe, they shall be fabricated from pipe hydrostatically tested in accordance with AWWA C200 with mitered joints dye checked for welding flaws. Changes in line and grade shall be made by steel specials or in the joints. Joint deflection shall not exceed that as recommended by the manufacturer. Inside diameter of steel specials and fittings shall be the required inside diameter of cement-mortar lining.
- 204.1.4 Where field cutting of steel pipe is permitted, pipe shall be cut by sawing. The inside lining shall be removed for a minimum of six inches each side of the cut and the pipe surface shall be cleaned and brushed to bright metal. After welding, the inside lining shall be replaced in accordance with AWWA C602.
- 204.1.5 Minimum thickness of steel pipe shall be 0.25 inches. The minimum thickness standard in inches for each following size pipe shall be as follows:

Minimum Thickness - Inches for Grade of Steel

Nominal Pipe Diameter	A-283 Gr. D	A-53 Gr. B	A-139 Gr. C
6" ~ 30"	A-570 Gr. 33	A-135 Gr. B	A-572 Gr. 42
		A-139 Gr. B	
		A-36	
36"	0.313	0.250	0.250
42"	0.313	0.281	0.250
48"	0.375	0.313	0.281
54"	0.438	0.375	0.313
60"	0.500	0.406	0.344
66"	0.500	0.438	0.375
72"	0.563	0.500	0.406

204.1.6 The design criteria for steel pipe thickness is based on 150 psi working pressure plus a 75 psi allowance for water hammer. Maximum depth of cover shall be 12 feet. Depth of cover in excess of 12 feet shall require special design.

## 204.2 JOINTS

204.2.1 Steel Pipe and fittings shall have one of the following type joints: slip joint ends for field lap welding, single beveled ends for field butt welding, double beveled ends for field butt welding, "O" ring bell and spigot joints, or plain ends for mechanically coupled field joints. Flange ends shall be used only when noted on the drawings.

204.2.2 Welded joints shall conform to, and be tested in accordance with the AWWA Standard for Field Welding of Steel Water Pipe Joints, AWWA C206. Slip joints for field lap welding shall be sized to provide a tolerance of not less than 0.09 inches and not more than 0.41 inches difference in measurement between the outside circumference of the spigot end and the inside circumference of the bell end.

204.2.3 Mechanically coupled joints shall consist of Dresser Couplings, Style 38, or equal, or as specified on the drawings. The harness lugs, tie bolts, and nuts shall conform to AWWA M11 Steel Pipe Design and Installation, Par. 19.8.

204.2.4 Bell and spigot joints with rubber gasket shall conform to the AWWA Standard for Steel Water Pipe 6-Inches and Larger, AWWA C200 and the AWWA Steel Pipe Manual, MII. The gasket shall be a continuous "O" ring design of natural rubber or neoprene and shall be of suitable cross-section and size to assure a watertight joint. Acceptable bell and spigot joints for all steel pipe diameters and thicknesses shall be the "O" Ring-Bar Type, or the "O" Ring-Carnegie Section, or rolled groove type joint. Bell and spigot ends shall be properly sized by forcing over a sizing die or by expanding to stretch the steel beyond its elastic limit so that the difference in diameter between outside of spigot and inside of bell at normal engagement is not less than .03" and not more than 0.10" as measured on circumference with a diameter tape. Shop applied interior lining on the bell end of the pipe shall be held back a minimum distance of the spigot engagement + 1-1/8" for the Bar and Carnegie Type Joints. Hold back for the rolled groove joint shall be the spigot engagement + 1/2". Interior lining for the spigot, shall be continuous to the end. Field replacement of the interior joint linings shall be in accordance with Section 203.4. of these specification for cement-mortar linings. All "O" Ring joints shall be electrically bonded using a #4 bare copper wire, 6" length #15 cadweld cartridge brazed to bare metal at the bell and spigot or equal. Shop applied exterior coatings shall be held back in accordance with manufacturer's specifications. Field replacement of exterior coatings at the joints shall be in accordance with the AWWA Standard for Cold-Applied Tape Coatings for Special Sections, Connections, and Fittings, for Steel Water Pipelines, AWWA C209, or AWWA C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot Applied, or AWWA

C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4" and Larger, Shop Applied.

204.2.5 Where steel pipe is to be tapped, a split tapping saddle of 150 psi working pressure shall be used. The saddle body shall be heavy welded ANSI/ASTM A36, or ANSI/ASTM A285, Gr. C steel with flange conforming to ANSI/AWWA C207, Class D. The gasket shall be natural rubber or neoprene design in a continuous ring of suitable cross-section, and sized to assure a watertight joint. The interior and exterior surfaces of the saddle body shall be shop coated with a fusion-bonded epoxy. The exterior coating or wrap on steel pipe shall be removed to bare metal beneath the entire area to be covered by the sleeve.

204.2.6 Flanged joints shall conform to the AWWA Standard for Steel Pipe flanges, AWWA C207, Class D.

### 204.3 EXTERIOR COATING

204.3.1 The exterior coating on steel pipe and fittings shall be in accordance with Coal Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot Applied, AWWA C203; or Tape Coating Systems for the Exterior of Water Pipelines, AWWA C214 or cement-mortar coatings in accordance with AWWA C205, Cement-Mortar Protective Lining and Coating For Steel Water Pipe, 4" and Larger, Shop Applied. Where tape coatings are used, the total thickness shall be no less than 80 mils. Where cement-mortar coating is used, the thickness shall be not less than 3/4" and reinforced with spiral-wire, wire-fabric, or ribbon mesh reinforcement in accordance with AWWA C205, Sec. 2.1. All above ground piping shall be cleaned, primed, and painted with an enamel, as shown in the plans. The total dry film thickness shall be 6 mils.

204.3.2 If field welding is used, the pipe joints shall be furnished with the outside coating held back, in accordance with standard joint detailed drawings. The coating and any touch up work shall be done under the direction of the coating manufacturer, and as approved by the Engineer.

### 204.4 INTERIOR LINING

204.4.1 The interior lining shall be installed in the field in accordance with AWWA C602, Cement-Mortar Lining of Water Pipelines, 4-Inch and Larger, In Place; or shop applied in accordance with AWWA C205, Cement Mortar Protective Lining and Coating for Steel Water Pipe, 4" and Larger, Shop Applied. The lining shall be 3/8" thick for diameters through 36", and 1/2" thick for 42" and larger, whether shop or in place lined. Tolerances shall be in accordance with the applicable AWWA standards. Coal-tar enamel and coal tar epoxy interior linings will not be permitted.

204.4.2 Where in place cement-mortar lining is used, the contractor shall furnish all materials, labor, equipment, prepare the interior surface, and machine place

the mortar lining in the pipe. The lining at valves, specials, and bends may be hand sprayed or troweled, or hand applied as required. The lining shall be maintained in a moist condition while curing. The contractor shall be responsible for any extended curing time until acceptance by the Engineer. No additional payment shall be made for any extended curing period.

- 204.4.3 Where in-place mortar lining is cracked or delaminated from steel cylinder pipe, contractor shall repair broken or delaminated areas with Hilti 2-part epoxy, or approved equal.

#### 204.5 STRUTTING AND BRACING

- 204.5.1 Strutting and bracing shall be provided on all specials, fittings, and straight pipe, where shop lined or coated with cement mortar, so as to limit the pipe deflection to 2% maximum of inside diameter. A minimum of three strutting braces shall be installed in each standard pipe joint. For pipe 54" and larger in diameter, the strutting shoes at each bearing point shall be minimum 4 feet long, parallel to the longitudinal pipe axis. The strutting shall remain in place until all compacting and backfilling has been completed. Where In Place cement mortar lining is to be installed, sufficient strutting braces subject to the approval of the engineer, shall be installed at the shop to insure against pipe deformation.

### **PART 205 - REINFORCED CONCRETE PIPE AND FITTINGS**

#### 205.1 REINFORCED CONCRETE PIPE AND FITTINGS FOR WATER AND SANITARY SEWER LINES

- 205.1.1 Where reinforced concrete pipe (RCP) and fittings are specified or required per AWWA C301, for water or sanitary sewer lines, they shall be designed, manufactured, and tested in accordance with the AWWA Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids, AWWA C301, or Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and other Liquids, AWWA C303. All pipe shall be manufactured by an established manufacturer who has had at least three years experience in successfully building this type of pipe. All specials and fittings shall be built to the details furnished by the manufacturer and approved by the Engineer. Each special and each length of straight pipe shall be plainly marked to indicate the head for which the pipe is designed and to indicate where the pipe will be used by reference to the layout drawings. All closure fittings shall be furnished with an 18-inch flanged access manway with an 18-inch steel blind flange. 6-inch screw type hand hole fittings will not be permitted.
- 205.1.2 Sanitary Sewer Prestressed Concrete Cylinder Pipe (PCCP) or Reinforced Concrete Pipe(RCP) shall have the following interior lining systems or equal:

The lining system shall be a plural component. 100% solids, moisture tolerant, epoxy primer followed with a plural component, 100% solids, polyurethane top coat. The primer shall be a Zebron Low Temperature Epoxy (ZLTE) and the topcoat shall be Zebron #486 polyurethane as manufactured by Zebron Corporation, Anaheim, CA or approved equal. The lining system shall be suitable for application by airless spray. The primer shall be applied to a thickness of 2 to 3 mils and can be top coated when the primer becomes tacky (sticky to the touch) or can be top coated during the next 8 hours. When waiting up to 8 hours to top coat the primer, special care must be taken to assure the surfaces to be top coated are not exposed to moisture, dust, or other contaminants. The topcoat shall be applied to a 50-mil thickness and shall not exhibit running, sagging, or shrinking. The lining system shall be compatible with application to cured or green (one day old) Portland cement concrete or mortar. The applied lining shall formed impermeable, pin-hole-free. Membrane, monolithically applied with tight adherence to the concrete or mortar. The cured lining shall not peel or spall from the concrete or mortar surfaces. The lining system shall be resistant to abrasion during normal pipe handling and installation.

- 205.1.3 All concrete or mortar substrates must be sweep-abrasive grit blasted to create adequate profile then made dust free. All surfaces to be lined must be free of any oil, grease, or other deleterious materials. The surface must be dry to the touch (no standing water), but can have some surface discoloration due to moisture.
- 205.1.4 The two-component epoxy lining for PCCP shall be tested in accordance with National Association of Corrosion Engineers Standard for Discontinuity (Holiday) Testing of Protective Coatings. Results of the Discontinuity Testing shall be furnished to \_\_\_Sapulpa\_\_\_. Any defects shall be repaired and retested.
- 205.1.5 RCP and fittings for water lines shall be designed for the following conditions (minimum): Normal operating pressure equal to 150 psi plus 50% for surge pressure plus earth load resulting from actual backfill depth, but not less than 8 feet plus external live load equal to AASHTO HS 20 loading. The thickness of the mortar coating shall provide a minimum cover of 1 inch over the reinforcing steel.
- 205.1.6 Reinforced concrete pipe and fittings for water lines shall be jointed according to AWWA Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids, ANSI/AWWA C301, or Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids, AWWA C 303.
- 205.1.7 Where concrete pressure pipe ANSI/AWWA C301, Steel Cylinder Prestressed Concrete or Pretensioned Concrete Pressure Pipe, AWWA C303 is to be tapped, the tapping saddle shall be fabricated in accordance with the American Water Works Association Manual M-9, and as recommended by manufacturers of Concrete Pressure Pipe. Saddle shall provide grout

gaskets and grout opening to enable filling the wall space between saddle and pipe wall with grout, to assure complete protection of the steel pipe wall. The saddle shall also provide gland assembly, including gasket and flange, to insure a tight seal.

- 205.1.8 Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand the working pressure of the line where no other provisions is made for closing the openings. Blind flanges shall be fabricated from material as specified under AWWA C200. All bolts shall be carbon steel ASTM A307, Grade A only, in accordance with ANSI/AWWA C207.

## 205.2 REINFORCED CONCRETE PIPE AND FITTINGS FOR STORMWATER AND SANITARY SEWERS

- 205.2.1 Where reinforced concrete pipe (RCP) and fittings are specified or required per ASTM C76, for storm and sanitary sewers, except as herein modified, they shall be designed, manufactured, and tested in accordance with ASTM C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe. Pipe shall be a minimum Class III. Pipe length shall be no less than 6'-0" except for shorts and specials. Pipe sections connected to a manhole or structure shall be no more than 4' - 0" in length, as measured from the inside face of the structure to the point of flexure of the joint. Elliptical reinforcement is not allowed. At least three circumferential reinforcing bars shall be provided in each pipe bell equal in area to an equivalent length of outside cage in the pipe barrel. Concrete shall have a minimum 28-day compressive strength of 6,000 psi, and absorption not to exceed six percent.

- 205.2.2 Testing shall be observed and reported by an independent testing laboratory approved by the Engineer. One (1) Three-Edge Bearing Test in accordance with ASTM C497 shall be performed on a representative sample of each diameter and class of pipe to be furnished. One (1) absorption test in accordance with ASTM C497 shall be performed for each 300 tons of pipe manufactured, not less than one (1) test per day's production. Four (4) concrete cylinders or core samples shall be tested for compressive strength from each days production, two at 7 days and two at 28 days. An in-plant hydrostatic test in accordance with ASTM C361 shall be performed on each section of pipe and each pipe joint at an internal hydrostatic head of 25 feet. The joints shall be tested for a minimum period of one (1) hour under constant pressure as specified. Each pipe unit that satisfactorily passes all hydrostatic testing shall bear the seal of the testing laboratory. This seal does not constitute acceptance of the pipe installation, which will be subjected to further testing and inspection in the field.

- 205.2.3 In lieu of the in-plant hydrostatic testing of each joint, the Contractor may substitute the following procedure: (1) Perform one in-plant hydrostatic test per days production, in accordance with the previously specified criteria; and (2) Perform an air test on each joint in the field after assembly, in accordance

with \_\_\_Sapulpa\_\_\_ Water and Sewer Department Standard Air Test Procedure. The Contractor shall furnish all air test equipment. Testing and test conclusions shall be verified by the Engineer. The Engineer reserves the right to require additional in-plant hydrostatic testing.

- 205.2.4 Reinforced concrete pipe and fittings for storm sewer shall be jointed in accordance with ASTM C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe. Joints shall be concrete bell and spigot, employing a rubber gasket and cement mortar formed by a diaper. Rubber gaskets shall be either a standard o-ring gasket or a Forsheda pre-lubricated gasket, or equal. For the o-ring gasket, the spigot end shall contain a groove to confine and compress the gasket on four surfaces when the joint is in final position. The Forsheda joint shall be designed and installed in accordance with the manufacturer's recommendations.
- 205.2.5 Reinforced concrete pipe and fittings for sanitary sewer shall be jointed in accordance with AWWA C302, Reinforced Concrete Pressure Pipe, Non-cylinder type. Joints shall be Steel End Ring with Spigot Groove and O-ring gasket, and include cement mortar formed by a diaper.

## **PART 206 - VITRIFIED CLAY PIPE AND FITTINGS**

### 206.1 PIPE AND FITTINGS

- 206.1.1 Where vitrified clay pipe (VCP), fittings and in-line tees are specified or required, they shall conform to the Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated ANSI/ASTM C700. Testing shall be in accordance with methods of Testing Clay Pipe, ANSI/ASTM C301.
- 206.1.2 Where vitrified clay pipe is being installed, in-line tees for future connections to the sanitary sewer shall be manufactured specifically for vitrified clay pipe.

### 206.2 JOINTS

- 206.2.1 Vitrified clay pipe shall be jointed with material conforming to the Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings, ANSI/ASTM C425. All jointing materials shall be used in accordance with the manufacturer's instructions and subject to the approval of the Engineer.
- 206.2.2 Where it is necessary to connect vitrified clay pipe to ductile iron pipe a rigid type adapter shall be used. Only the following adapters will be permitted: Dickey DPB- VC x DI, Dresser Style 39, and Rockwell Omni. Flexible couplings will not be permitted.

## **PART 207 - POLYVINYL CHLORIDE (PVC) PIPE, WATER SERVICE**

- 207.1 Where polyvinyl chloride (PVC) pipe four (4) inches in diameter through twelve (12) inches in diameter is specified or required, it shall conform to and be tested in accordance with AWWA C900, "AWWA STANDARD for POLYVINYL CHLORIDE (PVC) PRESSURE PIPE, 4 IN. THROUGH 12 IN., FOR WATER", as herein modified. PVC water pipe shall be approved by the Underwriters Laboratory Sanitation Foundation Testing Laboratory for potable water pipe. Polyvinyl chloride water pipe shall be restricted from use adjacent to arterial streets.
- 207.2 PVC pipe shall conform to pressure Class 200 (equivalent to Dimension Ratio 14) and shall have an outside diameter (OD) equal to the OD of equivalent size ductile iron pipe.
- 207.3 PVC pipe shall have integral wall-thickened bell ends and shall be jointed using one-piece elastomeric gaskets. Solvent cement jointing shall not be permitted.
- 207.4 Fittings for PVC pipe shall be polyethylene wrapped ductile or cast iron conforming to Part 202 of these specifications. The use of PVC fittings shall not be permitted.
- 207.5 Contractor shall submit certifications from the manufacturer that PVC pipe has been manufactured in accordance with AWWA C900, and that it meets the approval of the "NSF".
- 207.6 Where restrained joints are required, they shall be of a mechanical type assembly easily removed in field once assembled without special equipment. Assemblies shall be ANSI/AWWA approved. Setscrew type retainer glands will not be permitted.

## **PART 208 - POLYVINYL CHLORIDE (PVC) PIPE, SEWER SERVICE**

- 208.1 Where polyvinyl chloride (PVC) pipe eight (8) inches in diameter through fifteen (15) inches in diameter, fittings and inline tees are specified or required for sewer service, it shall conform to and be tested in accordance with ASTM D3034 "Type PSM Polyvinyl Chloride Sewer Pipe and Fittings" for standard dimensional ration (SDR) of 35. Minimum pipe stiffness for all sizes shall be 46 psi.
- 208.2 Where polyvinyl chloride (PVC) pipe 18-inches in diameter through 36 inches in diameter is specified or required for sewer service it shall conform to and be tested in accordance with ASTM F679, Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings Minimum pipe stiffness shall be 46psi.

- 208.3 The PVC sewer pipe shall be supplied in 12.5 foot, or 20 foot laying lengths as specified.
- 208.4 Where it is necessary to connect PVC sewer pipe to ductile iron pipe and AWWA C110 long body solid sleeve shall be used with a special gasket for the PVC pipe. Flexible couplings will not be permitted.
- 208.5 Where PVC sewer pipe is being installed, the fittings for the service line and the in-line tees for future service connections shall be manufactured and specifically designed for Schedule 40 PVC service lines.
- 208.6 The manufacturer shall maintain quality control through regularly scheduled testing in accordance with all referenced ASTM standards. Testing for flattening and the pipe stiffness shall be performed on one test specimen for each size and class of pipe produced for the project. Certifications shall be furnished that the material was manufactured, sampled, tested, and inspected in accordance with all applicable specifications. The certifications shall indicate the manufacturer's production code from which the plant location, machine, and date of manufacture can be identified.

## **PART 209 - CASTINGS**

- 209.1 Gray iron castings shall conform to and be tested in accordance with the Standard Specification for Gray Iron Castings ASTM A48 and applicable sections of Drainage Structure Castings, AASHTO M 306, current edition. All castings, including manhole steps, lamphole covers, water meter lids, manhole frames and lids, adjustment rings and valve boxes shall be Class 35B iron.
- 209.1.1 Iron class shall be determined using only those guidelines outlined in ASTM A48. Tensile specimens shall be obtained using AASHTO M306 Para 9.1.4, Acceptance on the Basis of Test Bars Cut from Portions of Units Supplied to Purchaser. Where samples are too thin and cannot be obtained under ASTM M306 Para 9.1.4, specimens shall be obtained under ASTM M306 Para 9.1.3 Acceptance on the Basis of Cast-on Test Bars. Elapsed time during tensile test shall follow ASTM A48 para 14. Tensile test specimens shall fit the holders of the testing machine in a way such that the load will be axial.
- 209.1.2 Additionally, castings that are rated for traffic loadings within dedicated public rights-of-way or other locations subject to vehicular traffic must pass an AASHTO proof load test that can maintain a 40,000 lb proof load for one (1) minute, applied on a 9"x9" contact area in the center of the casting. The load shall be applied at a constant rate requiring a minimum of 30 seconds to reach the 40,000 lb level. Following this test the casting shall be visually inspected for cracks or permanent deformation which will be cause for rejection. Following this, the casting shall be loaded to failure.

- 209.1.3 Cost for tensile and proof load testing shall be borne by manufacturer, and testing shall be performed at a testing facility acceptable to the Engineer. All tests shall be witnessed by the Engineer.
- 209.2 Casting dimensions shall vary by not more than  $\pm 1/16$  inch per foot.
- 209.3 All bearings surfaces shall be machined to prevent rocking and rattling.
- 209.4 Where sealed manholes are specified, only McGard locking system with 5/8" – 11 thread which is keyed to Sapulpa standard lock is allowed.
- 209.5 Only those castings which have been approved by the Department will be permitted. Approval for each casting shall consist of approved shop drawings, plus laboratory test reports of the tensile test and load test.
- 209.6 The City of Sapulpa, on an annual basis, reserves the right to randomly select any castings for tensile and proof load testing from the foundry's local representative's yard. Such testing shall be at manufacturer's expense.

## PART 210 - CONDUIT

- 210.1 Where conduit (also known as tunnel liner or pipe sleeve), 6 inches or larger, is specified or required, it shall be steel pipe, and be in accordance with AWWA C200, 3/8" wall thickness.

Conduit shall be sized according to the following:

Carrier Pipe		Conduit, ID
Water	Sanitary Sewer	
6"	6"	18"
8"	8"	20"
	10"	22"
12"		24"
	12"	26"
	15"	28"
16"		30"
	16"	32"
	18"	32"
24"	24"	42"
30"	30"	48"
36"	36"	54"
42"		60"
	42"	62"
	48"	68"

## **PART 211 - VAULT, PITS AND MANHOLES**

- 211.1.1 Concrete masonry units shall conform to, and be tested in accordance with the specifications for Concrete Masonry, Hollow Load Bearing Concrete Masonry Units, ANSI/ASTM C90, or Concrete Building Brick C55, Grade A.
- 211.1.2 Precast manholes shall conform to, and be tested in accordance with, the specifications for Precast Reinforced Concrete Manhole Sections, ANSI/ASTM C478, flat slab top type.
- 211.1.3 Manhole adjusting ring shall be solid cast iron that fits in the standard City of Sapulpa Sanitary Sewer manhole frame and the standard manhole lid fits in the adjusting ring.
- 211.1.4 Adjusting rings shall conform to and be tested in accordance with the Standard Specification for Gray Iron Castings ASTM A48 and Drainage Structure Castings, AASHTO Designation: M306-89. Castings shall be Class 35-B iron and unpainted.
- 211.1.5 The contact surface between manhole ring and manhole frame and the contact surface between manhole ring and manhole lid shall be machined smooth to prevent rocking and rattling.
- 211.1.6 The two (2) inch manhole adjusting ring where specified shall have a minimum weight of 70 pounds and the three (3) inch manhole adjusting ring where specified shall have a minimum weight of 100 pounds.
- 211.1.7 Markings on all gray iron castings shall conform to AASHTO Designation M306-89. (AASHTO M306-89 states: Each casting shall be identified by the foundry showing): Name of Foundry, Country of manufacturer, ASTM Designation Number, Class by a number followed by a letter indicating the minimum tensile strength and size of test bar. (i.e. Class 35-B), Heat Number and Date. No other wording or marking of any kind other than those stated above or shown on the plan will be permitted on castings.
- 211.1.8 All sanitary sewer manholes and structures 5-foot I.D. or larger shall have an interior epoxy coating
- 211.1.9 **MANHOLE COATING** - This section specifies the insitu-coating of new concrete sanitary sewer manholes to provide protection against corrosion to the manhole interior. This section includes requirements for product and contractor qualifications, work, materials, and equipment required for surface preparation, repairs, and application of a monolithic solvent-free epoxy coating to specified surfaces.

211.1.10 SUBMITTALS - The following items shall be submitted to Engineer for approval:

- A. Technical data sheet and material safety data sheet (MSDS) on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.
- B. Contractor Qualifications:
  - 1. Manufacturer certification that Contractor has been trained and approved in the handling, mixing and application of the products to be used.
  - 2. Certification that the plural component spray equipment to be used for applying the products has been manufactured or approved by the protective coating manufacturer and Contractor's personnel have been trained and certified for proper use of the equipment.
  - 3. Three (3) recent references of Contractor projects of similar size and scope indicating successful application of a high-build solvent-free epoxy coating by plural component spray application in underground concrete structures.
  - 4. Proof of any necessary federal, state or local permits or licenses necessary for the project.
  - 5. Design details for any additional ancillary systems and equipment to be used in site and surface preparation, application and testing.

211.1.11 DELIVERY, STORAGE, HANDLING AND SITE CONDITIONS

- A. Protective coating materials are to be stored and handled according to their material safety data sheets.
- B. Contractor shall conform with all local, state and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.

211.1.12 WARRANTY

Contractor shall warrant all work against defects in materials and workmanship for a period of one (1) year, unless otherwise noted, from the date of final acceptance of the project. Contractor shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said one (1) year period, and any damage to other work

caused by such defects or the repairing of same, at his own expense and without cost to the Authority.

211.1.13 EXISTING PRODUCTS

- A. Standard Portland cement or new concrete (not quick setting high strength cement) must be well cured prior to application of the protective coating. Minimum of 28 days cure time.

211.1.14 MANUFACTURER

- A. Raven Lining Systems, Inc., Tulsa, Oklahoma 800-324-2810 or 918-584-2810 or FAX 918-582-4311, or equal.

211.1.15 REPAIR MATERIALS

- A. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the Authority and protective coating Contractor. Repair materials must be compatible with the specified epoxy coating and shall be applied in accordance with the manufacturer's recommendations.

211.1.16 PROTECTIVE COATING MATERIAL

- A. Raven Lining Systems' Raven 405 epoxy coating system, or equal.

Product type	Amine cured epoxy
Color	Light Blue
Solids Content (vol %)	100
Mix Ratio	3:1
Compressive Strength, psi	18,000
Tensile Strength, psi	7,600
Flexural Modulus, psi	600,000
Hardness, Type D	88
Bond Strength - Concrete	>Tensile Strength of
Concrete	
Chemical Resistance to:	
Sulfuric Acid, 10%	Immersion Service
Sodium Hydroxide, 20%	Immersion Service
Municipal Wastewater	Successful pass L.A.
County	
	Sanitation District Coating
	Evaluation

211.1.17 SURFACE PREPARATION

- A. Contractor shall inspect all surfaces specified to receive a protective coating prior to surface preparation. Contractor shall

notify Engineer of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the repair mortar and protective coating.

- B. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.
- C. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface or replaced.
- D. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. Contractor shall utilize high pressure water cleaning equipment capable of 5,000 psi at 4 gpm.
- E. Infiltration shall be stopped by using a material which is compatible with the specified repair mortar and is suitable for topcoating with the specified epoxy protective coating.

#### 211.1.18 APPLICATION OF REPAIR MATERIALS

- A. Repair materials shall meet the specifications herein. If using approved cementitious repair materials, such shall be trowelled to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the protective coating. No bugholes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar. The repair materials shall be permitted to cure according to manufacturer recommendations.
- B. After leak repair is performed, all surfaces shall be inspected for remaining laitance prior to protective coating application. Any evidence of remaining contamination or laitance shall be removed. If repair materials are used, refer to these specifications for surface preparation. Areas to be coated must also be prepared in accordance with these specifications after receiving a cementitious repair mortar and prior to application of the epoxy coating.

#### 211.1.19 APPLICATION OF PROTECTIVE COATING

- A. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.

- B. The protective coating material must be spray applied with protective coating manufacturer approved heated plural component spray equipment by a Certified Contractor of the protective coating manufacturer.
- C. Specified surfaces shall be coated by spray application of a moisture tolerant, solvent-free, 100% solids, epoxy protective coating as further described herein. Spray application shall be to a minimum wet film thickness of 80 mils.
- D. If necessary, subsequent topcoating or additional coats of the protective coating should occur as soon as the basecoat becomes tack free, ideally within 12 hours but no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.

#### 211.1.20 TESTING AND INSPECTION

- A. All manholes shall be vacuum tested after installation and prior to protective coating preparation and application.
- B. During application a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating and uniform thickness during application. A log shall be submitted to Authority by Contractor that includes wet film thickness testing and protective coating material usage per manhole structure. This log is to be kept and certified by Contractor that material usage and WFT indicates proper coverage at a minimum of 80 mils per these specifications.
- C. After the protective coating has set hard to the touch it shall be inspected by Authority with high-voltage holiday detection equipment. Surface shall first be dried, an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 8,000 volts (100 volts per 1 mil of film thickness applied) but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. Large areas may require additional surface preparation and spray application to

achieve minimum thickness. All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations.

- D. At the Engineer's option, select structures may be subjected to adhesion testing and destructive testing for measurement of film thickness at no additional cost. Measurement of adhesion of the protective coating to the substrate can be made in accordance with ASTM D4541. Measurement of film thickness can be made from the dollies pulled during adhesion testing. Any areas detected to have inadequate adhesion shall be evaluated by the Engineer. Further tests may be performed to determine the extent of potentially deficient bonded area and repairs shall be made by Contractor in strict accordance with manufacturer's recommendations.
- E. A final visual inspection shall be made by the Authority and Contractor. Any deficiencies in the finished coating shall be marked and repaired by Contractor according to the procedures set forth herein.

## **PART 212 - SAND FOR CUSHION OR BACKFILL**

- 212.1.1 Sand shall be graded from fine to coarse, free from objectionable material, and contain not more than ten percent (10%) clay or loam by weight. One hundred per cent shall pass a three-quarter inch screen, and ninety-five per cent shall pass a number four screen.

## **PART 213 - CRUSHED STONE FOR SURFACING, BASE COURSE, AND STABILIZATION**

- 213.1 Crushed stone shall consist of clean, tough, durable fragments, free from an excess of soft or disintegrated particles. Sampling shall be in accordance with the Standard Method of Sampling Aggregates, ANSI/ASTM D 75. Sieve analysis shall be performed in accordance with the method of Sieve Analysis, ANSI/ASTM C136. Gradation to be used at each location will be specified by the Engineer. Crushed stone for aggregate base and surface course shall conform to the Oklahoma Department of Transportation Specifications for Highway Construction, and shall conform to the following gradations:

## 213.2

## Percent Passing

Sieve Size	Type A	Type B
3"	-----	100
1-1/2"	100	40-100
3/4"	40-100	30-75
3/8"	30-75	25-60
No. 4	25-60	20-50
No. 10	20-43	15-35
No. 40	8-26	7-22

213.2.1 Crushed stone aggregate for stabilization and bedding shall conform to the following ASTM D448 and C33 gradations:

## 213.2.2 Percent Passing

	Size #1	Size #467	Size #57
Sieve Size	3 1/2" to 1 1/2"	1 1/2" to No. 4	1" to No. 4
4"	100	-	-
3 1/2"	50-100	-	-
2 1/2"	25-60	-	-
2"	-	10	-
1 1/2"	0-15	95-100	100
1"	-	-	95-100
3/4"	0-5	35-70	-
1/2"	-	-	25-60
3/8"	-	10-30	-
No. 4	-	0-5	0-10

	Size #67	Size #7
Sieve Size	3/4" to No. 4	1/2" to No. 4
4"	-	-
3 1/2"	-	-
2 1/2"	-	-
2"	-	-
1 1/2"	-	-
1"	100	-
3/4"	90-100	100
1/2"	-	90-100
3/8"	20-55	40-70
No. 4	0-10	0-15

## **PART 214 - RIP RAP**

- 214.1      **QUALITY OF MATERIALS:** All stone for Rip Rap shall be either sandstone, limestone, or other hard stone of good quality that will not materially disintegrate under action of air or water. It shall weigh not less than 140 pounds per cubic foot as determined from the bulk specific gravity (saturated surface dry) of the sample in accordance with procedure in ANSI/ASTM Specifications C127-68, "Test for Specific Gravity and Absorption of Coarse Aggregate". Slabs or slivers shall not be used. Rocks shall be of angular shape. Gypsum, anhydrite, chert, shale, soft or weathered rock shall not be used. All stone material furnished shall be such that will yield hard, massive, heavy, durable stone, and shall be free from cracks, seams and other defects that would tend to unduly increase its destruction by natural causes. The contractor shall furnish for the work, an approved stone of good quality. The successful bidder shall, within fifteen (15) days after receipt of notice to proceed, submit to the contracting officer for approval, three (3) samples weighing not less than 150 pounds each, of the stone he proposes to furnish. The samples shall be fairly representative of the whole quarry. If it is proposed to furnish stone for more than one quarry, samples as stated above shall be furnished from each quarry. The City will notify the contractor of acceptance or rejection of the stone samples within ten (10) days after their submittal for approval. The submission of samples will not be required if the material is to be obtained from a source previously approved by the City from test and service records.
- 214.2      **TYPE "B":** Type "B" rip rap material shall be quarry-run rock free from overburden spoil, and no piece shall weigh more than 500 pounds. At least forty percent (40%) of any shipment shall consist of rocks weighing 100 pounds or more. Rock shall be graded so as to produce a reasonably well-graded mass with the minimum practicable percentage of voids. Rock carrying dirt and fines less than 1/2-inch in maximum cross section, accumulated from interledge layers or from blasting or loading operations, will be accepted if such material does not exceed ten percent (10%) by weight.
- 214.3      **TYPE "C":** Type "C" rip rap material shall be quarry-run rock free from overburden spoil, and no piece shall weigh more than 1,000 pounds. At least forty percent (40%) of any shipment shall consist of rocks weighing 200 pounds or more. Rock shall be graded so as to produce a reasonably well-graded mass with the minimum practicable percentage of voids.

**SECTION END**

## **DIVISION III**

### **CONSTRUCTION SPECIFICATIONS**

#### **PART 301 - RIGHT-OF-WAY CLEARING AND RESTORING**

- 301.1 Work under this item shall include the removal and reconstruction or replacement of all obstructions affected by the construction of the project, including, but not limited to fences, retaining walls, patios, trash burners, signs, mail boxes, out-buildings, landscaping, etc. Any such obstructions that are not to be reconstructed are so designated on the drawings. Such shall be removed and disposed of by the contractor. All obstructions to be replaced or reconstructed shall be restored to substantially the same condition as existed prior to the construction except as otherwise noted. The Contractor shall remove and dispose of all debris, restore the grade of the surface of the earth as reasonably as may be done to the grade existing prior to construction, and upon completion of the work shall leave the site in as neat, clean and orderly condition as nearly as it was prior to construction as may be reasonably done. Contractor shall document by photographing all concrete and asphalt driveway crossings and marking the location by street address on each photo. Photographs shall be filed with Public Works Department prior to commencing work. All costs of photography shall be included in Bid Item 301a, Right-of-way clearing and restoring.
- 301.2 Passable surfaces across or along the construction vicinity shall be maintained at all times with gravel, steel mat or plate, or temporary bituminous surfacing material where a sidewalk, driveway, parking lot, street or alley previously existed. Pavement damaged by the Contractor's equipment shall be replaced to original condition. Gravel surfaces shall be replaced with the same.
- 301.3 If an obstruction is of public ownership, the Contractor shall notify the appropriate agency, and obtain any necessary permit or license forty-eight hours before beginning any operations affecting the obstruction. All work shall conform to the current standards and specifications of that agency, and shall be approved by the agency before completion of the project. At the Contractor's request, the Engineer will furnish information as to what licenses or permits are required.
- 301.4 **PAYMENT:** Payment for this item shall be made at the unit price bid per linear foot. Total footage shall be the total length of pipe, not including bores, fittings, or specials, as included in other items. No additional payment shall be made for alterations of utility mains, service lines, or appurtenances, unless specifically provided for elsewhere in the Contract Documents.

#### **PART 302 - EXCAVATION AND BACKFILL, UNCLASSIFIED**

- 302.1 The work under this item shall include all earth, shale, gravel, loose rock, solid rock, debris, junk and/or other material excavated or otherwise removed in the

preparation of the trench; all work in connection with the excavation, removal and subsequent handling and disposal of such material, regardless of its type, character, or condition; subgrade preparation, all sheeting, piling, shoring, bracing, and dewatering of trenches; protection of adjacent property; backfilling; sand cushion; grade base stabilization; all specified backfill consolidation; and other work necessary or required.

- 302.2 The trench shall be excavated so that the pipe can be laid to the alignment and grades shown on the drawings, or as directed by the Inspector. In dense or built-up areas or where unstable soils exist, the trench shall be excavated a maximum of one hundred (100) feet in advance of pipe laying. In open areas or where soil conditions permit, the trench excavation may be unlimited in advance of pipe laying, as approved by the Engineer. Opening of trenches in excess of the maximum requires specific approval of the Engineer. Trenches shall be dry when the trench bottom is prepared. The trench bottom shall be shaped so that even bearing is obtained for the barrel of the pipe with the bells unsupported. The standard trench width as shown on the attached Standard Detail, shall not be exceeded at any elevation below a point twelve inches above the top of the pipe. If for any reason this portion of the trench exceeds the permitted width and if the Inspector shall determine that cradling or encasement then is required, said concrete cradle or encasement shall be installed. Any part of the bottom of the trench excavated more than four inches below the specified grade shall be corrected with approved material thoroughly compacted as directed by the Inspector. In the event suitable material is not available, sand shall be used. When rock is encountered and concrete cradle is required, it shall be excavated four inches below the bottom of the pipe and the trench refilled to grade with sand. When quicksand or other unstable earth is encountered, the Contractor shall excavate to sufficient depth to permit backfilling with Class "A" crushed stone in order to provide a stable base for the pipe. Trench safety shall be in accordance with applicable OSHA, State, and local regulations.
- 302.3 Bedding of pipe shall be as shown on the attached Standard Details. Sand shall be placed in the trench simultaneously on both sides of the pipe to an elevation of six inches above the top of the pipe, being carefully worked and hand-tamped around the pipe in order to consolidate the sand and assure excellent bedding. Backfill material shall not be placed in the trench covering the sand cushion without prior approval of the Inspector.
- 302.4 For large diameter (18" and above) flexible pipe, bedding shall be in accordance with the Bedding Detail for Large Diameter Flexible Pipe. The pipe shall be bedded in soil-cement, installed over a 6-inch sand cushion. The bedding shall be installed to the top of the pipe for the full width of the excavated trench. The soil-cement shall consist of a mixture of sand, portland cement, and water. Each cubic yard of soil cement shall contain 1 1/2 sacks of cement and approximately 70 gallons of water. Precautions shall be taken to prevent flotation. Movable trench supports shall not extend lower than the top of the pipe.
- 302.5 When the type of backfill material is not indicated on the Drawings or specified, the backfill may be made with the excavated material, provided that such

material, in the opinion of the Inspector is suitable for backfilling. In the event that excavated material is not suitable, sand or other approved material shall be used. From six inches above the pipe to eighteen inches above the pipe, the trench shall be backfilled by hand or by mechanical methods approved by the Inspector. Special care shall be used in placing this portion of the backfill to avoid damaging or moving the pipe. The remainder of the trench may be backfilled by mechanical methods. Backfilling operation shall be completed within one hundred (100) feet or less of the finished line at all times, as directed by the Inspector.

302.6

Unless otherwise directed by the Engineer, all trenches excavated across any sidewalk, driveway, parking lot or other paved area, across any traveled portion of unpaved streets or alleys, across any proposed roadways or proposed roadway fills, and as shown on the drawings shall be bedded and backfilled with Type A Crushed Stone (1-1/2" crusher run), placed in 8-inch maximum lifts and compacted to 95% Standard Proctor Density, as measured by the Nuclear Density Method. Compaction shall be done by a vibratory hand tamper. Trenches excavated across existing street or alley paving shall be backfilled in accordance with the standard detail for Pavement Removal and Replacement. For excavations where there is more than 6 feet of cover over the top of the pipe and where the trench width is sufficient for use of heavy compaction equipment, an engineered fill using a suitable compactable material may be used in lieu of crusher run, if approved in writing by the Public Works Director. If the backfilling has been completed and the backfill material does not meet the requirements for compaction, all the material shall be removed and hauled from the job site and the trenches refilled with material as specified above. Failure of backfill shall be corrected immediately, as directed by the Engineer.

302.7

**PAYMENTS:** Payment for this item shall be made at the unit price bid per cubic yard. Volume will be computed as follows: standard trench width as listed in Standard No. 315; length of line, as the actual horizontal measurement along the centerline of the ditch; depth of excavation as the actual depth of ditch from the original ground surface to the flow line of the pipe as shown in the construction notes. Average end-area method of computing volume will be used. No payment for excavation will be made for material excavated outside the neat lines of the standard trench width. No additional payment will be made for: sand cushion; backfilling; compaction of backfill; crushed stone used for backfill under existing and/or proposed roadways, roadway fills, streets, alleys, driveways, sidewalks, parking lots or as shown on the Drawings; removing and replacing top soils and obstruction, tunneling of trees, storm sewers or other obstructions; blasting; bracing and shoring; dewatering; pumping and draining; grade base stabilization; removal of excess excavated material; or restoration of the site. It is mutually understood that subterranean water, quicksand, or other unstable earth may be encountered and the Contractor has taken such into consideration in making this bid. Where such is encountered, Contractor will be required to excavate to sufficient depth to permit backfilling with crushed stone in order to provide a stable base for the pipe. Extra payment will not be made because of

such additional excavation or because it is necessary to excavate wider than the standard trench width; or for crushed stone.

## **PART 303 - MOBILIZATION**

303.1 This work shall consist of the performance of construction preparatory operations, including the movement of personnel and equipment to the project site and for the establishment of the Contractor's offices, buildings, and other facilities necessary to begin work on a substantial phase of the Contract. The Engineer's field office and laboratory is a separate pay item and is not included in this work.

### **303.2 PAYMENT**

303.2.1 Payment shall be full compensation for performing the work specified and the furnishing of all materials, labor, tools, equipment, and incidentals necessary to mobilize and subsequently demobilize the construction preparatory operations.

303.2.2 Payment for this item will be made in two installments unless the first estimate submitted is also the final estimate, in which case the total lump sum bid will be paid. The first payment of 50 percent of the lump sum Contract price will be made on the first estimate following partial mobilization and the initiation of construction work.

303.2.3 The second and final payment will be made on the next estimate following the completion of substantial mobilization. The determination of when an estimate is due shall be in accordance with Subsection 109.06 of the Standard Specifications. Mobilization will not be considered in this determination. The completion of the erection of materials processing plants, if any, will not be required as a condition to the release of the final payment.

## **PART 304 - CONTRACTOR CONSTRUCTION STAKING**

304.1 This work shall consist of furnishing, placing, and maintaining construction layout stakes necessary for the proper prosecution and inspection of the work under the contract.

304.1.1 Contractor shall exercise care in the preservation of stakes and benchmarks and have them reset when they are damaged, lost, displaced, or removed. Contractor shall use licensed land surveyor in the State of Oklahoma and suitable equipment for the layout work required.

304.1.2 Contractor shall set all additional stakes needed, such as offset stakes, reference point stakes, slope stakes, pavement, curb line and grade stakes, stakes for bridges, sewers, roadway drainage, pipe underdrains, paved gutter, fence, culverts, or other structures – and any other horizontal or vertical controls necessary to secure a correct layout of the work. Stake centerline/control line of temporary features, such as shoo-fly detours. Contractor shall make stakes for

line and grade adequate to maintain the specified tolerances for the operation being performed and satisfactory to Engineer. Mark the station number and the distance from the centerline of construction on all grade stakes.

304.1.3 Contractor shall furnish platforms and equipment necessary for proper and safe access for checking the staking, and when significant errors occur, resurvey to satisfaction of the Engineer.

304.1.4 Contractor shall notify Engineer immediately of plan errors. Special surveys necessary to determine corrective action shall be responsibility of Engineer.

## 304.2 PAYMENT

304.2.1 Payment shall be by lump sum for Contractor Construction Staking, and shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified, including profile measurements of connecting features.

304.2.2 Payment for this item of work shall be on the following schedule:

25 percent on the first payment estimate

25 percent when 10 percent of the contract work is complete

25 percent when 50 percent of the contract work is complete

20 percent when 75 percent of the contract work is complete

5 percent when all construction features have been verified as properly placed and completed

## **PART 305 - PIPE, VITRIFIED CLAY**

305.1 The work under this item shall include furnishing, delivery, and placing and jointing of vitrified clay pipe (VCP) in the trench in specific conformity with the line and levels given.

305.2 The pipe shall be laid on a firm trench bottom, true to the lines and grades shown on the Drawings and/or as given in the field by the Inspector. Pipe shall be protected during handling against impact shocks and free fall. The laying of pipe in finished trenches shall be commenced at the lowest point, with the spigot ends pointing in the direction of flow. Pipe shall be laid continuously through new manholes if both inlet and outlet pipes are of the same size and in line. Upon completion of the manhole the invert shall be shaped. The ends of adjoining pipes shall butt against each other for their entire circumference in such a manner that there is no shoulder or unevenness of any kind. If Contractor uses batterboards, a top line shall be maintained over a span of three grade stakes when laying pipe. As each batterboard is erected, the top line shall be sighted to assure the accuracy of the grade stakes and the batterboards' settings. Any errors, discrepancies, or displacement of grade stakes shall be called to the attention of the Inspector for correction.

- 305.3 Prior to making pipe joints, all surfaces of the portion of the pipe to be jointed shall be cleaned and dried. Jointing shall be done in strict accordance with the manufacturer's recommended procedure. Trenches shall be kept water-free during jointing and for a sufficient period thereafter to allow the joint to become fully set and completely resistant to water penetration. There shall be no realignment of the pipe after the joint is completed unless the pipe is removed and a completely new joint constructed.
- 305.4 Double joints of eight inch pipe may be prepared and laid, provided the double joints are prepared by jointing the pipe in a vertical position using a straight edge inside the pipe to align the joint. Double joints shall not be placed in a horizontal position prior to laying unless suitably supported in racks. Double joints of pipe shall be supported at the middle joint, as well as the ends, when the pipes are lowered into the trench.
- 305.5 **PAYMENT:** Payment for this item shall be made at the unit price bid per linear foot of the pipe specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes.

#### **PART 306 - PIPE, REINFORCED CONCRETE**

- 306.1 The work under this item shall include furnishing, delivery, placing and jointing of reinforced concrete pipe (RCP) in the trench in specific conformity with the lines and levels given.
- 306.2 For water and sewer lines, the American National Standard for Installation of Gray and Ductile Cast-Iron Water Main and Appurtenances, AWWA C-300, shall govern the installation as applicable. The method of bedding shall be as shown on the attached Standard Bedding Detail. Bedding for pretensioned concrete pipe shall be in accordance with Standard Bedding Detail for Pretensioned Concrete Pressure Pipe. The Drawings show the plan and grade for the pipeline. The Contractor shall submit detailed drawings to the Engineer for approval, showing the proposed method of laying the pipe to these grades. All pipelines to be crossed shall be located by the Contractor before these drawings are prepared. The ends of the pipes to be jointed shall be cleaned immediately prior to jointing and the rubber gasket thoroughly lubricated with vegetable soap before it is placed in position on the spigot end. Extreme care shall be taken in moving the spigot end of the pipe into the bell end of previously laid pipe. If the gasket is damaged or moved out of place, the new pipe shall be removed and a new gasket applied before rejoining. Any soap remaining on the exposed concrete surfaces inside or outside the pipe shall be completely removed. Fittings or specials included as pipe shall be blocked in accordance with the attached Standard Detail.
- 306.3 For sanitary and storm sewers, the methods of laying pipe, foundation, and grade specified under Pipe, Vitrified Clay, shall apply. All pipe shall be installed with

the mark "C-76" visible on the top of the pipe. The ends of the pipes to be jointed shall be cleaned immediately prior to joining and the rubber gasket. Extreme care shall be taken in moving the spigot end of the pipe into the bell end of previously laid pipe. If the gasket is damaged or moved out of place, the new pipe shall be removed and a new gasket applied before rejoining.

- 306.4 For all lines, after the pipe has been jointed, a band at least five-and-one-half inches wide shall be placed around the outside of the pipe at the joint. This band shall serve as a form for placing 1:1 cement mortar grout in the external recess formed by the face of the groove and the shoulder of the tongue. If a reinforced paper joint band is used, it shall be drawn up tight around the pipe and the backfill tamped against it up to the spring line before pouring the grout. If a cloth band is used, it shall be wired around the outside of the pipe, and the grout poured before backfilling. On all pipes, the joint space remaining on the inside of the pipe shall be filled with a stiff mixture of 1:1 cement mortar which shall be troweled in place to produce a continuous, smooth, flush surface across the joint.
- 306.5 PAYMENT: Payment for this item shall be made at the unit price bid per lineal foot of pipe of the type specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes, for fittings or specials included as pipe, or for concrete blocking or interior coatings.

## **PART 307 - PIPE, DUCTILE IRON**

- 307.1 The work under this item shall include furnishing, delivery, placing, and jointing of Ductile Iron pipe in the trench in specific conformity with the lines and levels given. All Ductile Iron pipe shall be wrapped with a loose fitting, slip-on polyethylene film. The polyethylene film shall be slipped over the end of the pipe length that has been raised above the ground at the trench side. After the joint on the pipe is made up, the one-foot length shall be slipped over the joint to form an over-or-under lap of the adjacent polyethylene tube at this point. The loosely fitting film shall then be neatly folded over the top of the joint and held in place with tape. The loosely fitting tube extending along the pipe shall be drawn up snugly and folded along the top and held in place by using short pieces of plastic tape at intervals not to exceed four (4) feet. Fittings, valves and corporation stops shall be wrapped with a section of polyethylene material split to form a flat sheet, using plastic tape to hold the material around the appurtenance. For all pipe, the American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600 shall govern the installation as applicable. The method of bedding shall be as shown on the attached Standard Detail for Thrust Blocks and Trench Conditions.
- 307.2 For water lines, all angled fittings or specials included as pipe shall be restrained, or blocked in accordance with the attached Standard Detail, the size to be determined by the Engineer.

307.3 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes, for fittings or specials included as pipe, interior coatings, or for concrete blocking.

Payment for any ductile iron pipe designated "restrained Joint" shall include cost of all components necessary to restrain joints of pipe.

## **PART 308 - PIPE, STEEL**

308.1 The work under this item shall include furnishing, delivery, placing, and jointing of steel pipe in the trench in specific conformity with the lines and levels given. For all lines, American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-200 shall govern the installation, as applicable. The method of bedding shall be as shown on the attached Standard Bedding Detail for Steel Pipe. The Drawings show the plan and grade for the pipeline. The Contractor shall submit detailed drawings to the Engineer for approval, showing his proposed method of laying the pipe to these grades. All pipelines to be crossed shall be located before these drawings are prepared. Fittings or specials included as pipe shall be blocked in accordance with the attached Standard Detail for Thrust Blocks and Trench Conditions.

308.2 If joints are field-welded, they shall develop the full strength of the pipe. The Contractor shall file with the Engineer a description of the method of welding which he proposes to use, the name of the individual or company who will do the welding, and a statement regarding the previous experience of such individual or company in this particular line of work. Testing shall be in accordance with Section 3.3 of AWWA C206. If requested, coupons shall be cut across the field welds and tested by a testing company approved by the Engineer and at the contractor's expense. The line may be welded continuously with provisions for slack in the line, or in sections to be lowered in the trench and connected by a position weld.

308.3 If joints are to be mechanically coupled, sections up to 240 feet may be coupled and lowered carefully into the ditch. Electrical continuity shall be provided at all joints. Preparation for, protection of, and repair of pipe coating and lining, and coating of mechanical couplings shall conform to the applicable section of these specifications.

308.4 Field replacement of the cement-mortar interior lining shall be in accordance with the AWWA Standard for Cement-Mortar Lining of Water Pipelines, 4-Inch and Larger, In Place, AWWA C602.

308.5 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Proposal, and placed as shown on the drawings. Total footage shall be the actual horizontal measurement along the

centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes, for fittings or specials included as pipe, or for concrete blocking.

Payment for any steel pipe designated "restrained joint" shall include cost of all components to restrain joints of pipe.

### **PART 309 - POLYVINYL CHLORIDE (PVC) PIPE, WATER SERVICE**

- 309.1 When PVC pipe is delivered to the jobsite it shall not be exposed to sunlight for more than three (3) weeks. PVC pipe exposed to sunlight for more than three (3) weeks shall be covered with an opaque protective covering. The pipe shall be left stacked and no more pipe than can be installed in one day shall be strung along the jobsite.
- 309.2 When a length of PVC pipe is cut, the plain end shall be beveled to the same configuration as the factory beveled end. The end shall be beveled using a pipe beveling tool, portable sander, or abrasive disc. After beveling, stop marks shall be applied to the plain end at a distance from the end corresponding to the original stop marks.
- 309.3 Both Bell End and Plain End of PVC pipe shall be thoroughly cleaned before connecting pipes.
- 309.4 Elastomeric Gaskets shall be placed into bell with colored side of the gasket to the outside.
- 309.5 Before connecting PVC pipes, the plain end shall be lubricated with an approved lubricant. The bell end of PVC pipe shall not be lubricated.
- 309.6 When connecting, the plain end pipe shall be inserted into the bell end pipe and then pushed until stop marks on plain end are flush with end of bell.
- 309.7 **PAYMENT:** Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings or specials included as pipe, or for concrete blocking.

Payment for any PVC pipe designated "restrained joint" shall include cost of all components to restrain joints of pipe.

### **PART 310 - LOCATOR WIRE AND DETECTABLE MARKING TAPE**

- 310.1 A Number 8 bare copper conductor wire for the purpose of locating PVC pipe shall be buried along the top of the pipe, and connected at each end to a fire hydrant by Cadweld Brazing just above the ground.

- 310.2 Detectable Mylar marking tape for location of PVC water pipe shall be required in areas as designated by the Engineer, more generally in commercial zones and open areas. Detectable Mylar marking tape shall be 2-inches wide, Blue in color with a continuous black lettered imprint stating "Caution: Water Line Below". Tape shall be equal to Lineguard Tape III as manufactured by Lineguard, Inc. of Wheaton, Illinois.
- 310.3 Detectable Mylar Tape shall be buried above PVC water lines at a depth of 10-inches below the surface.
- 310.4 Payment for tape and wire shall be included with unit price payment for PVC pipe.

### **PART 311 - TAPPING OF PVC PIPE FOR SERVICE CONNECTIONS**

- 311.1 Standard water service connections shall be made by using bronze service clamps as per standard drawings. The couplings shall be provided with factory installed brass bushings which conform to ASTM B62 and AWWA C800 for standard corporation stop threads. Bushings must match the corporation stops. Direct tapping of PVC water pipe will not be allowed.

### **PART 312 - FITTINGS**

- 312.1 The work under this item shall include all of the requirements specified under the item of pipe, in that "pipe" is understood to also mean "bends, tees, crosses, sleeves, outlet assemblies and other specified fittings." Unless otherwise specified, outlet assemblies shall consist of a flanged or mechanized (MJ) outlet constructed into the wall of steel or concrete pipe. If ductile iron pipe is used, the outlet shall consist of a tee with the outlet flanged. If a gate valve is shown on the Drawings to be attached to the outlet, the line side end shall be flanged and the opposite end shall be bell or mechanical joint according to the item for valves. All bends, tees, crosses, outlet assemblies, and plugs shall be blocked with concrete as shown on the attached Standard Detail, except where the fittings have flanged, welded, or harnessed joints, the Inspector may, under certain conditions, delete the blocking. Concrete blocking shall be placed so that joints are accessible for repair.
- 312.2 **PAYMENT:** Payment for this item shall be made at the unit price bid per fitting, of the type specified in the Proposal, and placed as shown on the drawings. Only fittings specifically noted in the Proposal are included in this item. No additional payment shall be made for excavation, backfilling, or concrete blocking.

Payment for any fittings designated "restrained" shall include cost of all components to restrain joints of fittings.

## **PART 313 - POLYVINYL CHLORIDE (PVC) PIPE, SEWER SERVICE**

- 313.1 The work under this item shall include furnishing, delivery, placing, and jointing PVC sewer pipe in the trench in specific conformity with the line and levels given. Installation shall be in accordance with ASTM D2321, Underground Installation of Flexible Thermoplastic Sewer Pipe, except as modified by these specifications.
- 313.2 Pipe shall be protected during unloading and installation against impact shocks and free fall. After unloading and before installation, pipe shall be stored on flat level ground with no rocks or other objects under the pipe.
- 313.3 The pipe shall be laid on a firm trench bottom, true to the lines and grades shown on the drawings and/or as given in the field by the Inspector. Pipe shall be protected during handling against impact shocks and free fall. The laying of pipe in finished trenches shall be commenced at the lowest point, with the spigot ends pointing in the direction of flow. Pipe shall be laid continuously through new manholes if both inlet and outlet pipes are of the same size and in line. Upon completion of the manhole, the invert shall be shaped. The ends of adjoining pipes shall butt against each other for their entire circumference in such manner that there is no shoulder or unevenness of any kind. The pipe grade shall be obtained by using laser or batterboards and a "top line". A top line shall be maintained over a span of three grade stakes when laying pipe. As each batterboard is erected, the top and the batterboards settings. Any error, discrepancies, or displacement of grade stakes shall be called to the attention of the Inspector for correction.
- 313.4 Prior to making pipe joints, all surfaces of the portion of the pipe to be jointed shall be cleaned and dried. Jointing shall be done in strict accordance with the manufacturer's recommended procedure.
- 313.5 At connections to manholes or other concrete structures, where the pipe is to be grouted or cast into the wall, a tight fitting rubber water stop gasket shall be installed around the pipe. The outer sealing surface of the pipe shall be planed smooth. The pipe section with the gasket shall be grouted or cast into the manhole wall. Only pipe with a smooth outer wall or concentric ribs shall be used for cast or grouted in place connections. Where A-Lock type gaskets are used, only smooth outer wall pipe shall be used.
- 313.6 Approximately 30 days after backfilling the contractor shall measure vertical ring deflection for all pipe. The deflection testing shall be performed in the presence of the Engineer or his designated representative. Maximum ring deflection of the installed pipe shall be limited to 5 percent of the base inside diameter. All pipe which exceeds the allowable deflection shall be replaced or corrected by the contractor at no additional cost. The Contractor shall provide all mandrels and necessary equipment to perform the tests. Deflection shall be tested using a Go/No/Go Deflection Test Gauge conforming to the standard detail or as manufactured by Cheme Industries, Inc., or equal in accordance with the manufacturer's instructions.

- 313.7 Any flushing of PVC sewer lines will be performed by the City, but the Contractor will lend assistance as may be required. Any infiltration of flushing water or other leaks into the sewer shall not be acceptable, and the contractor shall immediately correct the cause of the leak in a manner acceptable to the Engineer.
- 313.8 Where air testing of PVC pipe is specified, it shall be air tested in accordance with City of Sapulpa standard air test procedure. The air testing will be performed by the City.
- 313.9 PAYMENT: Payment for this item shall be made at the unit price bid per linear foot of the pipe specified in the Proposal, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes.

#### **PART 314 - MANHOLE**

- 314.1 The work under this item shall include all excavation, furnishing all materials required, construction, pipe connection thereto, finishing and backfilling of new standard or drop manholes. Construction of manholes shall progress as rapidly as installation of the line permits, and as directed by the Inspector. Brick manholes are not intended for new construction and shall be allowed only as approved by Engineer.
- 314.2 Excavation for manholes shall be made with vertical sides and minimum dimensions permitting construction of the manhole in accordance with the attached Standard Details. Manholes are to be built to an elevation not less than that of the existing ground surface, or as shown on the drawings.
- 314.3 New manholes shall be constructed around existing lines without disturbance to the line. When the manhole is completed, the existing pipe shall be removed from the invert of the manhole. Care shall be taken in removing the pipe to prevent any stoppage. Immediately upon completion of the manhole, all waste mortar and debris shall be removed from the bottom and invert. When the walls are completed, a standard manhole frame and cover shall be set in place. Above the base, manhole inverts shall be carefully constructed of solid concrete to maintain proper velocities. Changes in pipe grade, alignment or size shall be made by transition sections of the invert, determined by the lower half of the inlet and outlet pipes, but not greater than that of the outlet pipe. All inverts shall be plastered, troweled, and brushed to a smooth, clean surface. Inlet and outlet pipes shall not project beyond the interior wall of the manhole and shall be free from all sharp masonry.
- 314.4 During construction, each manhole step shall be set in place on the inside of the manhole, beginning eighteen inches above the bottom and placed not more than fifteen inches apart. No steps shall be placed closer than eighteen inches to the manhole top or farther than 27" to the manhole top. If concrete masonry units are used for the walls, special cut step blocks shall be installed to receive the steps. Steps shall be built firmly into the wall, allowing the steps to project five

inches inside the manhole. If five-inch concrete masonry units are used, the ends of the steps projecting beyond the outside wall shall be cut off flush with the wall, and plastered over. The centerline of the steps shall be as shown on the attached Standard Detail for Manholes. Four-and-one-half-inch steps shall be used for brick manholes and twelve-inch steps for precast manholes.

314.5 The use of concrete masonry units shall not be allowed in connection with pipes larger than eight inches in diameter. If concrete masonry units five inches thick are used, the manhole shall not be located within any dedicated street or alley, or any other location subject to vehicular traffic; and shall not exceed twelve feet in depth. The foregoing restrictions as to location and depth shall not apply if eight-inch concrete masonry units, brick, or precast manholes are used.

314.6 For brick manholes, a single rowlock course shall be turned over each pipe. Every unit shall have a full mortar joint on the bottom and sides, which shall be formed in one operation by placing sufficient mortar on the bed and forcing the unit into it. Horizontal joints shall not exceed three-eighths inch and vertical joints on the inside of the manhole shall not exceed one-quarter inch in thickness. All joints on the inside are to be rubbed full and struck as the manholes are built up. Walls shall be constructed in horizontal courses with vertical joints staggered. When the manhole top is above the proposed graded elevation, the taper shall be drawn in the manhole top to twenty-four inches I.D. at a point one foot below said proposed elevation and the remainder constructed with brick as a twenty-four inch cylinder. The inside and outside walls of the manholes are to be plastered with one-quarter inch of mortar to give a smooth and regular finish.

314.6.1 Testing of Manholes shall be done in accordance with Part 109.2 of the City of Sapulpa Specifications.

#### 314.7 PRE-CAST MANHOLES

314.7.1 Pre-cast manholes with cast-in-place base slabs will be permitted for all standard and drop manhole installations.

314.7.2 Pre-cast manholes with integral pre-cast floors will be permitted only for standard manhole installations with depths of 12 feet or less.

314.7.3 Pre-cast manholes with integral pre-cast floors will not be permitted for drop manhole installations. Pre-cast floors shall be placed on a minimum of 18-inches of compacted Class A crushed stone.

314.7.4 Pre-cast manholes shall conform to the specifications for Pre-Cast Reinforced Concrete Manhole Sections, ASTM C478. Joint construction shall be in accordance with the standard specification for Reinforced Concrete Pipe except that no exterior grout band is required. No more than eight (8) inches of concentric rings shall be used to bring the manhole to finished grade. Each concentric ring shall have a full mortar joint, not exceeding three-eighths (3/8) inch in thickness. Inside joints shall be rubbed full and struck.

314.7.5 Cost of sealed manhole rims and lids shall be included in cost of manhole.

314.8 **PAYMENT:** Payment for this item shall be made at the unit price bid per manhole of the type specified in the Proposal, and placed as shown on the drawings. If the manhole depth, measured from the invert to the top of the cover, exceeds six feet, the additional depth shall be paid for at the unit price bid per vertical foot of manhole depth over six feet. No additional payment will be made for excavation, backfilling, pipe or concrete bottoms or interior coatings.

## **PART 315 - CONNECTION**

- 315.1 The work under this item shall include all excavation, furnishing all materials required, construction, finishing, and backfilling of connections to existing mains, valves, manholes, special connections, service line re-connections, plugs, or in-line tees for future connections, as indicated on the Drawings or as directed by the Inspector.
- 315.2 The drawing shows details of the various connections and they shall be made in accordance with the details or as directed by the Engineer. On water mains, Contractor shall make the pressure and wet connections to existing mains, as shown on the drawing, unless specifically noted otherwise.
- 315.3 Connections to existing manholes shall be made by cutting into the manhole at the specified grade and inserting the pipe. Pipe installation shall be done in accordance with Standard Detail No. 405 using A-LOK or Z-LOK rubber gasket, or the pipe may be grouted in place with hydrophilic waterstop formed around the pipe and the cold joint. Acceptable hydrophilic compound is ADEKA P-201, or approved equal. Joint shall be watertight. Contractor shall not break into any existing sewer unless the Inspector is present and the work done shall be under the direction of the Inspector. Inlet and outlet pipes at the invert shall not project beyond the interior walls of the manholes. The manhole base shall be cut and reconstructed in such a manner that a proper invert section is maintained. All waste mortar, debris, and sharp edges shall be removed from the joints, bottom, and invert. Contractor shall remove and replace the manhole steps in the proper location and in accordance with Part 314.4 and Note #9 of Standard Detail No. 357, if they are not properly located after the connection is made. Any and all diversion or pumping of water or sewerage in a wet connection is included in this Item.
- 315.4 Methods of construction shall be the same for house line reconnections as for main sewers. Ductile iron pipe shall be used for all lines in parking areas, across open or closed storm sewers, across backfilled ditches, or within public rights-of-way. PVC shall be used in all other locations, unless ductile iron pipe is specifically required by the Engineer. All reconnections shall be constructed in conformance with the Plumbing Code of \_\_\_Sapulpa\_\_\_, unless modified herein. New pipe used shall be of the same diameter as the existing line.

- 315.5 Plugs shall be constructed of manhole brick and mortar, extending at least one foot into the line plugged from the manhole. The plug shall be watertight and troweled to a smooth finish on the interior of the manhole.
- 315.6 In-line tee fittings shall be installed for future service connections, as shown on the plans, in accordance with the Standard Detail for in-line tees. The tee shall be capped with a screw plug of either bronze, brass or a detectable plastic, marked by a non-magnetic, mylar tape, and stapled to both sides of a nominal 2" x 4" marker, 8' long, 4' buried, and 4' exposed, directly above fitting plug. The mylar tape shall be minimum 2-1/2" width, green in color, marked "Caution, Sanitary Sewer Below," as manufactured by Terra Tape or Line Guard.
- 315.7 After new water mains have been tested and chlorinated, the Contractor shall excavate around the new main for the service transfer. The existing mains and new mains shall remain in service during the transfer of services. The Contractor shall tap the new main and install a new corporation stop, service clamp, bend, copper tubing, and required fittings. The new service shall be connected to the existing meter after the service has been tested for leakage. The excavated area shall be backfilled and restored to original condition. Where galvanized service lines are encountered, they shall be replaced with copper. Where long services are replaced, they shall be bored under existing pavement. Open cutting will not be permitted unless approved by the Engineer. Copper tubing shall be Type K soft annealed conforming to ASTM B 88.
- 315.8 **PAYMENT:** Payment for this item shall be made at the unit price bid for each type of connection constructed, or in-line tee for future connection, as specified on the Proposal, or as directed by the Engineer. Payment for the first drop connection to a new manhole is included in the Manhole Item. No additional payment will be made for excavation, backfilling, furnishing and placing of concrete, removing and replacing of manhole steps, if necessary, or for the diversion or pumping of water or sewerage necessary to make the connection. Payment for water service transfers shall be made at the unit price bid for pipe and fittings under the appropriate connection bid item and shall include all necessary excavation, backfill, right-of-way clearing and restoring, materials, and labor.

## **PART 316 - LAMPHOLE**

- 316.1 The work under this Item shall include all excavation, furnishing all materials required, construction, pipe connection thereto, finishing and backfilling of new lampholes. Lampholes shall be located and constructed as shown on the Drawings, or as directed by the Inspector. When the concrete lamphole frame base is completed, a standard lamphole frame is to be set in place and closed with a lamphole cover.
- 316.2 **PAYMENT:** Payment for this item shall be made at the unit price bid per lamphole constructed as specified on the Proposal. No additional payment will be made for excavation, backfilling, or pipe.

## **PART 317 - VALVE**

- 317.1 The work under this item shall include furnishing, delivery, and installation of valves at the locations shown on the Drawings, and in accordance with the attached Standard Details. The American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600 shall govern the installation, as applicable. If the paint is damaged, the valve shall be cleaned by wire brushing and given two coats of black asphalt paint.
- 317.2 Gate valves shall be set with the stems plumb. Ball valves shall be set with the handwheels horizontal. Air relief valves shall be set so that the square operating nut on the two-inch valve can be operated from the top. Check valves shall be set horizontally. Construction standards for air relief and check valve vaults shall be the same as for manholes.
- 317.3 Fire hydrants shall be set so that the bottom of the steamer nozzle is not less than eighteen (18) inches nor more than twenty-one (21) inches above the finish grade of the ground. Breakable bolts damaged in the installation shall be replaced in kind. If the Mueller hydrant is used, the oil reservoirs shall be filled before the hydrant is set. Concrete blocking shall be placed so that the drain and joints are accessible. Restraining glands may be used in lieu of concrete blocking for fire hydrants. Fire hydrant and stem extensions shall be provided and installed as necessary, in accordance with the manufacturer's recommendations.
- 317.4 **PAYMENT:** Payment for this item shall be made at the unit price bid per valve, of the type specified on the Proposal, and placed as shown on the Drawings. If fire hydrant and stem extension are required, they shall be paid for at the unit price bid for each different length of extension used. The unit price bid for air relief and check valves shall include the valve vault. No additional payment shall be made for: excavation; backfilling; concrete blocking; the pipe length between the line and the fire hydrant, except where the pipe is shown on the Drawings in a separate profile; crushed rock for drains; air relief valve piping vaults; or restraining glands on fire hydrants in lieu of cement blocking.

Payment for any valve designated "restrained joint" shall include cost of restraining glands.

## **PART 318 - VALVE BOX**

- 318.1 The work under this item shall include furnishing, transporting, and installation of valve boxes at the locations shown on the Drawings. The American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600, shall govern the installation, as applicable.
- 318.2 Valve box shall include SW services' Debris Cap or equal.

- 318.3        **PAYMENT:** Payment for this item shall be made at the unit bid price per value box and debris cap and placed as shown on plans. Any valve box extension shall be paid under separate bid time. No additional payment shall be made.

### **PART 319 - ENCASEMENT, CONCRETE**

- 319.1        The work under this item shall include the installation of concrete encasement as shown on the Drawings or as directed by the Inspector, in accordance with the attached Standard Detail. Care shall be taken to assure that placing of encasement does not deflect the pipe from the proper grade and alignment.
- 319.2        Sanitary sewers shall be encased when the depth of cut from the original ground elevation to the flow line of the pipe is four feet (4') or less. Concrete encasement necessitated by trench widths more than the maximum as shown on the attached Standard Detail for Thrust Blocks and Trench Conditions shall be placed as directed by the Inspector.
- 319.3        **PAYMENT:** Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as encasement. All concrete encasement required because of excessive trench width shall be placed at the expense of the Contractor. No payment will be made for concrete used as fill or in excess of the theoretical quantity computation based on the attached Standard Detail for Thrust Blocks and Trench Conditions.

### **PART 320 - CRADLE, CONCRETE**

- 320.1        The work under this item shall include the installation of concrete cradle as shown on the Drawings or as directed by the Inspector, in accordance with the attached Standard Detail for Thrust Blocks and Trench Conditions. Care shall be taken to assure that placing of cradle does not deflect the pipe from the proper grade and alignment.
- 320.2        **PAYMENT:** Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as cradle. All concrete cradle required because of excessive trench width shall be placed at the expense of the Contractor. No payment will be made for concrete used as fill or in excess of the theoretical quantity computation based on the attached Standard Detail for Thrust Blocks and Trench Conditions.

### **PART 321 - PIERS, REINFORCED CONCRETE**

- 321.1        The work under this item shall include all materials, forming, construction and finishing of reinforced concrete piers, and necessary pipe anchorage. Piers shall be located and constructed as shown on the Drawings. Forms shall be made to conform to the shape of the pier and securely braced. Reinforcing steel shall be bent as detailed and securely tied in place. Bearing area for the pipe shall be

made to fit the outside diameter of the pipe and shall support the pipe at the proper grade. Steel strapping and bolts shall be installed and painted with one heavy coat of coal tar or asphalt paint after bolting in place. Any honeycomb or other unevenness in the concrete shall be patched with cement mortar immediately after form removal.

- 321.2      **PAYMENT:** Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as reinforced concrete piers in accordance with the attached Standard Details, at the location shown on the Drawings, or as directed by the Engineer. No additional payment will be made for excavation, forming, bracing, dewatering, backfilling, or pipe anchorage.

### **PART 322 - CONDUIT, BORED**

- 322.1      The work under this item shall include the installation of railroad, street, or other crossings by boring utilizing steel conduit as shown on the Drawings. The conduit pipe shall be installed to the line and grades given. Voids between the outside of the conduit and the surrounding earth shall be filled with cement grout or other material approved by the Engineer. The space between the outside of the carrier pipe and conduit shall be filled with sand and spacers.
- 322.2      **PAYMENT:** Payment for this item shall be made at the unit price bid per lineal foot of steel conduit, of the size specified in the Proposal, and placed as shown on the Drawings. All carrier pipe shall be paid for under other items. No additional payment shall be made for excavation, backfilling, boring, tunneling, dewatering, sand fill, bulkhead, or bore pits.

### **PART 323 - STRUCTURE, SPECIAL**

- 323.1      The work under this item shall include the furnishing of all materials and performing all work necessary to complete any special structures shown on the Drawings.
- 323.2      **PAYMENT:** Payment for this item shall be made at the unit price bid for each structure as specified in the Proposal, and constructed as shown on the Drawings. Pipe, fittings, valves and other appurtenances will be paid for under other items. No additional payment will be made for excavation, backfill, foundations, or any particular element of construction or interior coatings.

### **PART 324 - MATERIALS FURNISHED BY CONTRACTOR AND INSTALLED BY CITY**

- 324.1      The work under this item shall include furnishing and hauling of materials to the site of work. All necessary clearing, excavation, other site preparation, backfill and restoration, shall be performed by the contractor so that the City may install the materials in place with a minimum amount of delay. The Contractor shall furnish assistance to the City in installing the materials so that they may be

readily installed. The City's responsibility shall be only for the actual installation of the materials. All other work shall be performed by the Contractor.

- 324.2 **PAYMENT:** Payment for this item shall be made at the unit price bid per material item of the type specified in the Proposal and actually installed per Drawings. Only materials specifically noted in the Proposal are included in this item. All necessary clearing, excavation, other site preparation, backfill and restoration will be paid for under other bid items.

## **PART 325 - SODDING AND SEEDING**

- 325.1 Where the installation of water, sanitary or storm sewer mains traverse developed areas, residential or commercial, the Contractor shall restore all damaged sod turf using same type and variety. The restoration of sod turf shall be by either Sod Replacement or Hydromulch Seeding, as directed by the Engineer. Replacement sod shall match existing sod in type and variety.
- 325.1.1 Only that turf in one residential block may be removed at any time. Where residential blocks are not involved, only that turf in approximately 500 linear feet of trench excavation may be removed at any time. The Contractor shall restore all turf damaged by the construction. Payment for turf restoration will be per linear foot, based on the length of main installed through an area. The Contractor shall consider, when preparing his bid, the width of turf restoration required.
- 325.2 **Sod Replacement:** Remove the sod turf with approved cutting equipment. Store the turf in an area where construction operations will not damage it and apply sufficient water to preserve the root system. Replace the sod turf after the trench has been backfilled and compacted. As an alternate to this method, the Contractor may furnish and install new solid slab grass sod of the same type as that which was removed. The new sod shall be moist when excavated from the source and kept moist until planted. Sod shall consist of vegetative parts (rhizomes, stolons, and roots) with an appreciable quantity of adhering soil. Sod that becomes dry shall be discarded. Sodded areas shall be thoroughly watered after placement.
- 325.3 **Hydromulch Seeding:** Remove, store, and replace topsoil. Apply seed, fertilizer, and mulch together in homogeneously mixed slurry. Fertilizer shall be 10-20-10 and shall be applied at a rate of 10 lbs. per 1,000 sq. ft. Mulch shall be wood fiber and applied at a rate of 46 lbs. per 1,000 sq. ft. Grass seed shall be either hulled Bermuda applied at a rate of 2 lbs. per 1,000 sq. ft. or K-31 fescue applied at a rate of 8 lbs. per 1,000 sq. ft. as directed. Mulch shall be kept moist for a minimum of 10 days or until seeds have germinated and rooted. Watering shall be provided as required to maintain the grass.
- 325.4 The Contractor shall obtain a construction meter from the Connection Control Division and pay all required fees for any watering. The Contractor shall maintain all sodded or seeded areas until acceptance of the contract.

325.5        **PAYMENT:** Payment for Sod Replacement or Hydromulch Seeding will be made at the unit price bid per linear foot and shall include all necessary top soil replacement, fertilizing, watering, and maintenance. The linear foot pay quantity will be measured parallel to the pipe through the area being restored. The Contractor shall consider the width of turf restoration required for each area. No additional payment will be made for extra sodding or seeding required due to valve vaults, fire hydrants, tie-ins, service transfers, leak repairs, plugging, manholes, lampholes, or other appurtenances.

## **PART 326 - STREET WASH DOWN**

326.1        The Contractor shall, at the written direction of the engineer, wash down streets to control dust and clean the streets in the area of construction. Contractor shall obtain a construction meter from the Connection Control Division of the Water and Sewer Department and shall pay all required fees for obtaining and using the meter.

326.2        **PAYMENT:** Payment for street wash down shall be made at the unit price bid per linear foot of street. No payment will be made for street washing without prior written instructions from the Engineer.

## **PART 327 - TRAFFIC CONTROL DEVICES**

327.1        The Contractor shall furnish and install traffic control devices when construction is performed upon or adjacent to any street, alley, sidewalk, residence, public ground, or other location that is subject to pedestrian or vehicular traffic. Traffic control devices shall include safety fencing, barricades, signs, barrels, warning lights, arrow panels, flagmen, high level devices, etc.

327.2        Traffic Control Devices shall conform to the latest edition of the Manual on Uniform Traffic Control Devices.

327.3        Safety fence shall be an open mesh type, high-density plastic material, 48-inches in height, and colored International Safety Orange. Fence shall be supported by fence posts spaced at no more than 10 feet.

327.4        **PAYMENT:** Payment for safety fence shall be at the unit price bid per linear foot based on the total footage used for the duration of the project. No additional payment will be made for moving the fence as the job site changes. Payment for Type I, II, and III Barricades with flashing light; warning signs with flashing lights, 16 sq. ft. and over, and below 16 sq. ft.; barrels with steady burn light; advance warning arrow panels; and high level warning devices shall be made at the unit price bid per sign day. One sign day is one traffic control device in place for one day. Flagmen shall be paid for at the unit price bid per man-day. One man-day is one man flagging for one full eight (8) hour period. No payment will be made for cones.

## **PART 328 - BORE**

- 328.1 Waterline installed under existing concrete or asphalt driveways shall be bored. The diameter of the bore shall be a maximum of 2-inches larger than the outside diameter of the pipe bell. The annular space between the carrier pipe and the surrounding undisturbed earth shall be filled with sand. If the carrier pipe is ductile iron it shall be polyethylene wrapped and taped at one (1) foot intervals through the entire length of the bore. If the Engineer determines that boring is not possible, the driveway shall be open cut and the pavement replaced as directed by the Engineer.
- 328.2 **PAYMENT:** Payment for crossings by boring shall be at the unit price bid per linear foot as measured from edge to edge of the driveway. All carrier pipe shall be paid for under other items. No additional payment shall be made for excavation, backfilling, boring, tunneling, dewatering or sand fill, or bore pits.

## **PART 329 - PAVEMENT, REMOVAL AND REPLACEMENT**

- 329.1 Work under this item includes removal and replacement of concrete or asphalt for sidewalks, driveways, parking lots, curbs, streets, alleys, and the like. Pavement crossed at right angles shall be saw cut, removed, and replaced as shown on the standard drawings or as directed by the Engineer for the type of pavement indicated on the proposal. Pavement crossed diagonally shall be squared by saw cutting at right angles to the paved area. If a construction joint is within three (3) feet of a proposed saw line, the pavement shall be replaced to the joint as directed by the Engineer. New concrete pavement shall bridge the top of the trench by a minimum of one (1) foot on each side. All paving shall conform to the standards and specifications of the City of Sapulpa's City Engineer and ODOT. All street cuts shall be approved by the Office of the City Engineer and a Permit shall be obtained before work may begin.
- 329.2 All concrete pavement removal shall be a minimum of 3 feet by 3 feet. Concrete shall be High Early Strength Class P5 as per ODOT Section 701A with a minimum 28 day compressive strength of 5,000 psi, which contains the following:

Cement	705 lbs/Cu. Yd.
Flyash	0
Air	4-6%
W/C Ratio	44 lbs./lb.

- 329.3 Concrete shall meet the existing concrete depth with a minimum depth of 8" for streets, 6" for commercial Driveways, 5" for residential driveways, and 4" for sidewalks. Edges of cut shall be sawcut full depth. No traffic shall be allowed on the street replacement for 24 hours after placing of concrete. Twenty-four hours after placing of concrete, all butt joints must be sawed a minimum of 2", cleaned and sealed with joint sealer, ODOT Section 701A.08(e). If curb and gutter are removed, they shall be replaced to the standards and specifications of the typical

existing curb and gutter. When one or more longitudinal construction joints are removed, the joints shall be re-established in accordance with City of Sapulpa standards for concrete pavement. When a pavement section is removed along an existing longitudinal construction joint, the pavement shall be dowelled to the adjacent pavement.

329.4

All asphalt shall be Type B as per ODOT Section 708. The asphalt shall be compacted to a 92% maximum density as determined by AASHTO T-209 method. Spreading and finishing of asphalt shall meet ODOT Section 411.04(g). Edges of cut shall be saw cut full depth. Prior to placement of asphalt in cut, a tack coat shall be uniformly applied. Tack coat shall be an asphalt rubber, meeting the specifications of ASTM D1190. Optional tack coat - SS-IH meeting ODOT 708R Table 26. All surface edge joints of cut/overlay shall be sealed with an asphalt rubber meeting minimum specifications of ASTM D1190. Asphalt rubber shall be squeegeed into edge joints. Optional edge seal - SS-IH shall meet ODOT 708R Table 2C. SS-IH emulsion shall be squeegeed into edge joint and blotted with dry concrete screenings. If curb and gutter are removed, they shall be replaced to the standards and specifications of the typical existing curb and gutter. Macadamized or oiled surfaces shall be replaced with asphalt.

329.5

Materials for asphalt shall meet the following ODOT, Section 708R.04:

3/4"	100
1/2"	90-100
3/8"	70-90
NO. 4	45-70
NO. 10	25-50
NO. 40	12-30
NO. 80	7-20
NO. 200	3-9

% AC SOLUBLE IN SOLVENT	4.7-7.5
VISCOSITY GRADE ASPHALT CEMENT	AC-20
DENSITY, % OF MAX. THEO. SP. GR. 1000 ADT OR MORE	95-97
LESS THAN 1000 ADT	96-98
HVEEM STABILITY MIN. 5000 ADT OR MORE	40
LESS THAN 5000 ADT	35
V.H.A., MIN. %	15
% RETAINED STRENGTH MIN. FOR 5000 ADT OR MORE	75

329.6 **PAYMENT:** Payment for removal and replacement of concrete or asphalt pavement shall be at the unit price bid per square yard. The pay quantity of square yards will be computed using the standard pay width for the type of pavement replaced and the length of the pavement cut along the centerline of the pipe. The pay quantity will include pavement replaced due to the proximity of a construction joint if the specified criteria is met. For diagonal crossings, the pay quantity will include the areas replaced due to squaring. Payment for saw cut shall be at the unit price bid per linear foot. Payment for curb and gutter shall be at the unit price bid per linear foot. Payment for dowells shall be at the unit price bid per each. No payment will be made for disposal of broken pavement, temporary surfaces, excavation, preparation of subgrade, forms, or reinforcing. No payment will be made for removal or replacement of gravel. No payment will be made for the replacement of pavement damaged by the Contractor's equipment movement. No payment will be made for joint sealer, tack coats, or edge sealing.

### **PART 330 - EROSION CONTROL MEASURES**

330.1 The contractor is responsible to insure that measures are taken to minimize erosion and sedimentation problems, including but not limited to the following:

- a) Place straw bale dikes in bar ditches at 500 ft. intervals on relatively flat grades and 200 ft. intervals on grades over 5%.
- b) Place sediment sumps upstream of straw bales. Remove sediment on a regular basis.
- c) Keep excavation and silt off of streets.
- d) In areas where water line are being constructed adjacent to improved streets, measures shall be taken which will minimize siltation and excavation accumulating in existing storm sewers. Straw bales should be placed around inlets. Precautions should be taken during heavy rains to assure that a flooding condition is not created.
- e) Straw mulch can be used as an effective means of erosion control.
- f) Erosion control measures shall be placed at the toe of slope of all cut and fill areas.

330.2 Straw bales shall be standard rectangular size, approximately 18" x 20" x 36", and shall be securely bound with wire. Bales shall be firmly anchored with wood or metal stakes approximately 3 feet long. A sediment sump shall be placed immediately upstream of each bale. Contractor shall clean and maintain sediment sumps throughout the maintenance period.

330.3 The contractor shall furnish and install straw mulch as directed. Mulch shall be applied at a rate of 1½ tons per acre. Mulch shall be securely anchored in place.

- 330.4 Payment for straw bales will be at the unit price bid and shall include the cost of sediment sumps and anchoring. Payment for straw mulch will be at the unit price bid per square yard and shall include the cost of anchoring.

### **PART 331 - WATER TABLE CRADLE**

- 331.1 The work under this item shall include furnishing and installing Water Table Cradle as shown on the drawings or as directed by the Engineer and in accordance with the Standard Detail for Water Table Cradle.
- 331.2 The trench excavation shall be completely dewatered to provide a dry and stable trench bottom. The trench shall be excavated to a minimum of 18" below the bottom of the pipe. If additional base stabilization is required crushed stone, 3 1/2" to 1 1/2" (Gradation No. 1), shall be installed on the trench bottom, prior to the installation of water table cradle. Minimum trench widths for flexible pipe installations shall be as shown in the Standard Detail No. 367.
- 331.3 Geotextile filter fabric shall be installed on the trench bottom and walls. Crushed stone shall be installed in the trench directly on the filter fabric to a height of 12 inches above the top of the pipe. The crushed stone bedding material shall be carefully worked and compacted around the pipe. The filter fabric shall be placed over the top of the crushed stone with a minimum 18" lap. All fabric joints shall be lapped a minimum of 18". Water Table Cradle shall be installed for the full excavated width of the trench.
- 331.4 Crushed stone for Water Table Cradle shall be Gradation No. 57, 1" to No. 4. The Geotextile Filter Fabric shall be a nonwoven, needlepunch constructed fabric composed of petrochemical based polymers that are chemically and biologically inert. The fabric unit weight shall be not less than 13 ounces per square yard with a Mullen Burst Strength (ASTM D-3786) of not less than 600 psi.
- 331.5 **PAYMENT**
- 331.5.1 Payment for Water Table Cradle will be made at the unit price bid per linear foot for the specified diameter of pipe. The unit price shall include the cost of all labor, equipment, and materials required. No additional payment will be made for dewatering or crushed stone required for additional base stabilization.

### **PART 332 - CONDUIT, OPEN CUT**

- 332.1 The work under this item shall include the installation of railroad, street, or other crossings by open cut utilizing conduit as shown on the Drawings. The conduit pipe shall be installed to the line and grades given, and shall be installed in accordance with standard bedding detail for semi-rigid pipe.

The conduit shall be installed with spacers, sand fill, and bulkheads as shown in Standard.

332.2

**PAYMENT:** Payment for this item shall be made at the unit price bid per lineal foot of conduit, of the size specified in the Proposal, and placed as shown on the Drawings. All carrier pipe shall be paid for under other items. No additional payment shall be made for excavation, backfill, sand, spacers, or bulkhead.

**SECTION END**

**SPECIAL SPECIFICATIONS**  
**to the**  
**STANDARD SPECIFICATIONS**

**SECTION 011100**  
**SUMMARY OF WORK**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

Description of Work (1.2)

CONTRACTOR'S Use of Site (1.3)

OWNER Occupancy (1.4)

Constraints (1.5)

Work Sequence (1.6)

Specifications and Drawings (1.7)

1.2 DESCRIPTION OF WORK

- A. General: The work for City of Sapulpa, Project Bid No. COS 10049, Superpulsator Clarifier #1 and #2 – Replace Selected Components, consists of the following:
1. Contractor to coordinate with water plant personnel to identify a LAY-DOWN location for NEW materials and for material removed from clarifier #1 and #2. All PVC AND OTHER UV SENSITIVE MATERIAL to be shielded from direct sunlight and off the ground.
  2. City issues Notice To Proceed – Materials Procurement
  3. Contractor to insure all materials are on-hand, inventoried AND SAFELY STORED before proceeding to construction on the initial north #1 clarifier.
  4. City issues NOTICE TO PROCEED – CONSTRUCTION (DURATION: 5 CDs for each clarifier;28 CDs total)
  5. Contractor coordinates with water plant personnel, carefully draining selected clarifier.
  6. Beginning at the top of the clarifier, Contractor shall carefully remove all components in the clarifier (12" collection pipe, settling tubes, etc) down to the bottom of the baffles, inventorying, tagging, and mapping the components. Components removed will be replaced with either new or approved existing components. Engineer will assist contractor in identifying remaining defective components to be replaced. Defective components will be tagged as such and laid aside for disposal.
  7. Contractor shall use a 4000psi WATERJET to clean the clarifier, removing debris.
  8. Contractor and engineer shall perform a condition assessment of the clarifier interior
  9. Contractor shall perform concrete repair TYPE A OR TYPE B as directed by the engineer.
  10. Starting from the Clarifier bottom up, contractor shall carefully reinstall all approved existing serviceable components, or new replacement components.

11. Assist plant personnel with startup.

**B. The work includes:**

1. Furnishing all labor, materials, superintendence, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, services and other means of construction necessary for performing and completing the work
2. Sole responsibility for adequacy of plant and equipment.
3. Maintain the work area and clean the site in an acceptable manner to Owner.
4. Maintaining existing facilities in service at all times except where specifically provided for otherwise herein.
5. Protection of finished and unfinished work. Cure concrete correctly as planned
6. Repair and restoration of all structures and property damaged or disturbed during performance of the work.
7. Furnishing, as necessary, proper equipment and machinery of sufficient capacity to facilitate the work and to handle all emergencies normally encountered in work of this character.
8. Acquire and pay for all necessary permits for the project.

**C. Implied and Normally Required Work:**

It is the intent of these Specifications to provide the OWNER with complete rehabilitated systems, subsystems and other items of work. Any part or item of work which is reasonably implied or normally required to make each installation satisfactorily and completely is deemed to be included in the work and the Contract Amount. All miscellaneous appurtenances and other items of work incidental to meeting the intent of these Specifications are included in the work and the Contract Amount even though these appurtenances may not be specifically called for in these Specifications.

**D. Quality of Work:**

Regard the apparent silence of the Contract Documents as to any detail, or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished as meaning that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Interpretation of these specifications will be made upon this basis.

**1.3 CONTRACTOR'S USE OF SITE**

- A. Limit use of site and premises for work and storage to allow for the following:

1. OWNER occupancy and access to operate the existing facilities.
2. Coordination of site use with ENGINEER.
3. Responsibility for protection and safekeeping of products under this Contract.
4. Providing additional off-site storage at no additional cost to OWNER as needed.

#### 1.4 OWNER OCCUPANCY

- A. OWNER will occupy premises during entire period of construction. Cooperate with OWNER'S representative in all construction operations to minimize conflict.
- B. CONTRACTOR'S Responsibility: The CONTRACTOR shall be responsible for all other activities.

#### 1.5 CONSTRAINTS

- A. The Contract Documents are intended to allow the CONTRACTOR flexibility in the construction of the work, however, the following constraints apply:
  1. No work shall be performed between the hours of 6:00 p.m. and 7:30 a.m., nor on Saturday, Sunday, or legal holidays without the written approval or permission of the OWNER in each case, except such work as may be necessary for the proper care, maintenance, and protection of work already done, or of equipment, or in the case of an emergency.
  2. Before work in any area may commence, the CONTRACTOR must coordinate his actions in writing through the OWNER and ENGINEER at least 10 days prior to starting the work plan. Any operational functions of the existing water supply system that are required to be done to facilitate the work of the CONTRACTOR will be performed by the OWNER only if identified in the accepted sequence of construction.
  3. The facility does NOT have an upstream cabled warning barrier.
  4. Lake level and uncontrolled spillway
  5. Overhead power lines in close proximity and parallel to spillway
  6. Work Plan per pay item must be approved prior to beginning item work

#### 1.6 WORK SEQUENCE

- A. Construct work in accordance with the limitations on the sequence of construction specified and approved work plan. Coordinate construction schedules and operations with ENGINEER.
- B. Coordinate work of all SUBCONTRACTORS
- C. Conduct operations so as to inconvenience the general public in the least.

## 1.7 SPECIFICATIONS AND DRAWINGS

- A. After the Contract has been executed, the CONTRACTOR shall furnish each of the SUBCONTRACTORS such copies of the Specifications, Drawings and other Contract Documents as may be required for the work.
- B. The Specifications and Drawings are intended to supplement, but not necessarily duplicate each other; and together constitute one complete set of Specifications and Drawings. Execute any work exhibited in one and not in the other just as if it had been set forth in both. Complete the work according to the complete design or designs as decided and determined by the ENGINEER.
- C. The Specifications contain detailed requirements for the Project and supplement to the General Conditions. Where there appears to be a conflict between the Specifications and the General Conditions, the Specifications shall govern.
- D. Perform work not specified in either the Drawings or in the Specifications, but that is involved in carrying out their intent or is required in the complete and proper execution of the work, as though it were specifically delineated or described.
- E. Should anything be omitted from the Specifications and Drawings which is necessary for a clear understanding of the work, or should it appear various instructions are in conflict, request written instructions from the ENGINEER before proceeding with the construction affected by such omissions or discrepancies.
- F. The CONTRACTOR'S responsibility for construction covered by conflicting requirements, not provided for by addenda prior to the time of opening bids for the work represented thereby, shall not extend beyond the construction in conformity with the cheaper of the said conflicting requirements. Any increase in cost of work requested to be done in excess of the cheaper of the conflicting requirements will be paid for as extra work as provided for herein.
- G. When, in the opinion of the ENGINEER, it becomes necessary to explain more fully the work to be done or to illustrate the work further or to show any changes which may be required, drawings known as Supplementary Drawings, with specifications pertaining thereto, will be prepared by the ENGINEER and 5 paper prints thereof will be given to the CONTRACTOR. Consider the Supplementary Drawings binding with the same force as the Drawings. Where such Supplementary Drawings require either less or more than the estimated quantities of work, credit to the OWNER or compensation to the CONTRACTOR will be subject to the terms of the Contract.
- H. Verify all dimensions, quantities and details shown on the Drawings, Supplementary Drawings, Specifications or other data received from the ENGINEER, and notify him of all errors, omissions, conflicts, and discrepancies found therein. Do not consider failure to discover or correct errors, conflicts or discrepancies as relief from the full responsibility for unsatisfactory work, faulty construction or improper operation resulting there from nor from rectifying such conditions as part of the work. Do not take advantage of any errors or omissions, as full instructions will be furnished by the ENGINEER, should such errors or omissions be discovered. All schedules are given for the convenience of the ENGINEER and the CONTRACTOR and are not guaranteed to be complete. Assume all responsibility for the

making of estimates of the size, kind, and quality of materials and equipment included in work to be done under the Contract.

- I. Promptly notify the OWNER and the ENGINEER in writing of any latent physical conditions in the existing facilities which differ materially from those indicated or referred to in the Specifications, Drawings and other Contract Documents. The ENGINEER will promptly review those conditions and advise the OWNER in writing if further investigation is necessary. Promptly thereafter, the OWNER will obtain the necessary additional investigations and furnish copies to the ENGINEER and the CONTRACTOR. If the ENGINEER finds that the results of such investigations indicate that there are latent physical conditions which differ materially from those intended in the Specifications, Drawings and other Contract Documents, and which could not reasonably have been anticipated by the CONTRACTOR, a change order will be issued incorporating the necessary revisions.
- J. The Specifications are divided into individual sections, each covering a limited area of the work. Taken together, the individual sections provide details for the work to be performed under the Contract. Individual sections, by themselves, may not necessarily contain sufficient details to complete the work described in that section. Reference to additional sections of the Specifications may be necessary to determine the total work required to carry out work specified in any individual section of the Specifications. Failure by the CONTRACTOR to advise his SUBCONTRACTORS and suppliers of the necessity to review the Specifications as a whole, and not as individual sections, to determine the work required or to be supplied, shall not constitute a basis for a claim for additional compensation or an extension to the Contract completion time.
- K. The Drawings that are applicable to this Contract bear the general title:

City of Sapulpa, Oklahoma  
Department of Public Works  
Sapulpa WTP Superpulsator Clarifier #1 Remove & Replace Selected Components  
Bid No. COS \_\_\_\_\_

A listing of Drawings is included in the drawing set.

- L. The Drawings show the general work involved, but are not intended to show all details of the work.
- M. The Drawings are not intended to be scaled for dimensions. If dimensions not shown on the Drawings are required, request them from the ENGINEER. When obtaining data and information from the Drawings, use figures in preference to scaled dimensions and large scale drawings in preference to small scale drawings.
- N. Where existing utilities or other sub-surface obstructions are shown on the Drawings, the same have been located as nearly as practicable from information furnished by OWNERS of such, and from such surface indications as may exist at the work site. Such obstructions are shown for the purpose of advising the CONTRACTOR that they may interfere with the work

to be done hereunder, but not for the purpose of indicating that the work can be performed without such interference.

- O. Become satisfied by site visits, field measurements and by such other means deemed proper as to the constraints and conditions that will be encountered during the performance of the work. Be responsible for carrying out all work without additional compensation should existing conditions be encountered that are different than those shown on the Drawings.

## **PART 2 PRODUCTS**

Not Used

## **PART 3 EXECUTION**

- A. Start work within 10 days from and after the date of a written order from the OWNER. Execute work with such progress as may be required to prevent delay to other CONTRACTORS or to the general completion of the project. Execute work with such forces, material and equipment, as to complete the work in the time established by the Contract. At all times, schedule and direct the work so that it provides an orderly progression to completion within the specified time for completion.

END OF SECTION

## SECTION 013100

### COORDINATION AND MEETINGS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Coordination
- B. Preconstruction Conference
- C. Progress Meetings

##### 1.2 COORDINATION

- A. General: Coordinate scheduling, submittals, and Contract work to assure efficient and orderly sequence of installation of interdependent construction elements.

##### 1.3 PRECONSTRUCTION CONFERENCE

- A. General: Prior to commencement of the work the OWNER will conduct a preconstruction conference to be held at a predetermined time and place.
- B. Delineation of Responsibilities: The purpose of the conference is to designate responsible personnel, to establish a working relationship among the parties and to identify the responsibilities of the OWNER, ENGINEER and the CONTRACTOR. Matters requiring coordination will be discussed and procedures for handling such matters, established. The agenda may include:
  - 1. Submittal procedures
  - 2. Partial Payment procedures
  - 3. Maintenance of Records
  - 4. Schedules, sequences and maintenance of facility operations
  - 5. Safety and First Aid responsibilities
  - 6. Change Orders
  - 7. Use of site
  - 8. Housekeeping
  - 9. Materials and Equipment delivery
- C. Attendees: The preconstruction conference is to be attended by the representatives of the CONTRACTOR, the OWNER and the ENGINEER who will be associated with the project.

Representatives of regulatory agencies, SUBCONTRACTORS, and principal suppliers may also attend when appropriate.

- D. Chair and Minutes: The preconstruction conference will be chaired by the ENGINEER who will also arrange for the keeping and distribution of minutes to all attendees.

#### 1.4 PROGRESS MEETINGS

- A. Meeting Frequency and Format: Schedule progress meetings at least every two weeks or more frequently as warranted during critical phases of the Project, to review the work, discuss changes in schedules, maintain coordination and resolve potential problems. Invite OWNER, ENGINEER and all SUBCONTRACTORS. Suppliers may be invited as appropriate. CONTRACTOR to distribute an Agenda for the meeting to attendees 5 calendar days prior to the date of the meeting. Minutes of the meeting will be maintained by CONTRACTOR and reviewed by ENGINEER prior to distribution by the CONTRACTOR. Distribute reviewed minutes to attendees within 5 calendar days after each meeting.

### **PART 2 PRODUCTS**

Not Used

### **PART 3 EXECUTION**

Not Used

END OF SECTION

**SECTION 013250**  
**PROGRESS SCHEDULE**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Form of Schedules
- B. Content of Schedules
- C. Schedule Revisions
- D. Submittal Requirements

1.2 FORM OF SCHEDULES

- A. Prepare schedules in form of a horizontal bar chart.
  - 1. Provide separate horizontal bar for each trade or operation.
  - 2. Utilize a horizontal time scale and identify first work day of each week.
  - 3. Utilize scale and spacing to allow space for notations and future revisions.
- B. Utilize a listing format which chronologically indicates the order of start of each item of work.
- C. Identify each listing by major specification section numbers.
- D. Provide Preliminary Schedule at Preconstruction Conference.

1.3 CONTENT OF SCHEDULES

- A. Show complete sequence of construction by activity.
- B. Show dates for beginning and completion of each major element of construction. Elements shall include, but not be limited to, the following:
  - 1. Shop drawing receipt from supplier/manufacturer submitted to ENGINEER, review and return to supplier/manufacturer
  - 2. Material order, manufacturer, delivery, installation, and checkouts
  - 3. Demolition work activities
  - 4. Compensatory storage work activities
  - 5. Concrete placement sequence
  - 6. SUBCONTRACTOR'S items of work

7. Final cleanup
8. Allowance for inclement weather

Show projected percentage of completion for each item as of first day of each month.

#### 1.4 SCHEDULE REVISIONS

- A. As a minimum, revise construction schedule to reflect changes in progress of work for duration of Contract.
- B. Indicate progress of each activity at date of submittal.
- C. Show changes occurring since previous submittal of schedule.
  1. Major change in scope
  2. Activities modified since previous submittal
  3. Revised projections of progress and completion
  4. Other identifiable changes
- D. Provide a written report as needed to define:
  1. Problem areas, anticipated delays, and impact on schedule
  2. Corrective action recommended and its effect
  3. Effect of changes on schedules of other CONTRACTORS

#### 1.5 SUBMITTAL REQUIREMENTS

- A. For preliminary and final submittal of construction progress schedule and subsequent revisions thereof, furnish three copies to ENGINEER.

### **PART 2 PRODUCTS**

Not Used

### **PART 3 EXECUTION**

Not Used

END OF SECTION

## SECTION 01 33 00

### SUBMITTALS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Description of Requirements
- B. Submittal Procedures
- C. Specific Submittal Requirements
- D. Action on Submittals
- E. Repetitive Review
- F. Work Plan for each Contractor's Definable Feature of Work

##### 1.2 DESCRIPTION OF REQUIREMENTS

- A. This section specifies procedural requirements for Shop Drawings, product data, samples, and other miscellaneous work-related submittals.
- B. Procedures concerning items such as listing of manufacturers, suppliers, SUBCONTRACTORS, construction progress schedule, schedule of Shop Drawing submissions, bonds, payment applications, insurance certificates, and Schedule of Values are specified elsewhere.
- C. Work-Related Submittals:
  - 1. A Preparatory Inspection Worksheet will be required to be submitted and approved prior to the start of each Definable Feature of Work. A Definable Feature of Work is a group of tasks that are similar in nature and generally follow the Specifications; but there can be more than one Definable Feature of Work per Specification. At a minimum, the CONTRACTOR should use the following Definable Features of Work; 1) Utility Relocation. The Preparatory Worksheet should include the CONTRACTOR's plan to achieve quality as defined by the Plans and Specifications. The Worksheet should list all components, described in detail, manpower, equipment, materials, independent testing, logistics, procurement, storage, preparation, installation, safety considerations as outlined in Safety Plan and final completion of pay item work for a complete and acceptable installation. A copy of the Preparatory Worksheet will be provided to the Contractor at the Pre-Construction Meeting.
  - 2. Substitution or "Or Equal" Items:
    - a. Includes material or equipment CONTRACTOR requests ENGINEER to accept, after Bids are received, as substitute for items specified or described in Specifications by using name of a proprietary item or name of supplier.

Indicate on submittal to highlight to Engineer whenever a substitution is being proposed.

3. Shop Drawings:

- a. Includes technical data and drawings specially prepared for this Project, including fabrication and installation drawings, diagrams, data sheets, schedules, instructions, design mix formulas, measurements, and similar information not in standard printed form.
- b. Standard information prepared without specific reference to the Project is not considered a Shop Drawing.

4. Product Data:

- a. Includes standard printed information on manufactured products, and systems that has not been specially prepared for this Project, including manufacturer's product specifications and installation instructions, mill reports, and standard color charts.

5. Samples:

- a. Includes both fabricated and manufactured physical examples of materials, products, and units of work, swatches showing color, texture, and pattern, and units of work to be used for independent inspection and testing.
- b. Mock-ups are special forms of samples which are too large or otherwise inconvenient for handling in manner specified for transmittal of sample submittals.
- c. Miscellaneous Submittals:
- d. Work-related submittals that do not fit in the previous categories, such as guarantees, warranties, certifications, experience records, maintenance agreements, workmanship bonds, survey data and reports, physical work records, quality testing and certifying reports, copies of industry standards, record drawings, field measurement data, and similar information, devices, and materials applicable to the work.

D. Refer to Division 1 - General Requirements for related requirements.

### 1.3 SUBMITTAL PROCEDURES

A. Scheduling:

1. Submit electronically for acceptance via email, a Submittal Register with items to be reviewed by the Engineer, such as schedule, materials, testing, procedures as discussed in the Preparatory Inspection Worksheet within 15 calendar days after the NTP date of the Contract. Allow the ENGINEER 15 calendar days to submit comments.

2. Prepare and transmit submittals to ENGINEER sufficiently in advance of scheduled performance of related work and other applicable activities.

B. Coordination:

1. Coordinate preparation and processing of submittals with performance of work. Coordinate each submittal with other submittals and related activities such as substitution requests, testing, purchasing, fabrication, delivery, and similar activities that require sequential activity.
2. Coordinate submission of different units of interrelated work so that one submittal will not be delayed by ENGINEER'S need to review a related submittal. ENGINEER may withhold action on any submittal requiring coordination with other submittals until related submittals are forthcoming.

C. Submittal Preparation:

1. Stamp and sign each submittal certifying the Contractor representative reviewed and approved the submittal, i.e., for verification of products, field measurement, field construction criteria, coordination of information within submittal with requirements of the work and the Contract Documents.
2. Transmittal Form: In the transmittal form forwarding each specific submittal electronically to the ENGINEER include the following information as a minimum.
  - a. Date of submittal and dates of previous submittals containing the same material.
  - b. Project title and number.
  - c. Submittal and transmittal number.
  - d. Contract identification.
  - e. Names of:
    - (1) CONTRACTOR
    - (2) Supplier
    - (3) Manufacturer
  - f. Identification of equipment and material and Specification section number.
  - g. Variations from Contract Documents and any limitations which may impact the work.
  - h. Drawing sheet and detail number as appropriate.
  - i. Allow the ENGINEER 15 calendar days to review/approve each submittal. Include this review time for submittals in your schedule.

- j. Electronically submit all submittals to the ENGINEER. The ENGINEER will return comments electronically.

D. Resubmittal Preparation:

1. Comply with the requirements described in Submittal Preparation. In addition:
  - a. Identify on transmittal form that submittal is a resubmission.
  - b. Make any corrections or changes in submittals required by ENGINEER'S notations and resubmit the submittal to the ENGINEER, as shown below.
    - (1) On the transmittal or on a separate page attached to CONTRACTOR'S resubmission transmittal, answer or acknowledge in writing all notations or questions indicated by ENGINEER on ENGINEER'S transmittal form returned to the Contractor.
    - (2) Identify each response by question or notation number established by ENGINEER.
    - (3) If CONTRACTOR does not respond to each notation or question, resubmission will be returned without action by ENGINEER until CONTRACTOR provides a written response to all ENGINEER'S notations or questions.
  - c. CONTRACTOR initiated revisions or variations:
    - (1) On transmittal form identify variations, or revisions, from previously reviewed submittal, other than those called for by ENGINEER. Use designation ".1" for re-submittals, such as 01 45 00-1.1, for resubmission for each Definable Feature of Work.

1.4 SPECIFIC SUBMITTAL REQUIREMENTS

- A. Specific submittals required for individual elements of work are specified in the individual Specification sections. Except as otherwise indicated in Specification sections, comply with requirements specified herein for each indicated type of submittal.
- B. Requests for Substitution (Variation), or "Or Equal"
  1. Collect data for items to be submitted for review as substitution, or variation, into one submittal for each item of material or equipment.
  2. Submit with other scheduled submittals for the material or equipment allowing time for ENGINEER to evaluate the additional information required to be submitted.
  3. If CONTRACTOR requests to substitute for material or equipment specified but not identified in Specifications as requiring submittals, schedule substitution submittal request in Submittal schedule and submit as a variation as scheduled.

Clearly indicate "variation" on the transmittal cover sheet, and the information to support the substitution.

C. Shop Drawings:

1. Submit newly prepared information, with graphic information at accurate scale. Indicate name of manufacturer or supplier (firm name). Show dimensions and clearly note which are based on field measurement; identify materials and products which are included in the work; identify revisions. Indicate compliance with standards and notation of coordination requirements with other work. Highlight, encircle or otherwise indicate variations from Contract Documents or previous submittals.
2. Include on each drawing or page:
  - a. Submittal date and revision dates.
  - b. Project name, division number and descriptions.
  - c. Detailed Specifications section number and page number.
  - d. Identification of equipment, product or material.
  - e. Name of CONTRACTOR and SUBCONTRACTOR.
  - f. Name of Supplier and Manufacturer.
  - g. Relation to adjacent structure or material.
  - h. Field dimensions clearly identified.
  - i. Standards or Industry Specification references.
  - j. Identification of deviations from the Contract Documents.
  - k. CONTRACTOR'S stamp, initialed or signed, dated and certifying to review of submittal, certification of field measurements and compliance with Contract.
  - l. Physical location and location relative to other connected or attached material at which the equipment or materials are to be installed.
3. Provide 8-inch by 3-inch blank space for CONTRACTOR and ENGINEER stamps.
4. Submittals:
  - a. Submit redlines daily to the Inspector, and ENGINEER, will electronically add electronically on the Plans, pdf files, CAD files throughout the project.
5. Distribution:
  - a. Do not proceed with installation of materials, products or systems until copy of applicable product data showing only accepted information is in possession of

installer and after the ENGINEER, or OWNER's on-site representatives approve the CONTRACTOR's Work Plan at the Preparatory Meeting.

- b. Maintain one set of product data (for each submittal) at Project site.
- c. Update the Submittal Register when the submittals are approved by the ENGINEER and provide updated monthly Submittal Register, along with Monthly updated schedule. The Inspector shall review the updated Submittal Register each month when processing the Contractor's pay request.

D. Product Data:

1. Preparation:

- a. Collect required data into single submittal for each element of work or system. Where product data has been printed to include information on several similar products, some of which are not required for use on Project, or are not included in submittal, mark copies to clearly show such information is not applicable.
- b. Where product data must be specially prepared for required products, materials or systems, because standard printed data are not suitable for use, submit data as a Shop Drawing and not as product data.

2. Submittals:

- a. Submittal is for information and record, and to determine that products, materials, and systems comply with Contract Documents. Submittal is final when returned by ENGINEER marked "Accepted" or "Accepted as Noted".
- b. Submit electronically via email.

3. Distribution:

- a. Do not proceed with installation of materials, products or systems until copy of applicable product data showing only approval information is in possession of installer, and Preparatory Meeting has been held and Inspector has given the go ahead to proceed.
- b. Maintain one set of product data (for each submittal) at Project site, available for reference by ENGINEER and others.
- c. Update the Submittal Register when a submittal item has been approved by ENGINEER, and submitted the updated Submittal Register each month along with the Monthly updated schedule. The Engineer will keep record of all approved submittals.

E. Samples:

1. Preparation:

- a. Where possible, provide samples that are physically identical with proposed materials, or products, to be incorporated into the work. Where variations in

color, pattern or texture are inherent in material or product represented by sample, submit multiple units (not less than 3 units) showing approximate limits of variations.

- b. Provide full set of optional samples where ENGINEER'S selection required. Prepare samples to match ENGINEER'S selection where so indicated.
- c. Include information with each sample to show generic description, source or product name and manufacturer, limitations, and compliance with standards.
- d. Submit samples for ENGINEER'S visual review of general generic kind, color, pattern, texture, and for final check of coordination of these characteristics with other related elements of work.

2. Submittals:

- a. At CONTRACTOR'S option and depending upon the nature of the anticipated response from ENGINEER, initial submittal of samples may be either preliminary or final submittal.
- b. A preliminary submittal, consisting of a single set of samples, is required where specifications indicate ENGINEER'S selection of color, pattern, texture or similar characteristics from manufacturer's range of standard choices is necessary. Preliminary submittals will be reviewed and returned with ENGINEER'S "Action" marking. If physical samples are required, submit 3 sets of samples.
- c. Final Submittals: Submit electronically submittals, sheets, or Plans, will be marked up by ENGINEER, and will return comments electronically. If physical samples are required, submit 3 final sets of samples. .

3. Distribution:

- a. Maintain returned final set of samples at Project site, in suitable condition and available for quality control comparisons throughout the course of performing the work.
- b. Returned samples intended or permitted to be incorporated in the work are indicated in Specification sections and shall be in undamaged condition at time of use.

Miscellaneous Submittals:

4. Inspection and Test Reports:

- a. List each inspection and test report in the Daily Report to the Definable Feature of Work and whether Prime, or Subcontractor, will perform.
- b. For materials to be installed a quality control test is required by the CONTRACTOR to ensure the material meets the standards of the plans and

specifications. The CONTRACTOR shall submit a list of Quality Control Tests that are required by the specifications in the Preparatory Inspection Worksheet.

- c. During the Preparatory Meeting for the Definable Feature of Work the CONTRACTOR's Preparatory Inspection Worksheet will be discussed, including the required QC Tests and both the CONTRACTOR and ENGINEER will agree on the test procedures to be carried out.
  - d. When the work takes place, the CONTRACTOR notifies the ENGINEER and Inspector when a Quality Control Test is scheduled (date and time), the ENGINEER, or INSPECTOR, or both, will witness the Quality Control Test. If there is an irregularity in test results, the Quality Control representative will take counter measures to correct and re-test.
  - e. The Contractor Quality Control representative and Inspector will document in the Daily Report the preliminary results of the Quality Control test, and when the Quality Control Test Report is received, attach Test Report to Daily Report and send electronically to the Inspector.
5. Guarantees, Warranties, Maintenance Agreements, and Workmanship Bonds:
- a. Refer to Specification sections for specific requirements. Submittal is final when returned by ENGINEER marked "Accepted" or "Accepted as Noted".
  - b. Only provide electronic copies of submittals, except when a hard copy is required.
6. Certifications:
- a. Refer to Specification sections for specific requirement on submittal of certifications. Submit electronically certifications. Certifications are submitted for review of conformance with specified requirements and information. Submittal is final when returned by ENGINEER marked "Accepted".
7. Closeout Submittals:
- a. Refer to Specification sections and Section 01 78 00 for specific requirements on submittal of closeout information, materials, tools, and similar items.
    - (1) Contract Close Out: Section 01 78 00.
8. General Distribution:
9. Unless required elsewhere, provide distribution of approved submittals to SUBCONTRACTORS, suppliers, governing authorities, and others as necessary for proper performance of work.

## 1.5 ACTION ON SUBMITTALS

### A. ENGINEER'S Action:

1. General:

- a. Except for submittals for record and similar purposes, where action and return on submittals are required or requested, ENGINEER will review each submittal, mark the electronic file with appropriate action, and return electronically. Where submittal must be held for coordination, ENGINEER will also advise CONTRACTOR without delay.
- b. ENGINEER will stamp each submittal with uniform, self-explanatory action stamp, appropriately marked with submittal action.

B. Action Stamp:

1. Accepted:

- a. Final Unrestricted Release: Where submittals are marked "Accepted", work covered by submittal may proceed with ordering the material. Once material arrives on-site, then a Preparatory Meeting is held with the CONTRACTOR, ENGINEER, and/or OWNER on-site representative. The Preparatory Meeting will review the CONTRACTOR's Work Plan for the Definable Feature of Work and ensure approved submittals are complete and materials arriving on-site are inspected to ensure the quality meets submittal requirements. The OWNER's on-site representative approves the CONTRACTOR's Work Plan at the Preparatory Meeting, and the CONTRACTOR can begin with the work for that Definable Feature of Work. Beginning of work will depend upon that compliance.

2. Accepted As Noted:

- a. When submittals are marked "Accepted as Noted", work covered by submittal may proceed PROVIDED IT COMPLIES WITH BOTH ENGINEER'S NOTATIONS, OR CORRECTIONS ON SUBMITTAL AND WITH CONTRACT DOCUMENTS. Acceptance of work will depend on that compliance. Resubmittal is not required.

3. Examined and Returned for Correction:

- a. When submittals are marked "Examined and Returned for Correction", do not proceed with work covered by submittal. Do not permit work covered by submittal to be used at Project site or elsewhere where work is in progress.
- b. Revise submittal or prepare new submittal in accordance with ENGINEER'S notations in accordance with Paragraph 1.3D of this section. Resubmit submittal without delay. Repeat if necessary to obtain different action marking. Allow the Engineer 14 calendar days review time for resubmittals.

- C. The acceptance of Submittals will be only for compliance with the information given in the Contract Documents and shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto. Accepted shall not relieve the CONTRACTOR of responsibility for the accuracy of the Submittals, nor for the proper fitting and construction of the work, nor for the furnishing of materials or work required by the Contract and not indicated on the Submittals. No work called for by the Submittals shall be done until they have

been approved by the ENGINEER and after the Preparatory Meeting when the ENGINEER, or OWNER's on-site representative (INSPECTOR), will indicate you may proceed with the work.

#### 1.6 REPETITIVE REVIEW

- A. Cost of Subsequent Reviews: Shop submitted for each item will be reviewed no more than three times at the OWNER'S expense. All subsequent reviews will be performed at times convenient to the ENGINEER and at the CONTRACTOR'S expense based on the ENGINEER'S then prevailing rates including all direct and indirect costs and fees. Reimburse the OWNER for all such fees invoiced to the OWNER by the ENGINEER.
- B. Time Extension: Any need for more than one resubmission, or any other delay in ENGINEER'S review of submittals, will not entitle CONTRACTOR to extension of the Contract Time.

### **PART 2 PRODUCTS**

Not Used

### **PART 3 EXECUTION**

Not Used

END OF SECTION

## SECTION 014220

### REFERENCES

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Reference Abbreviations
- B. Abbreviations
- C. Reference Standards
- D. Definitions

##### 1.2 RELATED SECTIONS

- A. Information provided in this section is used where applicable in individual Specification Sections, Divisions 1 through 15.

##### 1.3 REFERENCE ABBREVIATIONS

- A. Reference to a technical society, trade association or standards setting organization, may be made in the Specifications by abbreviations in accordance with the following list:

AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ADC	Air Diffusion Council
AFBMA	Anti-friction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	Association of Home Appliance Manufacturers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute

AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
APA	American Plywood Association
ARI	American Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders' Hardware Manufacturers Association
BIA	Brick Institute of American
CABO	Council of American Building Officials
CAGI	Compressed Air and Gas Institute
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRD	U.S. Corps of Engineers Specifications
CRSI	Concrete Reinforcing Steel Institute
CTI	Cooling Tower Institute
DHI	Door and Hardware Institute
DOH	Department of Health
DOT	Department of Transportation
Fed. Spec.	Federal Specifications

FGMA	Flat Glass Marketing Association
FM	Factory Mutual
HMI	Hoist Manufacturing Institute
HPMA	See HPVA
HPVA	Hardwood Plywood Veneer Association
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IFI	Industrial Fasteners Institute
MIL	Military Specifications
MSS	Manufacturer's Standardization Society
NAAMM	National Association of Architectural Metal Manufacturers
NACM	National Association of Chain Manufacturers
NBS	National Bureau of Standards, See NIST
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NFPA	National Fluid Power Association
NIST	National Institute of Standards and Technology
NLMA	National Lumber Manufacturers Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act
PCI	Pre-stressed Concrete Institute
PDI	Plumbing and Drainage Institute

SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SPI	Society of the Plastics Industry
SSPC	Steel Structures Painting Council
STI	Steel Tank Institute
TCA	Tile Council of American
TIMA	Thermal Insulation Manufacturers' Association
UL	Underwriters' Laboratories, Inc.
USBR	U. S. Bureau of Reclamation
USBS	U. S. Bureau of Standards, See NIST

#### 1.4 ABBREVIATIONS

- A. Abbreviations which may be used in individual Specification Sections Divisions 1 through 15 are as follows:

alternating current	ac
American wire gauge	AWG
ampere(s)	amp
ampere-hour(s)	AH
annual	ann
Ampere Interrupting Capacity	AIC
atmosphere(s)	atm
average	avg
biochemical oxygen demand	BOD
Board Foot	FBM
brake horsepower	bhp

Brinell Hardness	BH	
British thermal unit(s)	Btu	
calorie (s)	cal	
carbonaceous biochemical oxygen demand		CBOD
Celsius (centigrade)	C	
Center to Center	C to C	
centimeter(s)	cm	
chemical oxygen demand	COD	
coefficient, valve flow	Cv	
condensate return	CR	
cubic	cu	
cubic centimeter(s)	cc	
cubic feet per day	cfm	
cubic feet per hour	cfh	
cubic feet per minute	cfm	
cubic feet per minute, standard conditions		scfm
cubic feet per second	cfs	
cubic foot (feet)	cu ft	
cubic inch(es)	cu in	
cubic yard(s)	cu yd	
decibels	dB	
decibels (A scale)	dBa	
degree(s)	deg	
dewpoint temperature	dpt	

diameter	dia
direct current	dc
dissolved oxygen	DO
dissolved solids	DS
dry-bulb temperature	dbt
efficiency	eff
elevation	el
entering water temperature	ewt
entering air temperature	eat
equivalent direct radiation	edr
face area	fa
face to face	f to f
Fahrenheit	F
feet per day	fpd
feet per hour	fph
feet per minute	fpm
feet per second	fps
foot (feet)	ft
foot-candle	fc
foot-pound	ft-lb
foot-pounds per minute	ft-lb/min
foot-pounds per second	ft-lb/sec
formazin turbidity unit(s)	FTU
frequency	freq

fuel oil	FO	
fuel oil supply	FOS	
fuel oil return	FOR	
gallon(s)	gal	
gallons per day	gpd	
gallons per day per cubic foot	gpd/cu ft	
gallons per day per square foot	gpd/sq ft	
gallons per hour	gph	
gallons per minute	gpm	
gallons per second	gps	
gas chromatography and mass spectrometry		GC-MS
gauge	ga	
grain(s)	gr	
gram(s)	g	
grams per cubic centimeter	gm/cc	
Heat Transfer Coefficient	U	
height	hgt	
Hertz	Hz	
horsepower	hp	
horsepower-hour	hp-hr	
hour(s)	hr	
humidity, relative	rh	
hydrogen ion concentration	pH	

inch(es)	in
inches per second	ips
inside diameter	ID
Jackson turbidity unit(s)	JTU
kelvin	K
kiloamperes	kA
kilogram(s)	kg
kilometer(s)	km
kilovar (kilovolt-amperes reactive)	kvar
kilovolt(s)	kV
kilovolt-ampere(s)	kVA
kilowatt(s)	kW
kilowatt-hour(s)	kWh
linear foot (feet)	lin ft
liter(s)	L
megavolt-ampere(s)	MVA
meter(s)	m
micrograms per liter	ug/L
miles per hour	mph
milliampere(s)	mA
milligram(s)	mg
milligrams per liter	mg/L

milliliter(s)	mL
millimeter(s)	mm
million gallons	MG
million gallons per day	mgd
millisecond(s)	ms
millivolt(s)	mV
minute(s)	min
mixed liquor suspended solids	MLSS
nephelometric turbidity unit	NTU
net positive suction head	NPSH
noise criteria	nc
noise reduction coefficient	NRC
number	no
ounce(s)	oz
outside air	oa
outside diameter	OD
parts per billion	ppb
parts per million	ppm
percent	pct
phase (electrical)	ph
pound(s)	lb
pounds per cubic foot	pcf
pounds per cubic foot per hour	pcf/hr

pounds per day	lbs/day
pounds per day per cubic foot	lbs/day/cu ft
pounds per day per square foot	lbs/day/sq ft
pounds per square foot	psf
pounds per square foot per hour	psf/hr
pounds per square inch	psi
pounds per square inch absolute	psia
pounds per square inch gauge	psig
power factor	PF
pressure drop or difference	dp
pressure, dynamic (velocity)	vp
pressure, vapor	vap pr
quart(s)	qt
Rankine	R
relative humidity	rh
resistance	res
return air	ra
revolution(s)	rev
revolutions per minute	rpm
revolutions per second	rps
root mean squared	rms
safety factor	sf
second(s)	sec

shading coefficient	SC
sludge density index	SDI
Sound Transmission Coefficient	STC
specific gravity	sp gr
specific volume	Sp Vol
sp ht at constant pressure	Cp
square	sq
square centimeter(s)	sq cm
square foot (feet)	sq ft
square inch (es)	sq in
square meter(s)	sq m
square yard(s)	sq yd
standard	std
static pressure	st pr
supply air	sa
suspended solids	SS
temperature	temp
temperature difference	TD
temperature entering	TE
temperature leaving	TL
thousand Btu per hour	Mbh
thousand circular mils	kcmil
thousand cubic feet	Mcf
threshold limit value	TLV
tons of refrigeration	tons

torque	TRQ
total dissolved solids	TDS
total dynamic head	TDH
total kjeldahl nitrogen	TKN
total oxygen demand	TOD
total pressure	TP
total solids	TS
total suspended solids	TSS
total volatile solids	TVS
vacuum	vac
viscosity	visc
volatile organic chemical	VOC
volatile solids	VS
volatile suspended solids	VSS
volt(s)	V
volts-ampere(s)	VA
volume	vol
watt(s)	W
watthour(s)	Wh
watt-hour demand	WHD
watt-hour demand meter	WHDM
week(s)	wk
weight	wt
wet-bulb	WB

wet bulb temperature	WBT
yard(s)	yd
year(s)	yr

- B. Use ASME Y1.1-1989, “Abbreviations for use on Drawings and in Text” for abbreviations for units of measure not included herein in Paragraph 1.4.

#### 1.5 REFERENCE STANDARDS

- A. Latest Edition: Construe references to furnishing materials or testing, which conform to the standards of a particular technical society, organization, or body, to mean the latest standard, code, or specification of that body, adopted and published as of the date of bidding this Contract. Standards referred to herein are made a part of these Specifications to the extent which is indicated or intended.
- B. Precedence: If a referenced standard is in disagreement with these Specifications, these Specifications shall govern. The duties and responsibilities of the OWNER, CONTRACTOR or ENGINEER, or any of their consultants, agents or employees are set forth in the Contract Documents, and are not changed or altered by any provision of any referenced standard specifications, manuals or code, whether such standard manual or code is or is not specifically incorporated by reference in the Contract Documents. 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 powers of the ENGINEER as set forth in the Contract Documents cannot be assigned to the ENGINEER or any of the ENGINEER'S consultants, agents or employees.

### **PART 2 PRODUCTS**

Not Used

### **PART 3 EXECUTION**

Not Used

END OF SECTION

**SECTION 01 45 00**  
**QUALITY CONTROL**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Inspection Services
- B. Inspection of Materials
- C. Quality Control
- D. Costs of Testing
- E. Acceptance Tests
- F. Failure to Comply with Contract

1.2 RELATED SECTIONS

- A. Section 01 33 00 - Submittals: Specific Submittal Requirements

1.3 SUBMITTALS

- A. General: The CONTRACTOR shall submit for approval a Quality Control representative who is qualified to perform the duties of a Quality Control representative. Provide a resume of like past projects for this individual and must have a minimum of 10 years of similar experience for projects like this project. The Quality Control representative can perform other work duties, such as Superintendent, or Safety.
- B. The Quality Control representative, prior to performing any work on a Definable Feature of Work, shall submit a Preparatory Inspection Worksheet for the Definable Feature of Work. The Worksheet will include all proposed materials, equipment and labor to be used, required submittals, required tests, safety considerations, etc., that is required for each Definable Feature of Work.
- C. The CONTRACTOR shall use as a minimum the following Definable Features of Work: 1) Demolition, 2) Grading, 3) Concrete/Rebar/Asphalt and 4) Detention ponds/structures. The Contractor may use others and combine Definable Features of Work; but must be approved by the ENGINEER. The purpose is to control the quality of each Definable Feature of Work using the 3-Phases of Inspection, 1) Preparatory, 2) Initial and 3) Follow-up.
- D. Preparatory Inspection Meeting. After submittals are approved and materials are on-site, the CONTRACTOR is prepared to schedule a Preparatory Meeting to be held with CONTRACTOR personnel and Inspector, and possibly the Engineer. The CONTRACTOR's plan with safety considerations will be reviewed and will be accepted/rejected during the meeting. The ENGINEER's acceptance will be given verbally and will be annotated on the submittal and returned to the CONTRACTOR.

The Preparatory Inspection Meeting form will be provided and will be completed by the CONTRACTOR and provided to the Inspector prior to the Prep Meeting. The items discussed at the Preparatory Inspection Meeting will be added to the QC Daily Report.

Initial Inspection Meeting. After a representative amount of work has been completed for the Definable Feature of Work, there will be an Initial Inspection Meeting held on-site. The CONTRACTOR's representatives will meet with the Inspector to discuss whether the quality of the Plans and Specifications is being achieved for the Definable Feature of Work. Any adjustments will be identified and adopted to correct any deficiencies that have been identified. The Initial Inspection Meeting form will be provided to the CONTRACTOR. The completed Worksheet is provided to the Inspector 5 days prior to the Initial Inspection meeting. The Inspection Meeting will be documented in the QC Daily Report.

- E. Follow-up Inspection. After the Initial Inspection daily follow-up inspections will be performed by the CONTRACTOR and Inspector and document in the Daily Reports until the work for the Definable Feature of Work is completed. The CONTRACTOR's follow-up inspections ensures that the quality established by Plans and Specifications are being met.
- F. Certificate Submittals: Furnish the ENGINEER authoritative evidence in the form of Certificates of Manufacture that the materials and equipment to be used in the work have been manufactured and tested in conformity with the Contract Documents. Include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

#### 1.4 INSPECTION SERVICES

- A. OWNER'S Access: At all times during the progress of the work and until the date of final completion, afford the OWNER, ENGINEER and Inspector every reasonable, safe, and proper facility for inspecting the work at the site. The observation and inspection of any work will not relieve the CONTRACTOR of any obligations to perform proper and satisfactory work as specified. The CONTRACTOR Quality Control representative will ensure rejected work, due to faulty design, inferior, or defective materials, poor workmanship, improper installation, excessive wear, or nonconformity with the requirements of the Contract Documents, will be replaced with satisfactory work at no additional cost to the OWNER. Replace as directed, finished or unfinished work found not to be in strict accordance with the Contract, even though such work may have been previously approved, and payment made therefor.
- B. Rejection: The ENGINEER have the right to reject materials and workmanship which are defective or require correction. The CONTRACTOR shall promptly remove rejected work and materials from the site.
- C. Inferior Work Discoveries: Failure or neglect on the part of the CONTRACTOR to condemn or reject bad or inferior work or materials does not imply an acceptance of such work or materials. Neither is it to be construed as barring the ENGINEER or Inspector at any subsequent time from recovering damages or a sum of money needed to build anew all portions of the work in which inferior work, or improper materials were used.

- D. Removal for Examination: Should it be considered necessary or advisable by the ENGINEER or Inspector at any time before final acceptance of the work, to make examinations of portions of the work already completed, by removing or tearing out such portions, promptly furnish all necessary facilities, labor, and material, to make such an examination. If such work is found to be defective in any respect, defray all expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the cost of examination and restoration of the work will be considered a change in the work to be paid for in accordance with applicable provisions of the Contract.

## **INSPECTION OF MATERIALS**

- E. Pre-manufacture Notification: Give notice in writing to the ENGINEER sufficiently in advance of the commencement of manufacture, or preparation of materials, specially manufactured or prepared for use in or as part of the permanent construction. When required, notice to include a request for inspection, the date of commencement, and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, ENGINEER will arrange to have a representative present at such times during the manufacture or testing as may be necessary to inspect the materials or will notify CONTRACTOR that the inspection will be made at a point other than the point of manufacture or testing, or that the inspection will be waived. Comply with these provisions before shipping any materials. Such inspection will not constitute a release from the responsibility for furnishing materials meeting the requirements of the Contract Documents.

## **QUALITY CONTROL**

- F. CONTRACTOR Responsible: CONTRACTOR shall be responsible for supervision of all work, for measuring and recording material temperatures, ambient temperatures, weather conditions, time of placements, amount placed, and method of placement and curing. Failure to perform correctly may result in removal of material. This data shall be added to the Daily Report, which is provided electronically to the ENGINEER or Inspector within twenty-four hours of its recording.

### **G. Testing**

#### **1. Field and Laboratory**

- a. The CONTRACTOR shall provide a list of all QC Tests in the Preparatory Worksheet for each Definable Feature of Work.
- b. The CONTRACTOR shall be responsible for all Quality Control testing using an ODOT approve testing laboratory in Oklahoma. Provide personnel to assist the ENGINEER and laboratory testing representatives in performing the following periodic Quality Control observation and associated testing services.
  - (1) Concrete: Inspect concrete forms and reinforcement; observe concrete placement; witness air entrainment tests, facilitate concrete cylinder preparation and assist with other tests performed by the CONTRACTOR's testing laboratory representative and observed by the ENGINEER or Inspector.

- (2) When specified in Division 2, Division 3, Division 7 or Division 31 of the Contract Documents, use an independent testing laboratory subcontractor to perform required Quality Control testing. It is preferred for the Contractor to use an ODOT approved testing laboratory in Oklahoma. Reference ODOT link for Qualified Labs List below:

[viewer.aspx \(ok.gov\)](#)

- (3) The proposed Quality Control testing lab should be submitted to the ENGINEER for review/approval. Qualify the laboratory as having a good reputation and performed previous satisfactory work.
- (4) Cooperate with the ENGINEER and Inspector and laboratory testing representative. Provide at least 48-hour notice prior to when a specified testing will be performed. Ensure the labor, materials and equipment are at the site as required by the ENGINEER and the testing laboratory for the tests.
- (5) Concrete testing, including field sampling and delivery to the laboratory, will be performed by the CONTRACTOR's testing laboratory representative as specified. ENGINEER will determine the exact time, location and number of tests to be performed.
- (6) Include Quality Control tests in the QC Daily Report when they occur and provide information, such as type of Concrete, air entrainment, ambient air temperature, location of test, who performed the test, etc...
- (7) Pipeline and Other Testing: Conform to test procedures and requirements specified in the appropriate Specification Section.
- (8) Testing Costs: Include the costs of all testing other than bentonite, soils, concrete and masonry testing in the appropriate Contract Item. Include the specified allowance for the bentonite, soils, concrete and masonry laboratory testing services in the Contract Item titled Independent Laboratory Testing Allowance. Make payments directly from the allowance with no CONTRACTOR markup to CONTRACTOR's Quality Control independent testing laboratory subcontractor for tests performed.

#### H. Reports

1. Certified Test Reports: Where certified test reports are required by the Contract Documents, the test reports should be noted in the Daily Report and attached to the Daily Report, and shall meet the following requirements:
  - a. Before delivery of materials submit and obtain approval of the ENGINEER for all required certified test reports, certified copies of the reports of all tests required in Specifications or specified in the Contract Plans. Perform all QC testing using an approved independent test laboratory, or the manufacturer's laboratory. Test reports are to be accompanied by a notarized certificate in the form of a letter from the manufacturer, or supplier, certifying that tested material meets the specified requirements and the same type, quality, manufacture and

make as specified. The certificate shall be signed by an officer of the manufacturer or the manufacturer's plant manager.

2. Certificate of Compliance: At the option of the ENGINEER, or where not otherwise specified, submit for approval a notarized Certificate of Compliance. The Certificates may be in the form of a letter stating the following:
  - a. Manufacturer has performed all required tests.
  - b. Materials to be supplied meet all test requirements.
  - c. Tests were performed not more than one year prior to submittal of the certificate.
  - d. Materials subjected to the tests are of the same quality, manufacture and make as those specified.
  - e. Identification of the materials.
3. Daily Reports. The CONTRACTOR shall electronically submit a Daily Report to the Inspector within 24 hours of the workday. The Daily Report should record activities for that day's work for all Definable Features of Work, including labor, materials, subcontractors, testing, submittals approved, etc. A Daily Report form the CONTRACTOR will use is attached. If the Contractor wants to use another format, submit to the ENGINEER for approval.

#### 1.5 ACCEPTANCE TESTS

- A. Field Tests: As soon as conditions permit, furnish all labor, energy, fuel, water and other materials, equipment and services and perform preliminary field tests of all work provided under this Contract. If the preliminary field tests disclose that any materials furnished and installed under this Contract does not meet the requirements of the Contract Documents, make all changes, adjustments and replacements required prior to the acceptance tests.
- B. Failure of Tests: If the acceptance tests reveal defects in material, or if the material in any way fails to comply with the requirements of the Contract Documents, then promptly correct such deficiencies. Failure or refusal to correct the deficiencies, or if the improved materials, when tested again, fail to meet the guarantees or specified requirements, the ENGINEER, notwithstanding its partial payment for work and materials, may reject said materials and may order the CONTRACTOR to remove the defective work from the site at no addition to the Contract Price, and replace it with material or equipment which meets the Contract Documents.

#### 1.6 FAILURE TO COMPLY WITH CONTRACT

- A. Unacceptable Materials: If it is ascertained by testing or inspection that the material does not comply with the Contract, do not deliver said material, or if delivered remove it promptly from the site or from the work and replace it with acceptable material without additional cost to the OWNER. If the CONTRACTOR fails to remove unacceptable materials and equipment from the site, or to make satisfactory progress in so doing, within forty-eight (48) hours after the service of a written notice from the ENGINEER ordering such removal, the acceptable material may be removed by the OWNER and

the cost of such removal to be taken out of the money that may be due or may become due the CONTRACTOR on account of or by virtue of this Contract. Fulfill all obligations under the terms and conditions of the Contract even though the ENGINEER fail to ascertain noncompliance or notify the CONTRACTOR of noncompliance.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

END OF SECTION

## SECTION 015000

### CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. General Requirements
- B. Temporary Utilities
- C. Temporary Construction
- D. Barricades and Enclosures
- E. Fences
- F. Security
- G. Temporary Controls
- H. Traffic Regulation
- I. Field Offices and Sheds
- J. Delivery, Storage and Handling

##### 1.2 GENERAL REQUIREMENTS

- A. Work Sites and Facilities: Furnish, install, maintain and remove all false work, scaffolding, ladders, hoist ways, braces, pumping plants, shields, trestles, roadways, sheeting, centering forms, barricades, drains, flumes, and the like, any of which may be needed in the construction of any part of the work and which are not herein described or specified in detail. Adequately shore, sheet and brace excavations or slope the sides of excavations in accordance with the State of Oklahoma Department of Labor requirements. Accept responsibility for the safety and efficiency of such works and for any damage that may result from their failure or from their improper construction, maintenance or operation.
- B. Staging Area: City of Sapulpa shall provide the green area immediately north of the clarifiers as a staging area. This area is accessible from an adjacent vehicle gate, which will be double locked.
- C. First Aid: Maintain a readily accessible, completely equipped first aid kit at each location where work is in progress.
- D. Safety Responsibility: Accept sole responsibility for safety and security at the site. Indemnify and hold harmless the OWNER and the OWNER'S Authorized Representative, including Keithline Engineering Group and for any safety violation, or noncompliance with governing bodies and their regulations, and for accidents, deaths, injuries, or damage at the site during

occupancy or partial occupancy of the site by CONTRACTOR'S forces while performing any part of the work.

- E. Hazard Communication: Furnish two copies of the CONTRACTOR'S Hazard Communication Program required under OSHA regulations before beginning on-site activities. Furnish two copies of amendments to Hazard Communication Program as they are prepared.
- F. Explosives: The use of explosives is prohibited.
- G. Power Lines: Prevent any person, materials and equipment from coming within six feet of any power line carrying more than 440 volts, unless the electric power service has been first discontinued.
- H. Fire Prevention and Protection: Take all necessary measures to prevent fire and provide satisfactory firefighting means at the location of the work.
- I. Condition of Equipment and Materials: Only handle and operate all of the equipment, tools, appliances, and materials used in connection with the project when they are in safe operating condition and in accordance with a standard safety procedure.

### 1.3 TEMPORARY UTILITIES

- A. Water: Provide all necessary and required water without additional cost, unless otherwise specified.
- B. Light and Power: Provide without additional cost to the OWNER temporary lighting and power facilities required for the proper construction and inspection of the work. If, in the ENGINEER'S opinion, these facilities are inadequate, do NOT proceed with any portion of the work affected thereby. Maintain temporary lighting and power until the work is accepted.
- C. Heat: Provide temporary heat, whenever required, for work being performed during cold weather to prevent freezing of concrete, water pipes, and other damage to the work or existing facilities.
- D. Sanitary Facilities: Provide sufficient sanitary facilities for construction personnel. Prohibit and prevent nuisances on the site of the work or on adjoining property. Discharge any employee who violates this rule. Abide by all environmental regulations or laws applicable to the work.
- E. Connections to Existing Utilities:
  - 1. Unless otherwise specified or indicated, make all necessary connections to existing facilities including structures, drain lines, and utilities such as telephone, and electricity. In each case, obtain permission from the OWNER or the owning utility prior to undertaking connections. Protect facilities against deleterious substances and damage.
  - 2. Thoroughly plan in advance all connections to existing facilities. Have on hand at the time of undertaking the connections, all material, labor and required equipment. Proceed continuously to complete connections in minimum time. Arrange for the operation of valves or other appurtenances on existing utilities, under the direct supervision of the owning utility.

#### 1.4 TEMPORARY CONSTRUCTION

- A. Bridges: Design and place suitable temporary bridges where necessary for the maintenance of vehicular and pedestrian traffic. Assume responsibility for the sufficiency and safety of all such temporary work or bridges and for any damage which may result from their failure or their improper construction, maintenance, or operation. Indemnify and save harmless the OWNER and the OWNER'S representatives, including Keithline Engineering Group from all claims, suits or actions, and damages or costs of every description arising by reason of failure to comply with the above provisions.

#### 1.5 BARRICADES AND ENCLOSURES

- A. General: When performing any type of construction or excavation work, or stockpiling or storing any materials or equipment upon or adjacent to any street, alley, sidewalk, residence, public ground, or other location that is likely to be subject to pedestrian or vehicular traffic, furnish, erect, and maintain substantial guard rails, safety fencing, lights, and traffic control devices around the project to protect pedestrians, animals, and vehicles from injury and damage. All traffic control shall be in accordance with State Traffic Engineering Standards and Procedures for Street Use and Temporary Traffic Control. Provide sufficient and proper signals and flagmen for warning during blasting operations.
- B. Protection of Workmen and Public: Effect and maintain at all times during the prosecution of the work, barriers and lights necessary for the protection of Workmen and the Public. Provide suitable barricades, lights, "danger" or "caution" or "street closed" signs and watchmen at all places where the work causes obstructions to normal traffic, excavation sites, or constitutes in any way a hazard to the public.
- C. Barricades and Lights:
  - 1. Protect all streets, roads, highways, excavations and other public thoroughfares which are closed to traffic; use effective barricades which display acceptable warning signs. Locate barricades at the nearest public highway or street on each side of the blocked section.
  - 2. Statutory Requirements: Install and maintain all barricades, signs, lights, and other protective devices within street and highway rights-of-way in strict conformity with applicable statutory requirements by the authority having jurisdiction.

#### 1.6 FENCES

- A. Existing Fences: Obtain written permission from the OWNER prior to relocating or dismantling fences which interfere with construction operations. Reach agreements with the fence OWNER as to the period the fence may be left relocated or dismantled. Install adequate gates where fencing must be maintained. Keep gates closed and locked at all times when not in use.
- B. Restoration: Restore all fences to their original or better condition and to their original location on completion of the work.

#### 1.7 SECURITY

- A. Preservation of Property:

1. Preserve from damage all property along the line of the work, in the vicinity of or in any way affected by the work, the removal or destruction of which is not called for by the Drawings. Preserve from damage public utilities, street signs and lights, trees, lawn areas, buildings, monuments, fences, pipe and underground structures public streets and the like. (Note: Normal wear and tear of streets resulting from legitimate use by the CONTRACTOR is not considered as damage.) Whenever damages occur to such property, immediately restore to its original condition. Costs for such repairs are incidental to the Contract. Intentional disturbances to such property must first be approved by its OWNER.
2. In case of failure on the part of the CONTRACTOR to restore property or make good on damage or injury, the OWNER may, upon 24 hours written notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from any moneys due or which may become due the CONTRACTOR under this Contract. If removal, repair or replacement of public or private property is made necessary by alteration of grade or alignment authorized by the OWNER and not contemplated by the Contract Documents, the CONTRACTOR will be compensated provided that such property has not been damaged through fault of the CONTRACTOR or the CONTRACTOR'S employees.

B. Public Utility Installations and Structures:

1. Public utility installations and structures include all poles, tracks, pipes, wires, conduits, vaults, manholes, and other appurtenances and facilities, whether owned or controlled by public bodies or privately owned individuals, firms or corporations, used to serve the public with transportation, gas, electricity, telephone, storm and sanitary sewers, water, or other public or private utility services. Facilities appurtenant to public or private property which may be affected by the work are deemed included hereunder.
2. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. Existing public utility installations and structures are indicated on the Drawings only to the extent such information was made available to, or found by, the ENGINEER in preparing the Drawings. These data are not guaranteed for completeness or accuracy, and the CONTRACTOR is responsible for making necessary investigations to become fully informed as to the character, condition, and extent of all public utility installations and structures that may be encountered and that may affect the construction operations.
3. Contact utility locating service sufficiently in advance of the start of construction to avoid damage to the utilities and delays to the completion date.
4. Remove, replace, relocate, repair, rebuild, and secure any public utility installations and structures damaged as a direct or indirect result of the work under this Contract. Costs for such work are incidental to the Contract. Be responsible and liable for any consequential damages done to or suffered by any public utility installations or structures. Assume and accept responsibility for any injury, damage, or loss which may result from or be consequent to interference with, or interruption or discontinuance of, any public utility service.
5. Repair or replace any water, electric, sewer, gas, or other service connection damaged during the work with no addition to the Contract price.

6. At all times in performance of the work, employ proven methods and exercise reasonable care and skill to avoid unnecessary delay, injury, damage, or destruction to public utility installations and structures. Avoid unnecessary interference with, or interruption of, public utility services. Cooperate fully with the OWNERS thereof to that end.
7. Give written notice to the OWNERS of all public utility installations and structures affected by proposed construction operations, sufficiently in advance of breaking ground in any area or on any unit of the work, to obtain their permission before disrupting the lines and to allow them to take measures necessary to protect their interests. Advise the Chiefs of Police, Fire and Rescue Services of any excavation in public streets or the temporary shut-off of any water main. Provide at least 24 hour's notice to all affected property OWNERS whenever service connections are taken out of service.
8. Do not operate a valve or other control on any utility main or building service line for any purpose.
9. At places where construction operations are adjacent to or crossing the plant of railway, telegraph, telephone, electric and gas companies or water lines, sanitary sewers and storm sewers, and damage to which might result in expense, loss or inconvenience, do not commence work until all arrangements necessary for the protection thereof have been made. Notify the Notification Center of Oklahoma One-Call System, Inc. of any excavation or demolition prior to the commencement of such work. Make notification no sooner than ten (10) days nor later than forty-eight (48) hours prior to start of work, excluding Saturdays, Sundays, and legal holidays.
10. Cooperate with the OWNERS or any underground or overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a reasonable manner and duplication or rearrangement work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted. Make revision and crossings of the various types of lines as follows:
  - a. Remove storm sewers and culverts at the time of crossing or adequately brace and hold them in position while the pipe is placed beneath them. If the storm sewer or culvert is removed, replace it with pipe of the same type and size as that removed, and re-join it to the undisturbed line with a joint satisfactory to the ENGINEER. Thoroughly compact the backfill over the pipe, up to and around the storm sewer, in order that no settlement will occur. The revision and crossing shall be at the expense of the CONTRACTOR. In the event lines, other than those shown on the Drawings, are encountered and fall within the standard trench limit and, in the opinion of the ENGINEER, revision of the line is necessary for the construction of the project, the CONTRACTOR will be reimbursed for the extra cost of the crossing or revision as extra work.
  - b. Protect all overhead and buried telephone and electrical conduits, and gas mains to be revised or crossed by the construction of this project in accordance with the directions of the utility company owning the conduits and/or mains. Notify the companies and obtain their permission before making any crossing or revisions. The revisions and crossing shown on the Drawings are at the expense of the CONTRACTOR. In the event lines, other than those shown on the Drawings, are encountered and fall within the standard trench limit and, in the opinion of the ENGINEER, revision of the line is necessary for the construction of the project, the CONTRACTOR will be reimbursed

for the extra cost of the crossings or revision as extra work. Repair, to the satisfaction of the ENGINEER and of the OWNER and at no additional compensation, any overhead cables or buried cables or conduits or gas mains damaged.

- c. Do not remove any water or sanitary sewer lines except as directed by the ENGINEER or as required by the Drawings and Specifications, and adequately brace and protect them from any damage during construction. Any existing water main or sewer main or lateral damaged by the CONTRACTOR'S operations will be repaired at the CONTRACTOR'S expense.
11. The locations of utility service lines serving individual properties may or may not be shown on the Drawings, but assume that such service lines exist whether or not they are shown on the Drawings, and be responsible for making any necessary changes in the line and/or grade of such services, or to secure the necessary changes therein to be made by the particular utility company involved or other OWNER thereof, or by an agent or individual CONTRACTOR approved by such utility company or other OWNER. Pay the cost of all such revisions whether performed by CONTRACTOR, the utility company, or other OWNER, or an approved CONTRACTOR. In the event of interruption of a utility service as a result of accidental breakage, promptly notify the ENGINEER and the OWNER of the utility, and repair or cause the same to be repaired, in the same manner as necessary changes above provided for, and do all things necessary to see to the restoration of services as promptly as may be reasonable done.
  12. Replace all damaged sanitary sewer service lines with cast iron pipe, regardless of type or kind damaged.
  13. In the event the CONTRACTOR in any way fails to comply with the requirements of protecting, repairing, and restoring any utility or utility service, the OWNER may, upon forty-eight (48) hours' written notice, proceed to protect, repair, rebuild or otherwise restore such utility or utility service as may be deemed necessary, and the cost thereof will be deducted from any money due or which may become due the CONTRACTOR pursuant to the terms of his contract.
  14. Refer to General Condition GC-22 for related requirements.
- C. Miscellaneous Structures: Assume and accept responsibility for all injuries or damage to culverts, building foundations and walls, retaining walls, or other structures of any kind met with during the prosecution of the Work. Assume and accept liability for damages to public or private property resulting therefrom. Adequately protect against freezing all pipes carrying liquid.
- D. Protection of Trees and Lawn Areas:
1. Protect with boxes, trees and shrubs, except those ordered to be removed. Do not place excavated material so as to cause injury to such trees or shrubs. Replace trees or shrubs destroyed by accident or negligence of the CONTRACTOR or CONTRACTOR'S employees with new stock of similar size and age, at the proper season, at no additional cost to the OWNER.
  2. Leave lawn areas in as good condition as before the start of the work. Restore areas where sod has been removed by seeding or sodding.

## 1.8 TEMPORARY CONTROLS

### A. During Construction:

1. Keep the site of the work and adjacent premises free from construction materials, debris, and rubbish. Remove this material from any portion of the site if such material, debris, or rubbish constitutes a nuisance or is objectionable.
2. Remove from the site all surplus materials and temporary structures when they are no longer needed.
3. Neatly stack construction materials such as concrete forms and scaffolding when not in use. Promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.
4. Properly store volatile wastes in covered metal containers and remove daily.
5. Do not bury or burn on the site or dispose of into storm drains, sanitary sewers, streams, or waterways, any waste material. Remove all wastes from the site and dispose of in a manner complying with applicable ordinances and laws.

### B. Smoke Prevention:

1. Strictly observe all air pollution control regulations.
2. Open fires will be allowed only if permitted under current ordinances.

### C. Noises:

1. Maintain acceptable noise levels in the vicinity of the work. Limit noise production to acceptable levels by using special mufflers, barriers, enclosures, equipment positioning, and other approved methods.
2. Supply written notification to the OWNER sufficiently in advance of the start of any work which violates this provision. Proceed only when all applicable authorizations and variances have been obtained in writing.

### D. Hours of Operation:

1. Refer to Section 01110.

### E. Dust Control:

1. Take measures to prevent unnecessary dust. Keep earth surfaces exposed to dusting moist with water or a chemical dust suppressant. Cover materials in piles or while in transit to prevent blowing or spreading dust.
2. Adequately protect buildings or operating facilities which may be affected adversely by dust. Protect machinery, motors, instrument panels, or similar equipment by suitable dust screens. Include proper ventilation with dust screens.

### F. Temporary Drainage Provisions:

1. Provide for the drainage of storm water and any water applied or discharged on the site in performance of the work. Provide adequate drainage facilities to prevent damage to the work, the site, and adjacent property.
  2. Supplement existing drainage channels and conduits as necessary to carry all increased runoff from construction operations. Construct dikes as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect the OWNER'S facilities and the work, and to direct water to drainage channels or conduits. Provide ponding as necessary to prevent downstream flooding.
  3. Maintain excavations free of water. Provide, operate and maintain the necessary pumping equipment. Properly dispose of all water removed from excavations.
- G. Pollution: Prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. Do not permit sanitary wastes to enter any drain or watercourse other than sanitary sewers. Do not permit sediment, debris, or other substances to enter sanitary sewers. Take reasonable measures to prevent such materials from entering any drain or watercourse.

#### 1.9 TRAFFIC REGULATION

- A. Parking: Provide and maintain suitable parking areas for the use of all construction workers and others performing work or furnishing services in connection with the Contract, to avoid any need for parking personal vehicles where they may interfere with public traffic or construction activities.
- B. Access: Conduct work to interfere as little as possible with public travel, whether vehicular or pedestrian. Provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, give reasonable notice to OWNERS before interfering with them. Such maintenance of traffic will not be required when the CONTRACTOR has obtained permission from the OWNER or tenant of private property, or from the authority having jurisdiction over the public property involved, to obstruct traffic at the designated point.

#### 1.10 FIELD OFFICES AND SHEDS

- A. CONTRACTOR'S Office: Erect, furnish, and maintain a field office trailer with a telephone. Have an authorized agent present at this office at all times while the work is in progress. Keep readily accessible copies of the Contract Documents, required record documents, and the latest approved shop drawings at this field office.
- B. Material Sheds and Temporary Structures: Provide material sheds and other temporary structures of sturdy construction and neat appearance.
- C. Portable Toilets: The CONTRACTOR shall provide portable toilets for use by the CONTRACTOR employees.
- D. Location: Coordinate location of field offices, material sheds and temporary structures with ENGINEER and OWNER.

E. ENGINEER'S OFFICE: Not required.

1.11 DELIVERY, STORAGE AND HANDLING

- A. All material and products delivered to the site of the work shall be adequately housed and protected against deterioration according to the recommended procedures from the manufacturer.
- B. The CONTRACTOR shall keep his storage yards in good order, pile his materials neatly, and protect them from damage. Store areas shall comply with all local, state and federal regulations.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

END OF SECTION

**SECTION 017220**  
**LINES AND GRADES**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. General
- B. Surveys
- C. Datum Plane
- D. Protection of Survey Data

1.2 GENERAL

- A. Construct all work in accordance with the lines, grades and elevations shown on the Drawings. Assume full responsibility for keeping all alignment and grade.

1.3 SURVEYS

- A. Control Points: Base horizontal and vertical control points will be established or designated by the ENGINEER and used as datum for the work. Perform all additional survey, layout, and measurement work.
  - 1. Keep ENGINEER informed, sufficiently in advance, of the times and places at which work is to be performed so that base horizontal and vertical control points may be established and any checking deemed necessary by ENGINEER may be done, with minimum inconvenience to the ENGINEER and at no delay to CONTRACTOR. It is the intention not to impede the work for the establishment of control points and the checking of lines and grades set by the CONTRACTOR. However, when necessary, suspend working operations for such reasonable time as the ENGINEER may require for this purpose. Costs associated with such suspension are deemed to be included in the Contract Price, and no time extension or additional costs will be allowed.
  - 2. Provide an experienced survey crew including an instrument operator, competent assistants, and any instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement of work performed by the CONTRACTOR.

1.4 DATUM PLANE

- A. All elevations indicated or specified refer to the datum plane of the United States Coast and Geodetic Survey and are expressed in feet and decimal parts thereof, or in feet and inches.

1.5 PROTECTION OF SURVEY DATA

- A. General: Safeguard all points, stakes, grade marks, known property corners, monuments, and bench marks made or established for the work. Reestablish them if disturbed, and bear the entire expense of checking reestablished marks and rectifying work improperly installed.
- B. Records: Keep neat and legible notes of measurements and calculations made in connection with the layout of the work. Furnish copies of such data to the ENGINEER for use in checking the CONTRACTOR'S layout. Data considered of value to the OWNER will be transmitted to the OWNER by the ENGINEER with other records on completion of the work.

**PART 2 PRODUCTS**

Not Used

**PART 3 EXECUTION**

Not Used

END OF SECTION

## SECTION 017320

### CUTTING AND PATCHING

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. General Requirements
- B. Scheduling of Shutdown

##### 1.2 RELATED SECTIONS

- A. Section 01110 - Summary of Work

##### 1.3 GENERAL REQUIREMENTS

- A. Coordination: Perform all cutting, fitting or patching of the work that may be required to make the several parts thereof join in accordance with the Contract Documents. Perform restoration with competent workmen skilled in the trade.
- B. Improperly Timed Work: Perform all cutting and patching required to install improperly timed work, to remove samples of installed materials for testing, and to provide for alteration of existing facilities or for the installation of new work in the existing construction.
- C. Limitations: Except when the cutting or removal of existing construction is specified or indicated, do not undertake any cutting or demolition which may affect the structural stability of the work or existing facilities without the ENGINEER'S concurrence.

##### 1.4 SCHEDULING OF SHUTDOWN

- A. Connections to Existing Facilities: If any connections, replacement, or other work requiring the shutdown of an existing facility is necessary, schedule such work at times when the impact on the OWNER'S normal operation is minimal. Overtime, night and weekend work without additional compensation from the OWNER, may be required to make these connections, especially if the connections are made at times other than those specified.
- B. Request for Shutdowns: Submit a written request for each shutdown to the OWNER and the ENGINEER sufficiently in advance of any required shutdown.

#### PART 2 PRODUCTS

NOT USED

#### PART 3 EXECUTION

##### 3.1 PREPARATION

- A. Safeguards: Provide all shoring, bracing, supports, and protective devices necessary to safeguard all work and existing facilities during cutting and patching operations.

- B. Material Removal: Cut and remove all materials to the extent shown or as required completing the work. Remove materials in a careful manner with no damage to adjacent facilities. Remove materials which are not salvageable from the site.

### 3.2 RESTORATION

- A. Final Appearance and Finish: Restore all work and existing facilities affected by cutting operations, with new materials, or with salvaged materials acceptable to the ENGINEER, to obtain a finished installation with the strength, appearance, and functional capacity required. If necessary, patch and refinish entire surfaces.
- B. Return all surface and substraight back to its original condition to the satisfactory of the Owner.

END OF SECTION

## SECTION 017400

### CLEANING

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Cleaning During Construction
- B. Final Cleaning
- C. Final Inspection

##### 1.2 CLEANING DURING CONSTRUCTION

- A. During construction of the work, at all times, keep the site of the work and adjacent premises as free from material, debris and rubbish as is practicable and remove it from any portion of the site, if in the opinion of the ENGINEER, such material, debris or rubbish constitutes a nuisance or is objectionable.
- B. All waste materials or byproducts of demolition and surface preparation shall be disposed of in accordance with applicable Federal, state and county laws, permits, regulations and ordinances. Disposal of these materials in the waterways will not be allowed. The disposal site shall be approved by the ENGINEER.
- C. Remove from the site all surplus materials and temporary structures when no further need therefor exists.
- D. Immediately upon installation of any portion of the work, restore all fills, topsoil, and utilities to their location and condition prior to construction.

##### 1.3 FINAL CLEANING

- A. Requirements: At the completion of work and immediately prior to final inspection, clean the entire project as follows:
  - 1. Thoroughly clean all work and equipment provided under the Contract, including finishes. Leave the structures and site in a complete and finished condition to the satisfaction of the ENGINEER.
  - 2. Direct all SUBCONTRACTORS to similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their contracts.
  - 3. Remove all temporary structures and all debris, including dirt, sand, gravel, rubbish and waste material.
  - 4. Should the CONTRACTOR not remove rubbish or debris or not clean the buildings and site as specified above, the OWNER reserves the right to have the cleaning done at the expense of the CONTRACTOR.

- B. Employ experienced workers, or professional cleaners, for final cleaning.
- C. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- D. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.
- E. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.
- F. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
- G. Remove erection plant, tools, temporary structures and other materials.
- H. Remove and dispose of all water, dirt, rubbish or any other foreign substances.

#### 1.4 FINAL INSPECTION

- A. After cleaning is complete the final inspection may be scheduled. The inspection will be done with the OWNER and ENGINEER.

### **PART 2 PRODUCTS**

Not Used

### **PART 3 EXECUTION**

Not Used

END OF SECTION

## **SECTION 017890**

### **CONTRACT CLOSE OUT**

#### **PART 1 GENERAL**

##### **1.1 SECTION INCLUDES**

- A. Warranties and Bonds
- B. Record Drawings

##### **1.2 WARRANTIES AND BONDS**

- A. Prior to final payment deliver to the OWNER the original and one copy of all bonds, warranties, guarantees and similar documents, including those customarily provided by manufacturers and suppliers which cover a period greater than the one year correction period. Show OWNER as beneficiary of these documents.

##### **1.3 RECORD DRAWINGS**

- A. At the site, keep and maintain one record copy of all Contract Documents, reference documents and all technical documents submitted in good order. Annotate Contract Drawings to show all changes made during the construction period. Annotated drawings are to be made available to ENGINEER for reference each day of construction. The Engineer shall enter the changes electronically and produce the Record Drawings.
- B. At completion of the CONTRACT and before final payment is made, ENGINEER shall deliver to the OWNER one set of clearly readable, reproducible Contract Drawings reflecting all changes made during construction. Mark each drawing "Record Drawing" in ink.

#### **PART 2 PRODUCTS**

Not used

#### **PART 3 EXECUTION**

- A. SUEZ manufacturer's representative shall be on-site during startup / commissioning and confirm in writing that the clarifier is operating correctly.

END OF SECTION

**SECTION 022310**  
**CLEARING AND GRUBBING**

**PART 1 GENERAL**

1.1 SUMMARY

- A. This section includes the requirements for clearing and grubbing of the site. The following information is shown on the project drawings:
  - 1. Limits of clearing.
  - 2. Limits of grubbing.
  - 3. All trees and shrubs shall be removed and disposed of in area to be cleared.
  - 4. Remove all roots.
  - 5. Describe size, density, and type of trees to be cleared and grubbed.
  - 6. Make access road improvements in accordance with plans.

1.2 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:
  - 1. Written permission to dispose of such products on private property shall be filed with the City.
  - 2. Samples of Tree wound paint and Herbicide. Submit samples in cans with manufacturer's label.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to, store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

**PART 2 PRODUCTS**

2.1 TREE WOUND PAINT (OUTSIDE LIMITS OF CLEARING AND GRUBBING)

- A. Bituminous based paint of standard manufacture specially formulated for tree wounds.

2.2 HERBICIDE

- A. Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on contractor's licensing, certification and record keeping.

## **PART 3 EXECUTION**

### **3.1 PROTECTION**

#### **A. Roads and Walks:**

1. Keep roads and walks free of dirt and debris at all times.

#### **B. Trees, Shrubs, and Existing Facilities:**

1. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

### **3.2 UTILITY LINES**

- #### **A.**
- Protect existing utility lines that are indicated to remain from damage. Notify the Engineer immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, the Contractor shall notify the Engineer in ample time to minimize interruption of the service.

- #### **B.**
- Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Apply herbicide in accordance with the manufacturer's label to the top surface of stumps designated not to be removed.

### **3.3 TREE REMOVAL**

- #### **A.**
- Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

### **3.4 PRUNING**

- #### **A.**
- Prune trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

### 3.5 GRUBBING

- A. Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform to the original adjacent surface of the ground.

### 3.6 DISPOSAL OF MATERIALS

- A. All timber on the project site noted for clearing and grubbing shall become the property of the Contractor, and shall be removed from the project site and disposed of offsite.
- B. Nonsalable Materials
  - 1. Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations may be disposed of by burning, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed. Refuse to be burned shall be burned at specified locations and in a manner to prevent damage to existing structures and appurtenances, construction in progress, trees, and other vegetation. The Contractor shall be responsible for compliance with all Federal and State laws and regulations and with reasonable practice relative to the building of fires. Burning or other disposal of refuse and debris and any accidental loss or damage attendant thereto shall be the Contractor's responsibility.

END OF SECTION

**26000**  
**BASIC MATERIALS AND METHODS ELECTRICAL**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The General Conditions of the Contract, including drawings, apply to the work of this section.

1.02 DESCRIPTION

- A. Furnish and install all electrical wiring, systems, equipment and accessories in accordance with the Specifications and Drawings.
- B. Capacities of equipment and cable are, in general, indicated on the Drawings.
- C. All ampacities herein specified or indicated on the Drawings are based on copper conductors with conduit and raceways accordingly sized.

1.03 WORK INCLUDED

- A. Work in this section includes electrical service utilities tie-in, and service entrance at lift stations and all other special systems and related electrical work. The work of this section is not limited to the above but is composed of all work specified in this section and indicated on the electrical plans. Electrical connection for receptacles, generators, etc. are included in the electrical scope.
- B. Provide all necessary labor, tools, equipment, and materials necessary to accomplish the work. Pay all required local, State and federal fees and obtain and bear all costs of permits required.

1.04 MINIMUM REQUIREMENTS

- A. The following codes and standards are hereby made a part of these specifications. Work and material furnished under these specifications shall be constructed and designed in accordance with the applicable requirements of these codes and standards, except to the extent that more stringent requirements are indicated or required by governing regulations.
- B. Whenever a particular standard is referenced, it is the latest edition of that standard to which is referred. In addition to the following list, comply with all state and municipal building and safety laws, ordinances and regulations relating to public health and safety.

Reference	Name and Address
<u>Abbreviation</u>	<u>Name and Address</u>

- |    |     |   |
|----|-----|---|
| 1. | ADA | The Americans With<br>Disabilities Act<br>U. S. Department of Justice |
|----|-----|---|

**BASIC MATERIALS AND METHODS ELECTRICAL**

Civil Rights Division  
Office on the Americans  
With Disabilities Act  
P. O. Box 6611B  
Washington, D.C. 20035-6118

2. ANSI American National Standards  
Institute, Inc.  
1430 Broadway  
New York, New York 10018  
USA
3. ASTM American Society for Testing  
Materials  
1916 Race Street  
Philadelphia, Pennsylvania  
19103 USA
4. BOCA Building Officials & Code  
Administration  
International, Inc.  
17926 South Halsted Street  
Homewood, Illinois 60430  
USA
5. IES Illuminating Engineering  
Society  
345 East 47th Street  
New York, New York 10017  
USA
6. NEC National Electrical Code (by  
NFPA)
7. NFPA National Fire Protection  
Association  
Batterymarch Park  
Quincy, MA 02269
8. NEMA National Electrical  
Manufacturers Assoc.  
2101 L Street, NW  
Washington, D.C. 20037 USA
9. UL Underwriters Laboratories,  
Inc.  
333 Pfingston Road  
Northbrook, IL 60062

**26000**  
**BASIC MATERIALS AND METHODS ELECTRICAL**

1.05 STRUCTURAL CONDITIONS

- A. These Specifications and Drawings accompanying same are intended to cover an installation which will not interfere with the structural design of the building, which will fit into the several available spaces, and which will insure a complete and satisfactory system.
- B. Contractor shall carefully examine the plans for all branches of the work and shall be responsible for the proper fitting of his material and apparatus into the building.
- C. Should the particular equipment which any bidder proposes to install require other space conditions than those shown on the Drawings, he shall arrange for such space with the Engineer before submitting his bid. Should changes become necessary on account of failure to comply with this clause, the Contractor shall make necessary changes at his (the Contractor's) own expense.
- D. The Contractor shall submit working scale drawings of all his apparatus and equipment which in any way varies from these Specifications and Plans, which shall be reviewed by the Engineer and approved before the work is started. Any interferences with the structural conditions shall be corrected by the Contractor before the work proceeds.

1.06 ACCESS PANELS

- A. Furnish access panels for installation as specified, where indicated, or wherever required for accessibility of equipment, junction boxes, controls, etc. Cooperate to provide panels that will suit the architectural treatment of the areas where access panels are required. All panels shall be flush type factory prime painted steel, key operated, and of sufficient size to facilitate operation and maintenance of the device enclosed. Furnish shop drawings of access panels for the approval of the Architect, before fabrication.

1.07 EQUIPMENT IDENTIFICATION

- A. Furnish laminated phenolic engraved black plastic nameplates attached with stainless steel screws to each piece of equipment identified by name or number on the Drawings. Nameplate shall have condensed gothic letters no less than 1/4" high and be indented white on black background. Equipment requiring name tags includes panelboards, disconnects and circuits within panelboards.

1.08 EQUIPMENT AND CONNECTIONS

- A. All apparatus, equipment, devices and appliances which are indicated to be electrically roughed-in shall be so equipped. Electrical connections to have JB with cover, disconnect or dedicated receptacle as shown on Drawings. These item must be coordinated with plans and equipment specifications.

## 26000

### BASIC MATERIALS AND METHODS ELECTRICAL

- B. Make complete final electrical power and electrical control connections to all equipment supplied under this contract and to all electrically powered equipment furnished or installed by others.

#### 1.09 USE OF ALLOCATED SPACES

- A. Consult the architectural plans, as well as the plans for all other trades, for spaces allocated to piping, conduits, equipment, etc. The electrical plans are essentially diagrammatic indicating approximate location of system components. The architectural plans and details shall take precedence in allocating space requirements for the various pipes, electric conduits, etc. All trades must consult with one another to the end that the available space is best utilized by all. Due consideration shall be given to the pipe, junction boxes, and conduit locations so that the accessibility of all the installed lines from access doors, hand holes, etc., is preserved; and space shall not be unnecessarily used by any contractor to save fittings, offsets, etc., whereby any interference results with other trades or where furring limits as shown on the architectural plans are exceeded. Each contractor shall consult the Engineer for space requirements for his equipment whenever same is not clearly indicated on the plans, or otherwise provided for. Failure to obtain clearance will leave the Contractor liable to removal and relocation of the affected equipment.

#### 1.11 OPENINGS - CUTTING REPAIRING

- A. Holes in Concrete: All holes through existing concrete shall be either core drilled or saw cut. All holes required shall have the approval of the Engineer prior to cutting or drilling. Dust containment shall be provided by the contractor. Fire seal around all floor and fire wall penetrations to ensure a 2-hour fire rating at penetration.

#### 1.12 SUBSTITUTIONS

- A. After execution of the contract, substitution of equipment of makes other than those specifically named in the contract documents will be approved by the Engineer for the following reasons only:
  - 1. That the equipment proposed for substitution is equal to and/or superior to equipment named (in construction, efficiency and utility) and further that the equipment named in the specifications cannot be delivered to the job in time to complete the work in proper sequence of work with other contractors, due to conditions beyond control of the contractor.
- B. This does not, in any way, relieve the contractor of the responsibility of ordering equipment for proper sequential delivery.

#### 1.13 SHOP DRAWINGS AND SUBMITTED DATA

- A. Refer to specifications for submittal requirements. No work indicated on any shop drawing shall be started until such drawings have been reviewed and approved by the Engineer.

**BASIC MATERIALS AND METHODS ELECTRICAL**

- B. Submittal data shall be referenced to section and paragraph numbers of the specifications and to fixture and equipment numbers listed or scheduled, and shall be assembled in numerical order of the specification paragraphs. Submittals shall be bound in sets between covers and all sets within a section shall be identical. Identification marks on submittals shall be made in black ink. Do not use red pencil or ink.
- C. Where equipment manufacturers named as equivalent, or approved equal, are proposed for use by the Contractor, he shall be responsible to coordinate the change with all trades affected and bear cost of changes required by other trades to accommodate the equipment substitution. Submit for approval 1/4" scale working drawings of equipment rooms, plan and section.

1.14 CLEANING EQUIPMENT AND MATERIALS

- A. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work.

1.15 INTERRUPTION OF SERVICES

- A. While work is in progress, except for designated short intervals during which connections are to be made, continuity of service shall be maintained to all existing systems. Interruptions shall be coordinated with the Owner as to time and duration. The Contractor shall be responsible for any interruptions to service and shall repair any damages to existing systems caused by his operations.

1.16 GUARANTEE

- A. Contractor shall guarantee all workmanship, materials and labor for a period of one (1) year, after warranty date set at substantial completion, to be free from defects not due to normal wear or abuse.

1.17 OPERATION MANUALS

- A. Furnish three bound sets of Operation Manuals along with the various warranties for mechanical and electrical equipment. Deliver Operation Manuals and Warranties to the Engineer prior to Final Inspection. Complete and satisfactory submittal of this material is a condition for final payment.

1.18 CONDITIONS OF FINAL INSPECTION

- A. The following items must be accomplished and delivered to the Engineer before request for Final Inspection and final payment will be acknowledged:
  - 1. Operating and Maintenance Instructions: Furnish three (3) complete sets of Operating and Maintenance Instructions for all equipment furnished under this contract.

**26000**

**BASIC MATERIALS AND METHODS ELECTRICAL**

2. All work and materials as called for by the contract must be complete.
3. All lamps shall be new. Personally make a special inspection trip to assure that the work on the project, as a whole, is ready for final acceptance before calling upon the Engineer to make a Final Inspection.

**END OF SECTION**

**ELECTRICAL SPECIFICATION INDEX-  
Sapulpa Lift Stations**

<b>SECTION</b>	<b>TITLE</b>
<b>26000</b>	<b>Basic Materials and Methods, Electrical</b>
<b>26213</b>	<b>Electric Natural Gas Generator</b>
<b>26416</b>	<b>Panelboards and enclosures</b>
<b>26519</b>	<b>Cable, Wires and Connectors</b>
<b>26526</b>	<b>Grounding</b>
<b>26533</b>	<b>Raceway Systems and Accessories</b>
<b>26816</b>	<b>Safety and Disconnect Switches</b>

**26213**  
**ENGINE GENERATORS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes packaged engine-generator sets for standby power supply with the following features:
  - 1. Natural Gas Powered Unit-mounted cooling system.
  - 2. Unit-mounted control and monitoring.
  - 3. Outdoor enclosure.
  - 4. Outdoor mounted automatic transfer switch circuit breaker on generator input.

**1.2 SUBMITTALS**

- A. Product Data: For each type of packaged engine generator and accessory indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Source quality-control test reports.
- D. Field quality-control test reports.
- E. Operation and maintenance data.
- F. Warranty: Special warranty specified in this Section.

**1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. 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.
- D. Comply with ASME B15.1.
- E. Comply with NFPA 37.

**26213**  
**ENGINE GENERATORS**

- F. Comply with NFPA 70.
- G. Comply with NFPA 99.
- H. Comply with NFPA 110 requirements for Level 2 emergency power supply system.
- I. Comply with UL 2200.
- J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- K. Noise Emission: Comply with applicable state and local government requirements for maximum noise level due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.4 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  - 1. Ambient Temperature: Minus 5 to plus 40 deg C.
  - 2. Relative Humidity: 0 to 95 percent.
  - 3. Altitude: Sea level to 700 feet.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide a Generac Power Systems, Inc. generator or a comparable product by one of the following:
  - 1. Caterpillar; Engine Div.
  - 2. Generac Power Systems, Inc.
  - 3. Kohler Co.; Generator Division.
  - 4. Onan/Cummins Power Generation; Industrial Business Group.

**26213**  
**ENGINE GENERATORS**

**2.2 ENGINE-GENERATOR SET**

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
- C. Capacities and Characteristics:
  - 1. Power Output Ratings: Nominal ratings is to be 40 KW, 480V, 3 phase, wye connected, with capacity as required to operate as a unit as evidenced by records of prototype testing. Assume .8 power factor.
  - 2. Output Connections: Three-phase, 4 wire.
  - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
  - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
  - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
  - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
  - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
  - 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
  - 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
  - 7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
  - 8. Start Time: Comply with NFPA 110, Type 10, system requirements.

**2.3 ENGINE**

- A. Fuel: Natural Gas
- B. Rated Engine Speed: 1800 rpm.
- C. Lubrication System: The following items are mounted on engine or skid:

**26213**  
**ENGINE GENERATORS**

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
  2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
  3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- E. Governor: Adjustable isochronous, with speed sensing.
- F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  2. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
- G. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
  2. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 85 dBA or less.
- H. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
  2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
  3. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
    - a. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236.

**2.4 CONTROL AND MONITORING**

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one

## 26213 ENGINE GENERATORS

or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

- B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 2 system, and the following:
  - 1. AC voltmeter.
  - 2. AC ammeter.
  - 3. AC frequency meter.
  - 4. DC voltmeter (alternator battery charging).
  - 5. Engine-coolant temperature gage.
  - 6. Engine lubricating-oil pressure gage.
  - 7. Running-time meter.
  - 8. Ammeter-voltmeter, phase-selector switch.
  - 9. Generator-voltage adjusting rheostat..
  - 10. Generator overload.
- D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- E. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
  - 1. Overcrank shutdown.
  - 2. Coolant low-temperature alarm.
  - 3. Control switch not in auto position.
  - 4. Battery-charger malfunction alarm.
  - 5. Battery low-voltage alarm.

### 2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
  - 1. Tripping Characteristic: Designed specifically for generator protection.
  - 2. Trip Rating: Matched to generator rating.
  - 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
  - 4. Mounting: Adjacent to or integrated with control and monitoring panel.

**26213**  
**ENGINE GENERATORS**

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- E. Enclosure: Drip proof.
- F. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
- B. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.8 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
  - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled base plate bonded to 1/4-inch thick, elastomeric isolator pad attached to base plate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
  - 2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

**26213**  
**ENGINE GENERATORS**

2.9 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

- 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- 2. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch on 8-inch high concrete base. Secure sets to anchor bolts installed in concrete bases.
- D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
- E. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
- F. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- G. Connect engine exhaust pipe to engine with flexible connector.
- H. Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

**26213**  
**ENGINE GENERATORS**

**B. Tests and Inspections:**

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection, except those indicated to be optional, for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
  - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
  - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
  - c. Verify acceptance of charge for each element of the battery after discharge.
  - d. Verify that measurements are within manufacturer's specifications.
4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

**C.**

**D.** Coordinate tests with tests for transfer switches and run them concurrently.

**E.** Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

**F.** Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

**G.** Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

**26213**  
**ENGINE GENERATORS**

- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

**3.3 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 263213

**26416**  
**PANELBOARDS AND ENCLOSURES**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. Furnish and install panelboards as indicated on drawings of voltage, phase, and current rating as indicated on drawings and schedules.

**1.02 SUBMITTALS**

- A. Submit manufacturers' data on all panelboards and enclosures showing physical dimensions, voltage characteristics, ampacity, breakers, bussing arrangements, enclosure mounting configuration and all accessories.

**1.03 QUALITY ASSURANCE**

- A. Comply with all UL, NEC, NEMA, and ANSI standards and label with UL and IBEW stamps.

**PART 2 - PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS.**

- A. General Electric, Square D, Cutler Hammer or pre-approved equal.

**B. 2.02 PANELBOARDS**

Lighting and Appliance Panelboards

1. Provide dead-front safety type lighting and appliance panelboards where indicated, with switching and protective devices in the number, rating, type and arrangement shown; with anti-burn solderless pressure type lug connectors approved for copper conductors, for connecting feeder to bus or main switch as scheduled; equipped with copper bus bars arranged for the service, voltage and capacity as scheduled and a full sized neutral bar with neutral bar mounted on opposite end of panel from main lugs; provide suitable lugs on neutral bus for each outgoing feeder required; provide a bare uninsulated grounding bar with lugs for each out-going feeder and suitable for bolting to the enclosure; and provide panelboards fabricated by the same manufacturer as enclosures. Panelboard to be adjustably mounted in its cabinet to permit an adjustment outward of at least 3/4" and to permit panelboard to be plumbed and centered.

**C. Panelboard Enclosures**

**26416**  
**PANELBOARDS AND ENCLOSURES**

1. Provide sheet steel enclosures with minimum 4-1/2" side gutters and 8" end gutters, or as required by NEC Art. 373, which ever is larger; NEMA Type as required for the application; code gage, minimum 16 gage thickness, with multiple knockouts; provide doors with flush lock and key, with concealed hinges. Provide painted grey enamel finish over a rust inhibitor. Provide enclosures fabricated by the same manufacturer as panelboards to be enclosed.

**D. Panelboard Accessories**

1. Provide panelboard accessories including, but not necessarily limited to, cartridge and plug type circuit breakers, as recommended by the panelboard manufacturer for the ratings indicated.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. Examine all areas and conditions where panelboards are to be installed and report to the Engineer any conditions detrimental to the installation of panelboards, or any areas where wall thickness is insufficient to fully recess flush mounted panels, prior to construction. Failure to report such conditions will cause the Contractor to be liable for cost of revising panelboard installation.
- B. Provide typed panel directories permanently affixed in each panel identifying each circuit connected by function and room numbers served and spares.
- C. Provide blank space fillers in all breaker spaces not occupied by breakers or switches.
- D. Install panelboards in accordance with manufacturer's instructions adjusting all interiors flush with panel front and all panel fronts of recessed panels tight against finished walls. Anchor panel boxes firmly to walls or other approved structural support.
- E. Handle panelboards and enclosures carefully to prevent breakage, denting and scoring the finish. Repair and paint, with manufacturer's specified paint, all dents and scratches. Store panelboards and enclosures inside and protect from weather. When necessary to store out-of-doors, elevate well above grade and enclose with durable, waterproof wrapping. A heat source is to be installed inside the equipment to prevent moisture buildup where such buildup could cause damage to the equipment.

**END OF SECTION**

**26519**  
**CABLE WIRES AND CONNECTORS**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Run all wire in metal raceways unless noted otherwise.
- B. Provide cable, wire and connectors in accordance with plans and specifications and in compliance with manufacturers' published application and installation recommendations.

1.02 QUALITY ASSURANCE

- A. Comply with National Electrical Code (NFPA 70), and National Electrical Manufacturers Association/Insulated Power Cable Engineers Assoc. Standards.
- B. Provide electric cable wire and connectors which have been listed and labeled by Underwriters Laboratories.
- C. Remove from project site any damaged materials.

1.03 SUBMITTALS

- A. Submit manufacturers' data on all cable wire and connectors to be used.

**PART 2 - PRODUCTS**

2.01 ACCEPTABLE MANUFACTURERS

- A. Wire and Cable: Anaconda Wire and Cable, General Cable Corp., General Electric Co., Triangle, or acceptable equal.
- B. Connectors: Amp, Burndy Corp, General Electric Co., Ideal Industries Inc., Minnesota Mining and Mfg. Co., O.Z./Gedney Co., Thomas & Betts Co., or acceptable equal.

2.02 WIRE

- A. Use soft drawn annealed copper having a conductivity not less than 98% of that of pure copper and with thermoplastic 600 volt insulation. Use no aluminum wire unless called for specifically on plans.
- B. All lighting and power wire indicated on drawings is size 12 unless indicated otherwise. Use no wire smaller than size 12 for power or lighting.
- C. Wire Sizes #12 and #10. Use solid copper dual rated THHN/THWN insulation temperature rated for 90 degrees C in dry locations and 75 degrees C in wet locations.
- D. Wire Size #8 and Larger. Use stranded copper Type THW or THHN/THWN 75 degrees C temperature rated insulation for wet locations. And THHN/THWN 95 degrees C temperature rated insulation for dry locations.

**26519**  
**CABLE WIRES AND CONNECTORS**

- E. Temperature Control Wire. Use stranded THHN copper wire with crimp spade lugs. Minimum size #16.

**2.03 CONNECTORS**

- A. Provide factory made metal connectors of size, rating, material, type, and class as indicated by NEC, NEMA, or as indicated on plans.
- B. Use pre-insulated spring-type pressure or crimp-type solderless connectors on wire sizes #12, #10, and #8. For wire sizes larger than #8, use solderless bolted or hydraulically die crimped compression type connectors.
- C. Insulate all bolted splices and taps using preformed factory made insulating boots with scotch fill and electrical tape.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. Do not pull any wire into raceway until raceway is complete and all burrs and abrading surfaces have been removed.
- B. A U.L. approved lubricant may be used where necessary to facilitate installation of conductors.
- C. Use only continuous conductors without welds or splices or joints between boxes. Mains and feeders are to be run their entire length without splices.
- D. Identify all conductors using color coded insulation or numbered linen or plastic Brady tags. Use the following color coding chart for all lighting and power circuits.

120/208 Volts

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground Wire	Green

Use numbered stick-on Brady wire tags to label all control wire ends according to the numbering scheme printed on the wiring diagram.

- E. Install crimp type ring or spade lugs on ends of all control wires.

**26519**  
**CABLE WIRES AND CONNECTORS**

- F. Install all wire cable and connectors as indicated and in accordance with manufacturers' written instructions, NEC requirements, and the National Electrical Contractors Association "Standard of Installation".
- G. Insulate all splices and taps to produce an insulated assembly equivalent to, or better than, the electrical and mechanical strength of the conductors being insulated.
- H. Use connectors compatible with the conductor and terminal materials.
- I. Before energizing, check for short circuits and megger all circuits in accordance with NEC.

**END OF SECTION**

**26526**  
**GROUNDING**

PART 1 - GENERAL

1.01 DESCRIPTION

A. Equipment Grounding.

1. All metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be grounded for personnel safety and to provide a low impedance path for possible ground fault currents.

1.02 RELATED WORK

- A. Section 26000, BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

1.03 APPLICABLE PUBLICATIONS

- A. The following specifications and standards, except as hereinafter modified, are incorporated herein by reference and form a part of this specification to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of invitation for Bids shall be applicable. In text such specifications and standards are referred to by basic designation only.

1. National Fire Protection Association (NFPA) Publications:

No. 70.....National Electrical  
Code (NEC)

2. Underwriters Laboratories, Inc. (UL) Publications:

No. 83.....Thermoplastic  
Insulated Wires

No. 44.....Rubber-Insulated  
Wires and Cables

No. 467.....Electrical Grounding  
and Bonding  
Equipment

3. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

No. 142.....Recommended Practice  
for Grounding of  
Industrial and  
Commercial Power  
Systems

**26526**  
**GROUNDING**

**PART 2 - PRODUCTS**

**2.01 GROUNDING WIRES.**

- A. Shall be UL and NEC approved types, copper, with TW or THWN/THHN or THW insulation color identified green.
- B. B. Wire size shall not be less than shown on the drawings and not less than required by the NEC.

**2.02 GROUND RODS**

- A. Shall be copperclad steel, 5/8-inch diameter by 8 feet long.

**PART 3 - EXECUTION**

**3.01 INSTALLATION, GENERALLY**

- A. Grounding shall be in accordance with the NEC, as shown on the drawings, and as hereinafter specified.
- B. Conduit Systems.
  - 1. Ground all metallic conduit systems.
  - 2. Non-metallic conduit systems shall contain a grounding conductor.
  - 3. Conduit provided for mechanical protection and containing only a grounding conductor shall be bonded to that conductor at the entrance and exit from the conduit.
- C. Feeders and Branch Circuits: Install green grounding conductors with all feeders and branch circuits as follows:
  - 1. Install grounding conductor with all feeders and branch circuits, including lighting and receptacle circuits.
  - 2. Connect to all circuits serving fixed equipment and appliances.
  - 3. Connect to all motors and motor controllers.
  - 4. All items of equipment where the final connection is made with flexible metal conduit shall have a grounding wire.
  - 5. All additional locations and systems as shown on the drawings.
  - 6. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs for terminating the ground wires.

**26526**  
**GROUNDING**

- E. Lighting Fixtures: Shall be grounded through green ground wire. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- F. Electrical Appliances and Equipment: Fixed electrical appliances and equipment shall have a ground lug installed for termination of the green ground conductor.

**END OF SECTION**

**26533**  
**RACEWAY SYSTEMS AND ACCESSORIES**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. Furnish and install complete systems of electrical raceways, including but not limited to, all conduit, fittings, outlet boxes, cover plates, wireways, gutters, expansion fittings, and accessories.
- B. Service feeds to main panels in individual units shall be routed in conduit. All exposed conduit outside shall be rigid steel. All buried conduit shall be schedule 40 PVC. EMT can be used in building voids and concealed spaces in offices. Phone and fiber in ceilings to be installed in cable trays or conduits. Phone and fiber to junction boxes to be routed in conduit, within walls and floors.

**1.02 QUALITY ASSURANCE**

- A. All raceway products shall have UL label stamp and shall comply with National Electrical Manufacturers Association standards and current edition of the National Electrical Code. All steel boxes, fittings, conduits and accessories shall be galvanized.
- B. Submit manufacturer's data on all raceway system components.

**PART 2 - PRODUCTS**

**2.01 CONDUIT AND FITTINGS**

- A. Rigid Steel Conduit
  - 1. Hot dip galvanized inside and outside, standard pipe size, threaded wrought steel. ANSI: C80.1, Federal Spec. WW-C-581.
- B. Weatherproof Outlet Boxes
  - 1. Provide cast metal weatherproof outlet boxes of type and shape to suit the application with threaded conduit connections, gasketed spring hinged covers, and corrosion-proof hinges and fasteners.
  - 2. Acceptable Manufacturer: Appleton, Crouse-Hinds, or acceptable equal.
- C. Junction and Pull Boxes (Inside)
  - 1. Provide galvanized steel junction and pull boxes with removable screw-fastened covers of size and gauge to comply with NEC and requirements of the application.

**2.02 BOXES**

**26533**  
**RACEWAY SYSTEMS AND ACCESSORIES**

A. General.

1. Provide metal boxes of shape, size, and mounting means to suit each respective location and usage, and to comply with NEC.
- B. Outside pull boxes are to be sized per ODOT standard size I, in ground pull boxes. Boxes to have lids engraved with the word "Telephone" or Electric" as applicable. Boxes to be concrete or Gunnite, with openings in the bottom and lids flush with the grade. Provide submittals for exterior ground boxes and lids.

C. Wireways and Gutters

1. Provide steel wireways and gutters of size as indicated on plans with hinged or removable covers. Interior wireways to be bonderized enameled steel.
2. Acceptable Manufacturer: Square D, Appleton, or acceptable equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General. Conduit

1. In general, conceal all conduit in walls and ceiling spaces and run as required. Run parallel or perpendicular to building walls and floors in straight runs, using bends and offsets as required. Make all conduit bends using proper bending tools with no more than 360 degrees in bends in a run of conduit without using pull boxes. Bends are to be made in such a manner that the internal diameter of the tubing will not be effectively reduced. Replace all flattened or crushed conduit prior to pulling wire. Ream all conduit ends. Swab all underfloor conduit, prior to pulling wire, and cap, or plug all conduit exposed to weather during construction. Wire shall be drawn into a completed conduit system so there is no danger to wire insulation.
2. Size all conduits as indicated on plans or as indicated in National Electrical Code, if not indicated on plans. In no case shall conduit be less than 3/4 inch when installed in poured concrete or underground. All conduit shall be of such size that required conductors may be drawn in without injury or excessive strain. No conduit may be less than 1/2 inch. Maintain a minimum of 3 inches between conduit and steam or hot water lines pipe insulation when running parallel with pipe. Maintain a minimum of 1 inch from the pipe insulation when crossing steam or hot water pipe. EMT is acceptable for interior conduits and conduits in voids and walls.
3. Support all conduit using pipe clamps spaced a maximum of 8 feet apart. PVC conduit supports shall be spaced per NEC. Support all raceway systems from building structure, not from ceiling system or ceiling hangers or from other pipe or duct systems. Rigid non-metallic conduit shall be supported as per table 347-8 of NEC. Make final conduit connections to motors and other equipment, subject to vibration using liquid tite flexible metallic tubing minimum 12 inches long and maximum 24 inches long.

**26533**  
**RACEWAY SYSTEMS AND ACCESSORIES**

Connection to 1 horsepower or smaller motors within a housing may use flexible metallic tubing.

4. Use liquid tight flexible metallic tubing where flexible conduit is required outdoors or in intermittent moisture environments. Install liquid tight flex conduit so that liquids run off of the surface without draining toward fittings. In areas subject to much vibration or strain, S.T. type connectors shall be used. Flexible conduit to only be used on short runs (3' or less) or to vibrating equipment.
5. Provide nylon pull cord in all empty conduits with ends marked to identify terminal points. When conduit passes through concrete or other structural outside walls below grade, a sleeve must be cast in place. Fill 1/4 inch gap between sleeve and pipe with silicone sealant and make entire installation water tight.
6. For conduit stub ups in floors, for future use, set threaded coupling flush with finished floor. Where stub is for future use, install threaded plug in coupler flush with finished floor.

**B. Sleeves**

1. Provide a sleeve constructed from Schedule 40 PVC conduit for each location where a conduit or hanger passes through a concrete slab, masonry wall, roof or other portion of the building structure. Make sleeve flush on both sides of the surface penetrated and pack around the conduit to maintain the fire rating of rated walls. Extend sleeves 1" above the finished floor in equipment rooms. Use PVC sleeves where PVC ground wire conduits pass through floors, or masonry walls.

**C. Boxes**

1. Install all outlet boxes with front of box within 1/4" of finished non-flammable surface and flush with finished ceiling or wall surface of a flammable surface. Use approved plaster rings to build out to wall surface when box is recessed.
2. Secure all boxes rigidly to building structural members.
3. Locate all boxes for ease of accessibility.
4. Provide knockout closures for knockouts not used.

**D. Fittings**

1. Use double lock nut bushings on all rigid steel conduit to box fittings, and secure all conduit tight to box.
2. Screw all compression type couplers and connectors tight to retain ground integrity of raceway system.
3. Use expansion fittings with bonding jumpers where rigid or EMT conduits cross building expansion joints.

**END OF SECTION**

**26816**  
**SAFETY AND DISCONNECT SWITCHES**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. Provide fusible and non-fusible disconnect switches where indicated on drawings, and where required by NEC. Confirm packaged equipment contains integral disconnects, where identified on the plans as such.

**1.02 QUALITY ASSURANCE**

- A. Use switches which comply with applicable provisions of NEC, NEMA, and which have been UL tested, listed, and labeled.

**PART 2 - PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

- A. General Electric Co., Square D, or acceptable equal.

**2.02 SWITCHES**

- A. Use heavy duty switches only, equal to General Electric Quick- Make Quick-Break, horsepower rated, externally operated with external padlocking provision in either the "ON" or "OFF" position. Ratings, number of poles, and enclosure type shall be as indicated or as required by NEC for the applications.
- B. Provide fuses for all fusible switches, size as indicated.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. Install all disconnect switches in accordance with NEC and manufacturers' recommendations. Maintain adequate clearances and generally mount at 4'-6" finished floor to center line unless field conditions or codes require other locations. Identify equipment served by each disconnect with white on black laminated plastic nameplate.

**END OF SECTION**

SECTION 031000  
CONCRETE FORMWORK

**PART 1 GENERAL**

1.1 SUMMARY

- A. Section Includes: Provide concrete formwork for structural concrete as specified to form concrete to profiles shown.
  - 1. Provide concrete finish with rubber or broom finish.
  - 2. Structural concrete is defined as all concrete that is not architectural concrete.
- B. Related Work Specified in Other Sections Includes:
  - 1. Section 03200 - Concrete Reinforcement
  - 2. Section 03150 - Concrete Accessories
  - 3. Section 03300 - Cast-In-Place Concrete

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ACI 318 - Building Code Requirements for Reinforced Concrete
  - 2. ACI SP-4 - Formwork for Concrete
  - 3. ACI 303R - Guide to Cast-in-Place Architectural Concrete

1.3 SUBMITTALS

- A. Provide all submittals, including the following, as specified in Division 1.
  - 1. CONTRACTOR'S Shop Drawings: Drawings of proposed formwork for Concrete. Review of these drawings by the ENGINEER does not relieve the CONTRACTOR of the responsibility for adequately designing and constructing forms.
  - 2. Samples: Pieces of each type of sheeting, chamfer strips, form ties, form liners and rustication strips.

1.4 QUALITY ASSURANCE

- A. Formwork Compliance: Use formwork complying with ACI SP-4 and ACI 303R.

**PART 2 PRODUCTS**

2.1 MANUFACTURER

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. Release Agent  
Magic Kote VOC by Symons Corporation
2. Form coating  
A.C. Horn Corporation, Brooklyn, NY

## 2.2 MATERIALS

- A. Structural Concrete: Provide structural concrete form materials as follows:
1. Obtain approval for form material before construction of the forms.
  2. Use a barrier type form release agent.
  3. Use form ties, hangers, and clamps of such type that, after removal of the forms, no metal will be closer than two inches from concrete surface. Wire ties will not be permitted.
  4. Provide ties with swaged washers or other suitable devices to prevent seepage of moisture along the ties. Ties to be left in place shall be epoxy coated. Leave the ties in place.
  5. Use lugs, cones, washers, or other devices which do not leave holes or depressions greater than 7/8-inch in diameter.

## PART 3 EXECUTION

### 3.1 DESIGN

- A. Design Responsibility: Be responsible for the design, engineering and construction of the structural concrete formwork. Conform the work to the recommendations of ACI SP-4 and ACI 303R.
- B. Setting Time and Slag Use: The presence of fly ash or ground granulated blast furnace slag in the concrete mix for structural concrete will delay the setting time. Take this into consideration in the design and removal of the forms.
- C. Responsibility during Placement: Assume and take sole responsibility for adequate design of all form elements for support of the wet concrete mixtures specified and delivered.
- D. Consistency: Design forms to produce concrete members identical in shape, lines and dimensions to members shown.

### 3.2 CONSTRUCTION DETAILS FOR FORMWORK

- A. Structural Concrete Details: Follow the following details for all structural concrete:
1. Provide forms which are substantial, properly braced, and tied together to maintain position and shape and to resist all pressures to which they may be subjected. Make forms sufficiently tight to prevent leakage of concrete.
  2. Determine the size and spacing of studs and wales by the nature of the work and the height to which concrete is placed. Make forms adequate to produce true, smooth surfaces with

not more than 1/8-inch variation in either direction from a geometrical plane. Provide horizontal joints which are level, and vertical joints which are plumb.

3. Supply forms for repeated use in sufficient number to ensure the required rate of progress.
4. Thoroughly clean all forms before reuse and inspect forms immediately before concrete is placed. Remove deformed, broken, or defective forms from the work.
5. Provide temporary openings in forms at convenient locations to facilitate cleaning and inspection.
6. Coat the entire inside surfaces of forms with a suitable form release agent just prior to placing concrete. Form release agent is not permitted on the reinforcing steel.
7. Assume and take responsibility for the adequacy of all forms and remedying any defects resulting from their use.

### 3.3 FORM REMOVAL

- A. General: Do not remove forms, form ties and bracing for structural concrete without specific permission of the CONTRACTOR'S Registered Professional ENGINEER.
- B. Structural Concrete Form Removal: Do not remove forms for structural concrete until the concrete has hardened sufficiently to support its own load safely, plus any superimposed load that might be placed thereon.
  1. Increase form removal times as required if concrete temperature following placement is permitted to drop below 50 degrees F or if fly ash or ground granulated blast furnace slag is used in the concrete mix.
  2. Withdraw the removable portion of form ties from the concrete immediately after the forms are removed. Clean and fill holes left by such ties with grout as specified in Cast-In-Place Concrete, Subsection Structural Concrete Surfaces.
  3. Plug tie holes flush with the surface using Portland cement mortar. Pre-wet tie holes with clean water and apply a neat cement slurry bond coat. Densely tamp mortar of a dry-tamp consistency into the tie holes exercising care so as not to smear mortar onto the finished concrete surface. Include sufficient white cement in the mortar mix to cause the plugged holes to blend in with the adjacent surfaces. Make sample patches with different mixes to assure that this requirement is met.

### 3.4 RESHORING

- A. Reshoring Method: Develop a system for reshoring and early removal of forms, in the event early stripping of forms becomes necessary. Include details and schedules in this system for each element which is to be reshored.
- B. Construction Load Support: Do not support construction loads upon any unshored portion of the structure exceeding the structural design loads.

### 3.5 TOLERANCES

- A. Tolerance Limits: Design, construct and maintain concrete form and place the concrete to provide completed concrete work within the tolerance limits set forth in ACI SP-4.

### 3.6 SURVEY OF FORMWORK

- A. Field Survey: Employ an ENGINEER or surveyor to check by instrument survey the lines and levels of the completed formwork before concrete is placed and make whatever corrections or adjustment to the formwork are necessary to correct deviations from the specified tolerances.
- B. Placement Surveying Requirements: Check formwork during the placement of the concrete to verify that the forms, braces, tie rods, clamps anchor bolts, conduits, piping, and the like, have not been knocked out of the established line, level or cross section by concrete placement or equipment.

END OF SECTION

## SECTION 032000

### CONCRETE REINFORCEMENT

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing concrete reinforcement as shown and specified herein. Reinforcement includes all steel bars, wire and welded wire fabric as shown and specified.
- B. Related Work Specified in Other Sections Includes:
  - 1. Section 03100 - Concrete Formwork
  - 2. Section 03150 – Concrete Accessories
  - 3. Section 03200 – Concrete Reinforcement
  - 4. Section 03250 – Concrete Anchors
  - 5. Section 03300 - Cast-In-Place Concrete

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ACI SP66 - ACI Detailing Manual
  - 2. ACI 318 - Latest edition "Building Code Requirements for Reinforced Concrete"
  - 3. ASTM A 185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
  - 4. ASTM A 615/A615M, - Deformed and Plains Billet-Steel Bars for Concrete
  - 5. ASTM A 706/A706M - Low Alloy Steel Deformed Bars for Concrete Reinforcement
  - 6. ASTM A 775/A775M - Epoxy Coated Reinforcing Steel Bars
  - 7. AWS D1.4 - Structural Welding Code - Reinforcing Steel

##### 1.3 SUBMITTALS

- A. Provide all submittals, including the following, as specified in Section 01330.
  - 1. Product Data and Information: Submit manufacturers' literature with product data, and material description of fusion bonded epoxy coating for reinforcement and reinforcement accessories, including manufacturer's recommendations for field touch-up of mars and cut ends.

2. CONTRACTORS' Shop Drawings: Submit checked Working Drawings, including bar lists, schedules, bending details, placing details and placing plans and elevations for fabrication and placing reinforcing steel conforming to "ACI Detailing Manual - 88".
  - a. Do not build wall and slab reinforcing in sections. Show complete elevations of all walls and complete plans of all slabs, except that, when more than one wall or slab are identical, only one such elevation or plan is required. These plans and elevations need not be true views of the walls or slabs shown. Bill every reinforcing bar in a slab on a plan. Bill every reinforcing bar in a wall on an elevation. Take sections to clarify the arrangement of the steel reinforcement. Identify all bars, but do not bill on such sections.
  - b. For all reinforcing bars, unless the location of a bar is clear, give the location of such bar or bars by a dimension to some structural feature which will be readily distinguishable at the time bars are placed.
  - c. Make the reinforcing steel placing drawings complete for placing reinforcement including the location of support bars and chairs, without reference to the design drawings.
  - d. Submit Detailer certification that every reinforcing steel placing drawing and bar list is completely checked and corrected before submittal for approval.
  - e. If, after reinforcing steel placing drawings and bar lists have been submitted for approval, a review reveals that the drawings and lists obviously have not been checked and corrected they will be returned for checking and correcting by the Detailer.
3. Samples: Submit the following samples when epoxy coated reinforcement is specified to be used.
  - a. 12-inch long epoxy-coated steel reinforcing bar, of any size typical to this Project
  - b. One of each type of epoxy-coated reinforcement accessory used on this Project
  - c. 12-inch long, nylon coated tie wire
4. Certificates: Test certificates of the chemical and physical properties covering each shipment of reinforcing steel bars.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle all products and materials as specified in Section 01500.
  1. Delivery Requirements: Have reinforcing steel delivered to the work in strongly tied bundles. Identify each group of both bent and straight bars with a metal tag giving the identifying number corresponding to the reinforcing steel placing drawings and bar lists.
  2. Storage: Properly store all bars in an orderly manner, with all bars completely off the ground. Keep bars clean after delivery to the site of the work.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.
  - 1. Mechanical connections
    - a. Dowel Bar Splicer/Dowel-In System and Coupler Splice System of the Richmond Screw Anchor System
    - b. Cadweld Rebar Splice by Erico Products Inc.
    - c. Bar Grip Splice by Barsplice Products Inc.

### **2.2 MATERIALS**

- A. Steel Bars: Use new billet steel bars, deformed bars, meeting the requirements of ASTM A 615/A625M Grade 60 for reinforcing steel bars.
  - 1. Roll all reinforcing steel bars with special deformations or identifying marks indicating the ASTM Specification and Grade.
  - 2. Use bars free from defects, kinks and bends that cannot be readily and fully straightened in the field.
  - 3. Supply reinforcing bars in lengths which will allow convenient placement in the work and provide the required lap of joints as shown. Provide dowels of proper length, size and shape for tying walls, beams, floors, and the like together.
- B. Welded Wire Fabric: Use welded wire fabric of the electrically welded type, with wires arranged in rectangular patterns, of the sizes shown or specified and meeting the requirements of ASTM A 185.
- C. Supports and Accessories: Provide bar supports and other accessories and, if necessary, additional supports to hold bars in proper position while concrete is being placed.
  - 1. Use side form spacers against vertical or sloping forms to maintain prescribed side cover and cross position of bars.
  - 2. Use individual hi-chairs with welded cross ties or circular hoops to support top bars in slabs thicker than 8 inches.
  - 3. Bolsters, chairs and other accessories:
    - a. Use hot-dipped galvanized or provide plastic coated legs when in contact with forms for surfaces of concrete other than architectural surfaces.
    - b. Use stainless steel when in contact with forms for architecturally exposed surfaces.

- c. Use epoxy coated bolsters, chairs and accessories including wire ties for epoxy coated reinforcing bars.
  - d. Use chairs of an approved type and space them properly to support and hold reinforcing bars in position in all beams and slabs including slabs placed directly on the subgrade or work mat. Do not use continuous hi-chairs for supporting of top bars in slabs over 8 inches in thickness.
- D. Mechanical Connections: Provide mechanical connections that develop at least 125 percent of the specified yield strength of the bar in tension.

## 2.3 FABRICATION

- A. Drawing Review Prior to Fabrication: Do not fabricate any material before final review and acceptance of shop drawings.
- B. Bending and Cutting: Cut bars to required length and bend accurately before placing. Cut ends must be coated after cutting with an epoxy equal to FBE coating. Bend bars in the shop unless written approval for field bending is obtained. If field bending is permitted, do it only when the air temperature, where the bending operation is performed, is above 30 degrees F. Do not field bend bars which have been partially embedded in concrete.
- C. Splices: Use lapped splices for tension and compression splices unless otherwise noted.
- D. Cleaning: Clean and bend reinforcement in accordance with ACI 315 and ACI 318.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Placement: Place all bars in accordance with CRSI "Recommended Practice for Placing Reinforcing Bars".
- B. Tolerances: Place bars used for top reinforcement in slabs to a vertical tolerance of plus or minus 1/4-inch. Place all other reinforcement to the tolerances given to ACI 318.
- C. Cleaning: Have reinforcing steel delivered without rust other than that accumulated during transportation to the work. At all times, fully protect reinforcing steel from moisture, grease, dirt, mortar and concrete. Before being placed in position, thoroughly clean reinforcing steel of all loose mill scale and rust and of any dirt, oil, grease coatings, or other material that might reduce the bond. If there is a delay in depositing concrete, inspect and satisfactorily clean the steel immediately before the concrete is placed.
- D. Bar Positioning: Place bars in the exact positions shown with the required spacing and cross wire bars securely in position at intersections to prevent displacement during the placing of the concrete. Fasten the bars with annealed wire of not less than 17 gauge or other approved devices.
- E. Bar Extension beyond Formwork: On any section of the work where horizontal bars extend beyond the length of the forms, perforate the form or head against which the work ends or at

the proper places to allow the bars to project through a distance at least equal to the lap specified.

- F. Unacceptable Materials: Do not place reinforcing steel with damaged, unsuitably bonded epoxy-coating or rusting. If approved, mars, exposed threads of mechanical connections and cut ends may be field coated with coaters recommended epoxy coating material.
- G. Review of Placement: Have reinforcing placement reviewed by the ENGINEER before concrete is placed.
- H. Welding - Not Allowed: Do not use reinforcing bar assemblies made by welding of any kind, or accessories of any kind which require field welding to reinforcing bars.
- I. Welding - Accepted: Where welding of reinforcing steel is shown, AWS D1.4 "Structural Welding Code - Reinforcing Steel" applies.
- J. Tension and Compression Lap Splices: Conform tension and compression lap splices to ACI 318 to all supplements. Avoid splices at points of maximum tensile stress wherever possible. Provide temperature bars with the clear spacing shown. Stagger all bar splices in hoop tension bars in circular tanks with not more than 50 percent of the bars spliced in any one direction. Have welded splices made by certified welders in accordance with AWS D1.4.
- K. Welded Wire Fabric: Place welded wire fabric in the positions shown, specified or required to fit the work. Furnish and place suitable spacing chairs or supports, as specified for bars, to maintain the fabric in the correct location. Where a flat surface of fabric is required, provide flat sheets, when available. Otherwise reverse roll the fabric or otherwise straighten to make a perfectly flat surface before placing.
- L. Concrete Cover: Place reinforcing steel and welded wire fabric and hold in position so that the concrete cover, as measured from the surface of the bar or wire to the surface of the concrete, is as shown or specified.

END OF SECTION

## SECTION 033000

### CONCRETE

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. The work of this section covers the furnishing of all equipment, labor, and materials for providing and placing cast-in-place concrete for the clarifier repairs.
2. Miscellaneous Items

###### B. Related Sections:

None

##### 1.2 APPLICABLE PUBLICATIONS

The following publications listed below, but referred to thereafter by designation only, form a part of this specification to the extent indicated by the references thereto:

###### A. AMERICAN CONCRETE INSTITUTE (ACI) STANDARDS.

- |          |   |
|----------|---|
| 117-90   | Standard Tolerances for Concrete Construction   |
| 211.1-91 | Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete                            |
| 304R-89  | Guide for Measuring, Mixing, Transporting, and Placing Concrete   |
| 305R-91  | Hot Weather Concreting  |
| 306R-88  | Cold Weather Concreting   |
| 308-92   | Standard Practice for Curing Concrete   |
| 318-95   | Building Code Requirements for Reinforced Concrete  |
| 503.2    | Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi Component Concrete Adhesive |

###### B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM).

- |          |  |
|----------|--|
| C 31-91  | Making and Curing Concrete Test Specimens in the Field |
| C 33-92a | Concrete Aggregates                                    |
| C 39-93a | Compressive Strength of Cylindrical Concrete           |

- C 94-94 Ready-Mixed Concrete
  - C 136-92 Sieve Analysis of Fine and Coarse Aggregate
  - C 143-90a Slump of Hydraulic Cement Concrete
  - C 150-94 Standard Specification for Portland Cement
  - C 171-92 Standard Specification for Sheet Material for Curing Concrete
  - C 172-90a Sampling Freshly Mixed Concrete
  - C 192-90a Making and Curing Concrete Test Specimens in the Laboratory
  - C 231-91b Air Content of Freshly Mixed Concrete by the Pressure Method
  - C 260-94 Air-Entrained Admixtures for Concrete
  - C 309-91 Liquid Membrane-Forming Compounds for Curing Concrete
  - C 494-92 Chemical Admixture for Concrete
  - C 618-93 Fly ash and Raw or Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
  - C 803-90 Penetration Resistance of Hardened Concrete
  - C 805-85 Rebound Number of Hardened Concrete
  - C 1064-86 Temperature of Freshly Mixed Portland Cement Concrete
  - C 1077-92 Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
- C. OKLAHOMA DEPARTMENT OF TRANSPORTATION (ODOT)
- 1. Standard Specification for Road and Bridge Construction
- D. U.S. ARMY CORPS OF ENGINEERS HANDBOOK FOR CONCRETE AND CEMENT (CRD).
- C 400-63 Water for Use in Mixing or Curing Concrete

### 1.3 SUBMITTALS

- A. All submittals shall be in accordance with the Contract Drawings and Specifications. The Contractor's Quality Control organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements.
- B. CONTRACTOR'S Concrete Operation Plan. A plan for all concrete operations planned under this contract shall be submitted for approval within 15 days after notice to proceed. The plan shall provide as a minimum:

1. Sources of cement, pozzolan, and aggregates;
  2. Location of aggregate stockpiles, batching plant, and mixing plant;
  3. Method of conveying concrete to and within the project area;
  4. Provisions for protection of fresh concrete from freezing, water splashing, or other damaging effects during conveyance, placement and curing;
  5. Method and equipment used for consolidation, finishing, and curing; and
  6. Location of proposed construction joints
  7. Contractor quality control measures.
- C. Mix Design and Test Reports. Concrete mixture proportions indicating weight of cement, water, and weights of aggregates in a saturated surface-dry condition, and type, quantity and name of admixtures per cubic yard of concrete. The submittal shall be accompanied by test reports from a laboratory complying with ASTM C 1077 which show that proportions thus selected will produce concrete of the qualities indicated.
- D. Cementitious Materials. Cement and pozzolan will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports that materials meet the requirements of the specification under which it is furnished.
- E. Admixtures. Manufacturer's literature shall be submitted for review and approval for conformance with these specifications. All admixtures in a mix design shall be compatible with each other and certified for compliance with all specification requirements as evidenced by a Manufacturer's Certificate of Compliance.
- F. Curing. The curing medium, method, and manufacturer's literature shall be submitted for review and approval for conformance with these specifications. The curing medium used shall be certified for compliance with all contract requirements as evidenced by a Manufacturers Certificate of Compliance.
- G. Cold-Weather Requirements. If concrete is to be placed under cold weather conditions the procedures, materials, methods, and protection proposed to accomplish it shall meet the requirements of ACI 306 and be submitted for review.
- H. Hot-Weather Requirements. If concrete is to be placed under hot weather conditions the procedures, materials, methods, and protection proposed to accomplish it shall meet the requirements of ACI 305 and be submitted for review.
- I. Underwater Requirements. If concrete is to be placed underwater, the procedures, materials, methods, and protection proposed to accomplish the work shall meet the requirements of ACI 304, and be submitted for review.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. General. Concrete shall be composed of cementitious material, water, fine and coarse aggregates and admixtures. The admixture shall be an air-entraining agent and, at the CONTRACTOR'S option, water reducer and during cold weather a non-chloride accelerator. Materials shall meet the requirements of the respective publications and other data specified below.
- B. Cementitious Material. Cementitious material shall be Portland Cement or Portland Cement in combination with pozzolan. Portland Cement shall conform to ODOT Standard Specification Section 701.02 (ASTM C 150), Type I or Type II. Optional pozzolan replacement of cement shall be limited to 0% by weight of the total cementitious material of a mix. Pozzolan shall conform to ODOT Standard Specification Section 701.01 (ASTM C 618).
- C. Aggregates. Fine aggregate shall consist of natural sand. Coarse aggregate shall consist of gravel, crushed gravel, crushed stone, or a combination thereof. The aggregate particles shall be clean, hard, unweathered, and uncoated. The shape of the particles shall be generally cubical or spherical. Where required, fines shall be removed from the coarse aggregates by adequate washing. Total deleterious materials shall not exceed 5 percent. The coarse aggregate shall meet the requirements of ODOT Standard Specification Section 701.06, Gradation Size No. 67.
- D. Admixtures.
  - 1. Air-entraining admixtures conforming to ODOT Standard Specification Section 701.03 (a) (AASHTO M 154) shall be batched in the mixing water.
  - 2. Water-reducing admixtures shall conform to ODOT Standard Specification Section 701.03. High-range water-reducing admixtures will not be allowed.
- E. Curing Materials. Curing materials shall conform to ODOT Standard Specification Section 701.07 and approved work plan.
- F. Water. Water for mixing shall be fresh, clean and drinkable, except that undrinkable water may be used if it meets the requirements of CRD-C 400. Water for curing shall not contain any substance that stains or is injurious to the concrete.
- G. Ready Mixed Concrete. Ready-Mixed Concrete shall conform to ODOT Standard Specification Section 701 (ASTM C 94) except as otherwise specified.
- H. High Density Concrete inlay shall be place on the top of the north non-overflow section of the dam. The high density concrete material shall meet ODOT Standard Specification 701.10 or 701.11, contractor's option.
- I. Epoxy Bonding Agent for underwater applications shall consist of "Eva-Pox Underwater Bonder No. 47" as manufactured by E-poxy Industries, Inc. of Albany, New York, or "Weld-Crete" as manufactured by Larsen Products Corp., or approved equal.

- J. Epoxy Bonding Agent for dry applications shall consist of “Sika Armatex 110” as manufactured by Sika Corporation of Lyndhurst, New Jersey, or “Weld-Crete” as manufactured by Larsen Products Corp., or approved equal.

## 2.2 MIXTURE PROPORTIONING

- A. Proportions for ALL mixtures shall be selected so that the following requirements are met.
  - 1. Strength. Specified compressive strength ( $f_c$ ) shall be 4,000 pounds per square inch at 28 calendar days (90 days if pozzolan is used). Concrete shall be proportioned to provide an average compressive strength as prescribed in Section 5.3.2 of ACI 318. The criteria for evaluation and acceptance of concrete strength shall be as prescribed in Section 5.6 of ACI 318.
  - 2. Maximum water/cement ratio shall be 0.45.
  - 3. Air content shall be  $5.0 \pm 1.0$  according to ODOT Standard Specification Section 701.01 and shall be determined according to AASHTO T 152 or AASHTO T 196.
  - 4. Slump shall be between 2 and 4 inches determined in accordance with ODOT Standard Specification Section 701.01 (c) (AASHTO T 119).
  - 5. Maximum nominal size coarse aggregate shall be -1/2 inch.
  - 6. Proportioning of high density concrete material shall be in accordance with current ODOT specifications.

## PART 3 EXECUTION

### 3.1 PREPARATION FOR PLACING

- A. CONTRACTOR shall remove all loose and deteriorated concrete in the areas designated on the plans to receive new concrete, and those areas identified by the ENGINEER in the field. Existing concrete will be removed by chipping hammers, hydraulic splitters, or other approved means to expose sound, intact concrete. Removal shall be performed to eliminate featheredging. Chipping and cutting tools shall be selected by the CONTRACTOR so as not to damage existing sound concrete or reinforcing steel to remain in place. Existing deteriorated concrete shall be removed until the remaining concrete is demonstrated to be sound in accordance with the method of ACI 503 Appendix A.
- B. Concrete surfaces to receive new materials shall be cleaned of grease, dirt, laitance, corrosion, or other contamination, and roughened by high velocity air or water jets, chipping, sandblasting, or other approved means. At a minimum, all surfaces will be wire brushed and chipped to sound materials using hand tools. Existing concrete surfaces to receive new concrete shall be coated with an epoxy bonding agent in accordance with manufacturer’s instructions.
- C. Any existing reinforcing steel bars exposed by the removal of unsound concrete shall be cleaned by wire brushing, sandblasting, power tools, or other approved means. Bars with less than 75 percent of their original bar diameter remaining shall be removed and replaced.

Damaged portions of bars shall be mechanically cut and removed, and new bar reinforcement welded to the existing bars with sleeve splices, mechanically coupled to existing bars, or lap spliced to existing bars. All welding shall conform to AWS D1.4.

- D. If removal of concrete exposes more than one half of the perimeter of the bar, the bar shall be exposed with sufficient clearance under the bar to assure encasement and bond.
- E. Existing reinforcing bars in the repair area shall be coated with a high quality epoxy corrosion inhibitor such as Sika Armatec 110 or approved equal.
- F. Existing surfaces to receive repairs shall be thoroughly saturated, and free standing and excess water shall be removed with clean compressed air before applying repair materials.
- G. Existing concrete surfaces to receive new concrete shall be coated with an epoxy bonding agent in accordance with manufacturer's instructions.
- H. All waste materials or byproducts of demolition and surface preparation shall be disposed of in accordance with applicable laws, permits regulations and ordinances. Disposal of these materials in the waterways will not be allowed.
- I. Equipment. All equipment needed to place and consolidate the concrete shall be at the placement site and in good operating condition. Aluminum pipes, chutes, troughs, spouts or tremies shall not be used for pumping, conveying or placing concrete.
- J. Embedded Items. Before placing concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place. Embedded items shall be free of oil and other foreign matter such as loose coatings or rust, paint and scale.
- K. Sampling. The CONTRACTOR shall provide suitable facilities and labor for obtaining representative samples of concrete for quality control testing. All necessary platforms, tools, and equipment for furnishing samples shall be furnished by the CONTRACTOR.
- L. Protection. The CONTRACTOR shall take all necessary precautions to protect the concrete from any condition that will damage the concrete, including preventing water from splashing on the concrete while it is being poured or still green.

### 3.2 PLACING

- A. Carefully place concrete using the best construction practices given in ACI 304. Concrete placement will not be permitted when weather conditions prevent proper placement and consolidation.
- B. Concrete shall be deposited as close as possible to its final position, and in so depositing there shall be no vertical drop greater than five feet. The top of the lift should be level and made reasonably even by means of vibration. The surfaces of construction joints shall be kept continuously wet for the first twelve hours during the twenty-four hour period prior to placing concrete. As a lift is completed, the top surface shall be immediately and carefully protected from any condition that will damage the concrete.
- C. Time Interval between Mixing and Placing. Concrete shall be placed within thirty (30) minutes after discharge into non-agitating equipment. When concrete is truck mixed or when

a truck mixer or agitator is used for transporting concrete mixed by a concrete plant mixer, the concrete shall be delivered to the site of the work and discharge and final placement shall be completed within 1-1/2 hour after introduction of the cement to the aggregates.

- D. Cold-Weather Placing. When the average daily ambient air temperature is below 40 degrees F, concrete placement shall conform to the requirements of ACI 306.
- E. Hot-Weather Placing. The temperature of concrete as placed shall be maintained below 90 degrees F by methods recommended in ACI 305.
- F. Underwater Placing. Placement of concrete underwater shall conform to the requirements of ACI 304, Chapter 8.
- G. Consolidation. Immediately after placement, each layer of concrete, including flowing concrete, shall be consolidated by internal vibrating equipment. Vibrators shall not be used to transport concrete within the forms. Hand spading may be required if necessary with internal vibrating along formed surfaces permanently exposed to view. Vibrators of the proper size, frequency, and amplitude shall be used for the type of work being performed.
- H. The high density inlay shall be placed and finished in accordance with the latest ODOT Standard Specification Section 505 – Repair and Overlay of Concrete Bridge Decks. This work is classified as a ‘Class A Bridge Deck Repair’. All work shall be performed in strict conformance with applicable specifications.

### 3.3 CONSTRUCTION TOLERANCES

- A. Concrete work for which more precise tolerances are not indicated shall be constructed so that the finished work does not exceed the tolerance limits specified in ACI 117. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing. When forms or shoring are used, the measurements shall be made prior to removal. Tolerances are not cumulative. The most restrictive tolerance controls.
- B. The surface tolerance for the high density inlay is that ponding is NOT permitted.

### 3.4 FINISHING

- A. General. No finishing or repair will be done when either the concrete or the ambient temperature is below 50 degree F.
- B. Finishing Formed Surfaces. All fins and loose materials shall be removed, and surface defects including tie holes shall be filled. All honeycomb areas and other defects shall be repaired. All unsound concrete shall be removed from areas to be repaired. Surface defects greater than 1/16 inch in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. The prepared area shall be brush-coated with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filled with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of Portland cement and white cement so that the final color when cured will be the same as adjacent concrete.

- C. **Finishing Unformed Surfaces.** All unformed surfaces that are not to be covered by additional concrete or backfill shall be float finished to elevations shown on the drawings, unless otherwise specified. Surfaces to receive additional concrete or backfill shall be brought to the elevations shown on the drawings and left as a true and regular surface. Exterior surfaces shall be sloped for drainage unless otherwise shown on the drawings. Joints shall be carefully made with a jointing tool. Unformed surfaces shall be finished to a tolerance of 3/8 in. for a float finish as determined by a 10-ft straightedge placed on surfaces shown on the plans to be level or having a constant slope. Finishing shall not be performed while there is excess moisture or bleeding water on the surface. No water or cement shall be added to the surface during finishing. Surfaces to be float finished shall be screeded and darbyed or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darby or bullfloat shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh concrete. When the water sheen disappears and the concrete will support a person's weight without deep imprint, floating should be completed. Floating should embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

### 3.5 CURING AND PROTECTION

- A. Beginning immediately after placement and continuing for at least 7 days, all concrete shall be cured and protected from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage, and exposure to rain or flowing water. All materials and equipment needed for adequate curing and protection shall be available and at the site of the placement prior to the start of concrete placement. Preservation of moisture for concrete surfaces not in contact with forms shall be accomplished by one of the following methods:
  - 1. Continuous sprinkling or ponding.
  - 2. Application of absorptive mats or fabrics kept continuously wet.
  - 3. Application of sand kept continuously wet.
  - 4. Application of impervious sheet material conforming to ODOT Standard Specification Section 701.07 (e) (ASTM C 171).
  - 5. Application of membrane-forming curing compound shall conform to ODOT Standard Specification 701.07 (d) and shall be accomplished in accordance with manufacturer's instructions.
- B. The preservation of moisture for concrete surfaces placed against wooden forms shall be accomplished by keeping the forms continuously wet for 7 days. If forms are removed prior to end of the required curing period, other curing methods shall be used for the balance of the curing period. During the period of protection removal, the temperature of the air in contact with the concrete shall not be allowed to drop more than 25 degree F within a 24-hour period.

### 3.6 EVALUATION AND ACCEPTANCE

- A. **Concrete Strength.** The criteria for evaluation and acceptance of concrete strength shall be as prescribed in ACI 318, Section 5.6.

- B. Appearance. Permanently exposed surfaces shall be cleaned, if stained or otherwise discolored, by an approved method that does not harm the concrete. Abrupt variations in color, shade or tint will not be permitted on these surfaces.

### 3.7 QUALITY CONTROL

- A. General. CONTRACTOR quality control is that system by which a CONTRACTOR regulates, tests, and inspects his procedures, equipment, materials, and personnel so that the complete project will comply with the requirements of the project specifications. The individuals who sample and test concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.
- B. The CONTRACTOR shall obtain the services of an independent testing agency to perform concrete strength, slump, temperature, and air entrainment testing in accordance with ACI and ASTM standards. The laboratory performing the tests shall conform with
- C. ASTM C 1077. The testing agency shall be submitted to the Engineer for Acceptance.
- D. Preparations for Placing. Foundation or construction joints, forms, and embedded items shall be inspected in sufficient time prior to each concrete placement by the CONTRACTOR to certify to the ENGINEER that it is ready to receive concrete. Placing shall not be continued if any pile is inadequately consolidated.
- E. Air Content. Air content shall be checked at least once during each shift that concrete is placed. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 231. Whenever a test result is outside the specification limits, the concrete shall be rejected and shall not be delivered to the forms and an adjustment shall be made to the dosage of the air-entrainment admixture.
- F. Concrete Slump. Slump tests shall be made at the point of delivery for each 50 cubic yards of concrete placed, or fraction thereof placed in any one day. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 143. Whenever a test result is outside the specification limits, the concrete shall be rejected and shall not be delivered to the forms and an adjustment should be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the water-cement ratio does not exceed that specified in the submitted concrete mixture proportion.
- G. Concrete Strength. Three samples for strength testing shall be taken for each 100 cubic yards of concrete placed, but at least one test for strength shall be made during each day during which concrete is placed. A minimum of three specimens shall be made from each sample; one shall be tested at 7 day and two at 28 days. If a fly-ash mix is used, two additional specimens shall be made and tested at 90 days. Compression test specimens shall be made and cured in accordance with ASTM C 31 and compression test specimens tested in accordance with ASTM C 39. Concrete not meeting the specified strength requirements will be removed and replaced by the Contractor at no additional cost to the OWNER, or additional testing may be conducted by the CONTRACTOR at his own expense to provide satisfactory evidence to the ENGINEER that the specified strength requirements have been achieved.
- H. Consolidation and Protection. The CONTRACTOR shall ensure that the concrete is properly consolidated, finished, protected, and cured.

- I. Reports. The results of all tests and inspections conducted at the project site shall be reported informally at the end of each shift and in writing weekly and shall be delivered to the OWNER and ENGINEER within 3 days after the end of each weekly reporting period.

END OF SECTION

**SECTION 460001  
DUPLEX PACKAGE LIFT STATION**

**DESCRIPTION**

The contractor shall furnish and install three sewage lift stations with, pumps, piping, and factory built wet well-mounted submersible pump control station and all needed equipment factory installed on a stainless steel base and fiberglass enclosure. The principal items of equipment shall include a U. L. certification for package pumping stations, 3" steel internal piping, valves, 3" ductile iron riser piping, control panel, two submersible vortex pumps, all as shown on the plans and specified herein. The station manufacturer will also provide a certificate of liability insurance of no less than \$10,000,000.00 dollars.

The "PumpMate" shall be as manufactured by USEMCO, Inc., Tomah, Wisconsin and Represented by Southwest Fluid Systems, LLC. or approved equal.

**ALTERNATES**

The contractor may, if he so chooses, provide an alternate pre-approved package lift station supplier. The alternate shall include all costs or savings, which will result from the proposed alternate and will include any special expenses incurred by anyone affected by the offered alternate. This shall include, but is not limited to, greater energy cost due to less efficient equipment, required greater installation space, or any other item with which this system is to be interfaced. In order for an alternate to be considered, it will be necessary for the contractor to provide one set of written information completely describing the alternate fourteen (14) days prior to the bid date. Should the alternate or the information describing it fail to describe its capability in meeting the job requirements or if the contractor fails to furnish complete information, the engineer shall regard the proposal as an inferior alternate and disregard the alternate bid.

**SYSTEM COORDINATION AND SINGLE SOURCE RESPONSIBILITY**

The equipment provided shall have a completely integrated microprocessor based automatic control and monitoring system consisting of the required controller, power equipment, motor starters, level/flow and alarm monitoring equipment in a factory wired and tested assembly. The automatic control and alarm/monitoring system components shall be standard, catalogued, stocked products of the system supplier to assure one source responsibility, immediately available spare/replacement parts, proper system interconnections and reliable long term operation, also included shall be dry contacts for SCADA monitoring.

**FIELD SUPERVISION**

The services of a factory trained, qualified representative shall be provided to inspect the completed installation, make all adjustments necessary to place the system in trouble free operation and instruct the operating personnel in the proper care and operation of the equipment.

**GUARANTEE**

The manufacturer of the pump station shall guarantee for a period of one year from the date station is placed into operation or eighteen months from date of shipment, whichever occurs first, that the entire station and all equipment therein shall be free from defects in design, materials and workmanship. In the event a component fails or is proven defective during the guarantee period; the manufacturer will provide a replacement part without cost, upon return of the defective part.

**SYSTEM DESCRIPTION**

Furnish and install TWO (2) submersible vortex pumps, KSB Model KRT F 80-250/74XG or approved equal meeting the following performance requirements. The pump's submersible electric motor shall be

capable of operation at 480 Volts, three (3) phases, 60 Hz service. The motor shall be supplied with 30 feet of properly sized electric submersible power cable sized in accordance with NEC standards. Each pump shall be fitted with 30 feet of lifting chain or cable.

**PERFORMANCE REQUIREMENTS:**

**Phase 1**

Design Flow: 100 GPM  
Total Dynamic Head (TDH): 121 ft  
Motor: 4.0 HP @ 1750 RPM

**Phase 2**

Design Flow: 50 GPM  
Total Dynamic Head (TDH): 100 ft  
Motor: 3.0 HP @ 1750 RPM

**Phase 3**

Design Flow: 50 GPM  
Total Dynamic Head (TDH): 50 ft  
Motor: 1.0 HP @ 1750 RPM

NOTE FOR CLARIFICATION: *The Phase 3 force main discharges into one of the Phase 1 sanitary sewer manholes. From there, the flow joins the Phase 1 flow and continues to the Phase 1 lift station before entering the public right-of-way and connecting to the City of Sapulpa's sanitary sewer system.*

**REFERENCED STANDARDS:**

American Iron & Steel Institute (AISI)  
American Society for Testing and Materials (ASTM)  
Factory Mutual (FM)  
Hydraulic Institute Standards for Centrifugal, Rotary, and Recip. Pumps (HI)  
National Fire Protection Association (NFPA)  
National Electric Code (NEC)  
National Electrical Manufacturers Association (NEMA)  
Anti-Friction Bearing Manufacturers Association (AFBMA)

**WARRANTY**

The pump manufacturer shall warrant the pump and motor to the Owner against defects in workmanship and materials for a period of 7 years from installation or eighteen (84) months after shipment. Pump manufacturer warranty shall be in published form and shall to all similar units. A copy of each warranty shall be provided to the Owner at startup.

**PUMP DESIGN**

The pump's design shall allow for removal and reinstallation of the pump without the need for personnel to enter the confined space of the wet well and without the removal of bolts, nuts or other fasteners. The pump shall connect to a permanently mounted discharge connection by simple downward motion, without rotation, guided by at least two non-load bearing Type 316 stainless steel guides. Final connection shall insure zero leakage between the pump and its discharge connection flange by means of an o-ring seal. No part of the pump shall bear directly on the floor of the wet well. The contractor shall also supply stainless steel lifting chain or cable of sufficient length to properly and safely lift the pumps from the wet well.

## **PUMP CONSTRUCTION**

Major components (pump casing, impeller, intermediate housing, motor housing) shall be of at minimum ASTM A48 Class 35 cast iron with smooth surfaces devoid of blowholes and other irregularities. All exposed fasteners shall be ASTM A 276 Type 316Ti stainless steel. The cutter/grinder assembly shall be of at minimum a hardened white iron having a minimum Brinell Hardness Rating (BHR) of 750 - 1000.

Mating surfaces between components where watertight integrity is critical shall be machined and fitted with Nitrile Rubber or Viton O-rings. Because these are critical passages and flame paths, no secondary sealing compounds, greases, or other devices shall be used.

## **COOLING SYSTEM**

The motor shall be adequately sized and designed so that integrally cast motor cooling fins have sufficient surface area to allow the motor to run continuously in submerged or partially submerged conditions without the need for internal oil circulation systems or cooling jackets which circulate the pumped media up inside the motor shell. Further, the motor's design shall allow it to be capable of running for extended periods in a dry mode without damage to the motor or seals.

## **CABLE AND CABLE ENTRY SEAL**

The power cable shall be suitable for the submersible application and sized in accordance with NEC requirements. The cable entry design shall insure that no entry of moisture is possible into the high-voltage motor terminal area even if the cable is damaged or severed below water level to a submerged depth of up to 85 feet.

## **MOTOR**

The submersible motor shall be squirrel cage, induction in design, housed in a completely watertight and air filled chamber. The motor shall have at minimum a 1.10 service factor and be suitable for use in Class I, Division 1, Group C & D atmospheres as Explosion Proof. The motor stator shall use at minimum Class F insulation rated for 311 Degrees F. The motors shall be designed, rated, and warranted for continuous operation and capable of at minimum twenty (20) starts per hour. Temperature monitors shall be embedded in the motor windings for use in conjunction with and supplemental to external motor overload protection. The pump's control shall shut down the pump should any of the monitors detect high temperature and automatically reset once motor temperature returns to normal. Do not provide motors that contain other than ecologically safe paraffin base oil in the seal chamber. Do not provide motors containing di-electric oils used for motor cooling and/or bearing lubrication.

## **BEARINGS**

Furnish upper and lower bearings as needed to provide a B10 bearing life of at minimum 40,000 hours at anticipated axial and radial loadings. The bearings shall be sealed/shielded permanently lubricated for the life of the pump/bearings.

## **MECHANICAL SEALS**

Each pump shall be provided with two totally independent shaft seals, installed in tandem. The upper seal shall operate in an oil-filled chamber with drain and inspection plug (with positive anti-leak seal) for easy access from external to the pump. The lower seal shall be of bellows type with both faces of at minimum Silicon Carbide. The seals shall require neither routine maintenance nor adjustment, but capable of being easily inspected and replaced. The seals shall be non-proprietary in design, with replacements available from a source other than the pump manufacturer. Do not provide seals with the following characteristics:

conventional double mechanical seals with single or multiple springs acting in opposed direction; cartridge-type mechanical seals; seals with face materials other than those specified.

#### **SHAFT**

Provide a common pump/motor shaft of sufficient size to transmit full driver output with a maximum deflection of 0.002 inches measured at the lower mechanical seal. The shaft shall be completely of at minimum ASTM A 276 Type 420 stainless steel. Do not use carbon steel as shaft material without using a stainless steel shaft sleeve.

#### **IMPELLER**

The impeller(s) shall be of gray cast iron, Class 35B, dynamically balanced, semi-open, non-clogging design capable of handling soils, fibrous materials, heavy sludge and other matter found in wastewater. The impeller(s) shall have a back shroud only with back pump-out vanes to equalize axial thrust, and curved blades which protrude into the pump casing for maximum efficiency. The impeller will create a vortex which carries solids through the pump casing without passing through the blades. Impeller(s) shall be capable of passing a minimum 3" diameter solid.

#### **VERIFICATION OF PERFORMANCE**

All pumps shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation or over-heating. Any pump that fails to meet any of the contract specifications will be modified, repaired, or replaced by the contractor at no additional cost to the owner.

The manufacturer or his Authorized Representative shall conduct site tests. Tests shall include checking for correct rotation, maximum motor amperage draws within nameplate specifications, balanced voltages on each power leg with the pump operating to within manufacturers tolerances, and demonstrated compatibility of the pump/motor with the controls supplied. Test results shall be in printed form and signed by the manufacturer or his Representative and supplied to the owner.

#### **ABOVE GRADE EQUIPMENT CHAMBER**

The equipment chamber common base shall be of stainless steel plate to be bolted to the Contractor furnished concrete top.

The exterior shall be a tan textured surface. Smooth and/or glossy exteriors will not be acceptable and will not be considered due to their appearance and reflectivity characteristics.

The cover will have access doors on two sides. All access doors shall be equipped with continuous hinges and tamperproof keyed latches. All hardware for the cover shall be tamperproof. The entire cover shall be removable in order to service the equipment in the pump station. Removal shall require no more than two maintenance personnel for removal without the use of lifting equipment. The cover shall be provided with inlet and discharge louvers and a thermostatically controlled fan. A forced air electric heater with a minimum capacity of 1500 watts that is controlled by a thermostat and plugs into the control panel with a twist lock connection will be provided with the enclosure.

Removable lifting eyes shall be placed about the perimeter of the equipment base to facilitate lifting and handling of the station.

Station shall have 4" Emergency Pump Connections on the Suction AND Discharge piping of the Above Grade Valve Chamber.

An aluminum hatch located exterior to the equipment chamber shall be provided for access to the wet well. Steel hatches or access doors will not be acceptable. The aluminum frame shall be ¼" thick extruded aluminum having a continuous concrete anchor as a part of the one-piece extrusion. The access cover shall be of ¼" aluminum diamond plate, reinforced with stiffener bars as required. The cover shall be able to withstand the live load of 300 lbs. per square foot. The cover will have stainless steel hinges and be

equipped with a lifting handle and a padlock locking post (padlock by others). The cover shall open to 90 degrees and lock automatically in that position by a stainless steel positive locking arm. The cover will have a full-length ¼" thick aluminum skirt that will be continuous from the frame to the bottom of the base. This aluminum hatch will be manufactured by the control station manufacturer and will not be a "buy out" item.

Removable lifting eyes shall be placed about the perimeter of the equipment base to facilitate lifting and handling of the station.

An aluminum hatch located exterior to the equipment chamber shall be provided for access to the wet well. Steel hatches or access doors will not be acceptable. The aluminum frame shall be ¼" thick extruded aluminum having a continuous concrete anchor as a part of the one-piece extrusion. The access cover shall be of ¼" aluminum diamond plate, reinforced with stiffener bars as required. The cover shall be able to withstand the live load of 300 lbs. per square foot. The cover will have stainless steel hinges and be equipped with a lifting handle and a padlock locking post (padlock by others). The cover shall open to 90 degrees and lock automatically in that position by a stainless steel positive locking arm. The cover will have a full-length ¼" thick aluminum skirt that will be continuous from the frame to the bottom of the base. This aluminum hatch will be manufactured by the control station manufacturer and will not be a "buy out" item.

A 1000 lb mounted jib crane shall be provided to facilitate pump removal.

#### **WIRING**

All wiring shall be minimum 600-volt (UL) type MTW or AWM and have a current carrying capacity of not less than 125% of the full load current.

The conductors shall be in complete conformity with the National Electric Code, state, local and NEMA electrical standards.

To ensure the safety of all personnel working with this equipment, as well as providing a simple means of tracing wires when troubleshooting, all wiring shall be color-coded in strict accordance with the wiring diagrams furnished by the equipment supplier.

An isolation plate shall be provided for pump and float cord entry into the wetwell. The plate shall be drilled and tapped to accept cord grips that are rated for this service. The plate will be gasketed and installed with a sealant to insure a gas tight fit.

#### **UL APPROVAL**

The control panel shall be constructed in compliance with Underwriter's Laboratories Industrial Control Panels listing and follow-up service; utilizing UL listed recognized components where applicable. The control panel shall bear the Underwriters Laboratories 508/698A serialized label and relating to hazardous locations with intrinsically safe circuit extensions.

#### **CONTROL PANEL**

The described equipment shall be housed in a NEMA 3R painted steel enclosure arranged for mounting within the equipment chamber as shown on the drawings. The enclosure shall be approximately 36" high and 10" deep. The enclosure shall be constructed of not less than 14-gauge #304 stainless steel.

This weather proof, tamper proof, rain-tight enclosure shall be designed specifically for mounting in an unprotected outdoor location. The enclosure shall be gasketed. It shall have a hinged front weather door

with 3 point latching mechanism and locking capability. It shall also have an internally mounted hinged aluminum inner panel so that all the components normally actuated by operating personnel are accessible without opening the dead front and yet are not exposed to the elements or to unauthorized personnel.

All major components and sub-assemblies shall be identified as to function with laminated, engraved Bakelite nameplates or similar approved means.

The Control panel shall include the following standard features:

- a) overload relays
- b) circuit breakers
- c) running lights
- d) H-O-A switches
- e) Alternator
- f) terminal strip
- g) time delay relay (For lag pump following power failure.)
- h) DRY CONTACTS for SCADA Monitoring for: Power Failure, Seal Failure(both pumps) , Thermo Failure (both pumps) , HI alarm, LO alarm, and Run Time (each pump). (SCADA SYSTEM By Others)

All control wiring within the control panel shall conform to the National Electrical Code. All wiring shall be neatly installed and run in plastic raceways to prevent interference with any operating devices. All door mounted devices shall be labeled to functions with permanently attached nameplates and all internal wiring, terminal strips, etc. shall be properly identified for field connections and trouble shooting.

The following options shall also be included:

- a) running time meters
- b) alarm light
- c) Four alarm dry contacts
- d) lightning arrestor
- e) 115 Volt Convenience Outlet
- f) UL 508 listing

The pump motor shall have short circuit and overload protection by means of properly sized motor starters and thermal magnetic molded case. Circuit breakers shall be provided as disconnect switches, protection against short circuits, or a ground for each pump motor. Circuit breakers shall have an interrupting rating of 14,000 amps at 460 volts and shall be U.L. listed. The operating mechanism shall allow manual switching and shall indicate when the breaker has tripped.

#### **ACROSS THE LINE STARTERS**

The magnetic across-the-line starters with manual reset shall be provided with the melting alloy type overload relays for each phase to assure positive motor protection.

#### **DUPLEX LOGIC**

The sewage pumps shall alternate automatically on the completion of each pumping cycle. One pump shall start as the lead pump and the other pump shall be started if the wet well level continues to rise to the start level of the lag pump. After each operating cycle the lead and lag positions shall alternate. A manual selector switch shall be provided so that the operator can designate either pump to stay continuously in the lead position. Adjustable time relays shall be provided to prevent simultaneous starting of pumps after power failure.

**FLOAT SWITCHES**

Shall be Mercury or Mechanical Tilt Normally Open Float Switch. Floats shall be internally weighted with Heavy Duty Exterior. Float cable shall be no less than 30' long.

**START-UP SERVICES**

Manufacturer shall furnish start-up services by a qualified representative and furnish report if requested.

**OPERATIONS AND MAINTENANCE MANUALS**

Contractor shall furnish three (3) acceptable manufacturer O&M Manuals to the user for the package lift station installed.

**ON-SITE ELECTRICAL AND COMMUNICATIONS INSTALLATION**

*Includes all labor materials and equipment to install all electrical and communications specified.*

**Electrical** includes all cabinets, conduit, wire, etc for fused disconnect, surge protector, automatic transfer switch for generator, underground connections to power pole and generator, and electric meter. All electrical and communications for the 40kW genset is to be included in this pay item. This bid item includes cost of radio tower, if required.

**Communications** includes installation of link to Sapulpa SCADA system providing POWER STATUS (power is available or not), GENERATOR STATUS (generator is on or off), HI alarm status (tripped or not), LO alarm status (tripped or not), SEAL alarm (for each pump), TEMP alarm (for each pump), and run time (for each pump). Cost includes programming of Sapulpa SCADA system to accommodate and display the Lift Station monitored data. Martin Brown with Control System Solutions LLC (918) 230-3839 is the contact for programming the SCADA computer at the Sapulpa Wastewater Lift Station.

**CONSTRUCTION DOCUMENTS  
PREPARED BY:**



**KEITHLINE ENGINEERING GROUP, PLLC**

8556 East 101<sup>st</sup> Street, Suite C  
Tulsa, Oklahoma 74133  
918.369.7911