

**CONTRACT DOCUMENTS  
AND  
SPECIFICATIONS  
FOR  
PROJECT NO. WPC 21-1  
WATER POLLUTION CONTROL  
CAPITAL EQUIPMENT REPLACEMENTS**

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**ATTENDANCE AT PRE-BID CONFERENCE IS MANDATORY**

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PREPARED BY:  
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WATER AND SEWER DEPARTMENT

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Account Numbers: 7503382-544003, 7503383-531105,  
7503392-544003, 7503395-544003

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Water and Sewer Department  
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Tulsa, Oklahoma 74103  
(918) 596-9845

**TECHNICAL SPECIFICATIONS**

**PROJECT SPECIFICATIONS**

**FOR**

**TULSA METROPOLITAN UTILITY AUTHORITY**

**PROJECT NO. WPC 21-1**

**WATER POLLUTION CONTROL CAPITAL EQUIPMENT REPLACEMENTS**

**TULSA, OKLAHOMA**

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## INTRODUCTION:

200.1 Project work shall include all equipment, labor, materials, hardware, cable, terminations, and incidentals necessary to remove existing equipment that is to be replaced, install the new equipment, and place the new equipment in fully operational, functional and warrantable service. All equipment to be supplied shall be brand new current year model and not used, remanufactured, or discontinued items.

200.2 The Authority's contact people are:

Water Pollution Control:	Matt Vaughan – Section Manager 175 E. 2 <sup>nd</sup> Street, Suite 1400 Tulsa, OK 74103 918-596-9845 mvaughan@cityoftulsa.org
Northside Wastewater Plant Lower Bird Creek WWTP Port South Lift Station	Shawn Glen – Northside WWTP and Lower Bird Creek WWTP Superintendent 5628 N 105 <sup>th</sup> East Avenue Tulsa, OK 74117 918-591-4570
Southside Wastewater Plant Southeast Basin Lift Station	Josh Fisher – Southside WWTP Superintendent 5300 S. Elwood Avenue Tulsa, OK 74107 918-591-4450

## 201 QUALIFICATION REQUIREMENTS

201.1 Only contractors holding a valid pre-qualification certificate from the Tulsa Metropolitan Utility Authority in Classification A or D, General Utility Constructions, are eligible to bid on this project. No additional qualification information is required to be submitted.

201.2 Only contractors that attend the mandatory pre-bid meeting will be allowed to bid on this project.

## 202 SUMMARY OF BID ITEMS

The Basis of Award shall be determined by the total Base Bid plus Additive Alternates No. 1 to 3. Additive Alternate(s) No. 1-3 may or may not be awarded at the sole discretion of the City of Tulsa. Any proposal submitted with Additive Alternates No. 1-3 incomplete shall be considered non-responsive.

<b>BID ITEM</b>	<b>SPEC NO.</b>	<b>DESCRIPTION</b>
1	203.998	Mobilization
2	203.150	All materials, labor, equipment, and supervision required for the Operations Building Roof and Roof Drain Replacement at the Southside WWTP per these specifications.
3	203.200	All materials, labor, equipment, and supervision required for the Digester #3 & #4 Roof and Roof Drain Replacement at the Southside WWTP per these specifications.
4	203.300	All materials, labor, equipment, and supervision required for the Odor Controls System Improvements at the Southeast Basin LS per these specifications.
5	203.400	All materials, labor, equipment, and supervision required for the Covers for Blend System Pumps, Valves, Piping at the Northside WWTP per these specifications.
6	203.600	All materials, labor, equipment, and supervision required for the Pump #1 Improvements at Spunky Creek LS at the Lower Bird WWTP per these specifications.
7	203.820	All materials, labor, equipment, and supervision required for the Operations Laboratory HVAC Controls at the Northside WWTP per these specifications.
8	203.860	All materials, labor, equipment, and supervision required for the Disinfection Surge Protection at the Northside WWTP per these specifications.
9	203.999	Mechanical, Electrical, Plumbing and Unforeseen Circumstances Allowance for various mechanical, electrical, plumbing and unforeseen work not shown on the construction drawings or specified in the contract documents.
Add Alternate No. 1		
10	203.100	All materials, labor, equipment, and supervision required for the Operations building Remodeling Improvements at the Southside WWTP per these specifications.
Add Alternate No. 2		
11	203.800	All materials, labor, equipment, and supervision required for the Phase 3 Exterior Lighting at the Southside WWTP per these specifications.
Add Alternate No. 3		
12	203.840	All materials, labor, equipment, and supervision required for the Phase 3 Interior Lighting at the Northside WWTP per these specifications.

END OF SECTION

**TMUA PROJECT NO. WPC 21-1  
WATER POLLUTION CONTROL CAPITAL EQUIPMENT REPLACEMENTS  
SPECIFICATION CERTIFICATION SHEET**

**200 INTRODUCTION**

**201 QUALIFICATION REQUIREMENTS**

**202 SUMMARY OF BID ITEMS**

**203 DESCRIPTION OF BID ITEMS/WORK**

203.150 SS Ops Bldg. Roof Replacement  
203.200 SS Digester Roof Replacement  
203.400 SE Basin Lift Station Odor Control System  
203.600 Spunky Creek LS Improvements  
203.601 Spunky Creek LS VFD  
203.998 Mobilization  
203.999 MEP

**204 ANCILLARY EQUIPMENT & WORK**

204.4 General Electrical  
204.5 Painting  
204.6 Concrete Coating  
204.7 Concrete Rehabilitation  
204.8 Cast In Place Concrete  
204.9 Concrete Reinforcement  
204.10 Construction Joints, Expansion Joints and Waterstops  
204.11 Concrete Formwork  
204.12 Carpentry and Caulk

**205 SUBMITTALS**

**206 MONTHLY PROGRESS REPORTS & PROGRESS MEETINGS**

**207 SECURITY**

**208 SAFETY**

**209 PROTECTION OF PROPERTY**

**210 PROTECTION OF MATERIALS**

**211 REFERENCES TO OTHER SPECIFICATIONS**

**212 CLEAN-UP**

**213 PLACING WORK IN SERVICE**

**214 PAYMENT**

**END OF SPECIFICATIONS**



**Stephen Tolar, P.E., S.E.**  
**OK 20679**  
**Holloway, Updike and Bellen, Inc.**  
**C.A. No. 219**  
**Expires June 30, 2021**

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**TMUA PROJECT NO. WPC 21-1  
WATER POLLUTION CONTROL CAPITAL EQUIPMENT REPLACEMENTS  
SPECIFICATION CERTIFICATION SHEET**

203.800 SSWWTP Exterior Lighting  
203.840 NSWWTP Interior Lighting Improvements



**Bruce Brown, P.E.  
OK 20995  
Brown Engineers of Arkansas, LLC.  
C.A. No. 4933  
Expires June 30, 2022**

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203.150 All materials, labor, equipment, and supervision required for installation of new roofing system and drain system improvements at the Southside WWTP Digester 3-4 building per these specifications. The work and costs includes, but is not limited to new roofing membrane, build up rigid insulation, fascia, and custom flashing to equipment/roof mounted items, vent flashing, coping rehabilitation, and coordination with roof drains and new walk pads throughout. Other inclusions are includes protecting, coordinating and repairs to the lightning protection, along with rehabilitation and repairs to the roof parapet wall coping. **BID COSTS ALSO INCLUDE SPECIAL 15 YEAR WARRANTY WITH CERTIFICATE TO THE CITY OF TULSA.** See Bid Proposal for base bid and alternate bid items.

203.150.1 The work consists of the following scope of improvements:

- A. Demolition of the existing roofing systems complete, including but not limited to the roof system, ballast as applicable, insulation, flashing, trim, roof penetration flashing, fasteners, fascia or other component of the existing roofing systems for a complete replacement to new roofing system and warrantee.
- B. Contractor shall provide new roofing system complete, including but not limited to the roof membrane, insulation, flashing, trim, roof penetration flashing, fasteners, fascia or other component of the roofing system for a complete replacement to new materials and warrantee.
- C. Protection of existing roof decking, surface mounted equipment, skylights, vents and another roof mounted item.
- D. Refer to Specification Section 204 for additional painting and preparation requirements.

203.150.2 Refer to Contract Drawings for additional information and details.

203.150.3 Project work shall include all materials, equipment, labor, and supervision necessary to complete the project as specified herein, including but not limited to any and all crane work, rigging, scaffolding, access to, work area safety and other items as required to provide a complete and functional installation.

203.150.4 Contractor shall submit work plan acceptable to the Engineer describing the duration and sequence of work. Plan shall be approved prior to commencement of work. Contractor shall coordinate this work with other work in order to minimize time equipment is out of service.

203.150.5 The Contractor shall install equipment and materials in a workmanlike manner utilizing craftsmen skilled in the particular trade. Installation practices shall conform to Manufacturer's recommendations.

203.150.6 Submit all materials for approval prior to work.

203.150.7 **Manufacture Product Warranty:** Contractor shall coordinate, complete Manufacture form requirements and provide the City all final warrantee documentation. Payment for completed in place work shall be 90% of bid item cost and remaining 10% of bid item payment shall represent acceptable completed warrantee paperwork transmitted to the City, c/o Plant Superintendent.

203.150.8 **Contractor shall coordinate and provide a Manufacturer's warranty commencing on date of substantial completion, including costs for labor and materials for loss of water tightness without financial limit for a period of 15 years with a no dollar limit (NDL).**

203.150.9 Roofing TPO fastened 60 mil membrane roofing system shall be manufactured by Carlisle Syntec or equal, see contract drawings for requirements and details which govern over specification. All other accessories required for proper operation that meet the following specification:

-Roof area(s):	See plan sheets.
-Insulation	Carlisle HP-H Polyiso grade 3 or equal.
-Walk mats	From each ladder access to and around equipment and items which require maintenance. Additional locations and paths are show on the contract plans.
-Color of membrane	Standard color, white
-Electrical improvements:	No new electrical, Provide new welded custom 316 stainless flashing. Custom welded corners. Any laps shall be 6" min and caulked with NP or equal.
-Skylight(s):	No new skylights, Provide new welded custom 316 stainless flashing. Custom welded corners. Any laps shall be 6" min and caulked with NP-1 or equal.
-Roof Mounted Mechanical:	No new equipment, Provide new welded custom 316 stainless flashing. Custom



	welded corners. Any laps shall be 6" min and caulked with NP or equal.
-Plumbing Vents:	Yes, Provide new neoprene rubber stainless flashing at all existing and new piping vent locations.
-Hardware/fastener	All shall be 316 Stainless unless specifically specified otherwise. No plated carbon steel will be accepted. All fasteners exposed shall be caulked.
-Coping, Fascia edge system	Metal Era Anchor-tite fascia, ES1 with 215mph rated and lifetime warranty, ES1 certified. Coordinate coping and blocking with insulation and system requirements. Color shall be dark "Bronze" anodized heavy aluminum flashing/trim confirmed through the submittal process. Specific details uniquely shown on the contract drawings will govern. For example, in locations where custom 316 stainless steel flashing is required in high corrosion areas.
-Exposed Parapet/Coping	New unless shown on the plans otherwise. Work shown on contract plans. Reuse existing.
-Adhesives, primers, bonding	As required by Roofing System Membrane Manufacture requirements for this project application.
- Step treads (anti-slip steps)	Step treads shall be provided to and from any and all ladders to any and all equipment. Step treads shall be laid out around all equipment for maintenance and any roof item requiring regular or periodic maintenance. Contractor to confirm existing equipment and general layout for submittal sketch for approval

- Roof Drains
  - Lightning Protection
- of the step tread paths as part of the material submittal package.
- See plan sheets. Replace unless plan sheets specifically note otherwise.
- Reconnect lightning protection with new fasteners as required. Protect existing system during construction. Replace cable hold down clips and glue to new roofing system. Maintain system design and coordinate cables with existing routing and layout.

203.150.10 TAGGING: No tagging is required. Roofing does have an equipment number which should be included on the project's Warranty Log sheet. No physical tag is required.

END OF SECTION

203.400 All materials, labor, equipment, and supervision required for installing one (1) new carbon adsorber odor control system at the Southeast Basin Lift Station per these specifications

- 203.400.1 The work consists of installing one (1) carbon adsorber odor control system and associated piping, fittings, valves, bases, rails, supports, and electrical improvements at the Southeast Basin Lift Station. The project includes the correct and complete installation of new components specified herein in conformance with the manufacturer's instructions and recommendations for installation, subsequent testing of the new units and ensuring all components are in proper operation.
- 203.400.2 Odor Control System is identified as S110-LFT1-OCF01 on Drawings 203.400.A and B.
- 203.400.3 Contractor shall be knowledgeable about and shall field verify all elevations and dimensions of existing structures, piping, conduit, valves and equipment that in any way, directly or indirectly, relates to the removal of existing equipment and/or installation of new equipment. Work shall be based on field measurements. The Authority will make information on file that pertains to the existing equipment available for review.
- 203.400.4 Project work shall include all materials, equipment, labor, and supervision, necessary to complete the project as specified herein including, but not limited to, any and all crane work, rigging, delivery and complete installation of components to fully operational and warrantable condition.
- 203.400.5 All work requiring flow stoppage or equipment removed from service must be scheduled 48 hours in advance with Plant Superintendent. Contractor shall have valves, temporary pumps and any other necessary materials and equipment at the installation site prior to flow stoppage. It is the contractor's responsibility to prepare the impacted system and any related systems for disassembly. This includes closing of upstream/downstream valves and pumping down any reservoirs as necessary.
- 203.400.6 The Carbon Adsorber Odor Control System shall consist of the following major components:
- Equipment Skid
  - FRP Exhaust Fan
  - FRP Transition from Fan to Vessel Inlet
  - FRP Inlet Volume Control Damper

- FRP Carbon Adsorber Vessel
- Activated Carbon Media (High H<sub>2</sub>S Capacity)
- FRP Electrical Control Panel
- FRP Exhaust Stack

203.400.7 System Description:

203.400.7.1 The activated carbon odor control system shall consist of an exhaust fan, FRP damper, FRP vessel, activated carbon media, control panel, exhaust stack, valves, piping and all other equipment and accessories for a complete system.

203.400.7.2 All components of the system shall be mounted on the skid.

203.400.7.3 The skid-mounted carbon adsorber odor control system shall be a once-through system. The system is equipped with an exhaust fan that continuously draws the odor-laden air from the process areas into the activated carbon odor control vessel for treatment. The foul air flows through a densely packed bed of high H<sub>2</sub>S capacity carbon where hydrogen sulfide (H<sub>2</sub>S) is removed by adsorption onto the carbon media. The air shall continue through the vessel and cleaned air is discharged to the atmosphere through the stack at the top of the unit. A pre-wired control panel shall be provided to ensure proper control and operation of the system.

203.400.7.4 The odor control system shall be designed for the following operating conditions:

<b>Model Number</b>	<b>MCS-054</b>
Quantity	1
Airflow Rate, cfm	900
Average Inlet H <sub>2</sub> S Conc., ppm	10
Peak Inlet H <sub>2</sub> S Conc., ppm	20

203.400.7.5 The odor control system shall demonstrate the following performance:

<b><u>INLET</u></b>	<b><u>OUTLET</u></b>
1-10 ppm H <sub>2</sub> S	0.1 ppm H <sub>2</sub> S
> 10 ppm H <sub>2</sub> S	1% of inlet

203.400.8 Reference Standards

- PS 15-69: National Bureau of Standards Voluntary Product Standard "Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment."
- ASTM D-883: "Definition of Terms relating to Plastics."

- ASTM D-2583: "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor."
- ASTM D-2563: "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts."
- ASTM D-4097-82: "Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks."

203.400.9 Quality Assurance

203.400.9.1 Manufacturers Requirements:

203.400.9.1.1 All equipment provided under this section shall be obtained from a single manufacturer, who shall:

- A. Assume full responsibility for the completeness and proper operation of the activated carbon odor control system.
- B. Have experience; be reputable and qualified in designing and manufacturing activated carbon odor control system equipment.
- C. Supply units containing all necessary appurtenances and components for a complete and operating system conforming to this specification. The entire system shall be skid-mounted, piped, wired, and factory tested prior to shipment to facilitate installation and start-up at the jobsite. The overall system footprint shall not exceed the dimensions shown on the drawings.

203.400.9.1.2 To ensure quality and complete unit responsibility, the complete system must be assembled and tested by the manufacturer at its facility. The manufacturer must have a physical plant, technical and design staff, and fabricating personnel to complete the work specified.

203.400.9.1.3 SPECIFIED MANUFACTURERS - Activated carbon odor control systems shall be as manufactured and supplied by Integrity Municipal Systems, LLC (IMS), Poway, CA, (858) 486-1620., or approved equal.

203.400.9.1.4 WARRANTY - The manufacturer shall warrantee that the equipment provided shall be free of defects in material and workmanship for a period of 12 months from beneficial occupancy.

203.400.10 PRODUCT SUBMITTALS

203.400.10.1 The following product data shall be submitted by the activated carbon odor control system manufacturer for review and approval by the engineer prior to the fabrication of the system:

203.400.10.1.1 Shop drawings and catalog literature showing dimensional information, details of piping and fabrication and erection of all materials and equipment furnished under this section

203.400.10.1.2 Drawing of general arrangement and major system components

203.400.10.1.3 Process and Instrumentation drawing

203.400.10.1.4 Calculations showing theoretical anticipated life of carbon media based on anticipated hydrogen sulfide inlet concentration.

203.400.10.1.5 Major system component information and descriptive literature for the following:

- A. Exhaust fan
- B. Carbon media SDS and specification sheet
- C. Vessel fabrication
- D. System controls and control panel details including power and control wiring diagrams, terminals, and numbers
- E. Miscellaneous instrumentation and accessories

203.400.10.1.6 Installation instructions

203.400.10.1.7 Operating weight of all equipment

203.400.11 Products

203.400.11.1 ACTIVATED CARBON ODOR CONTROL SYSTEM

203.400.11.1.1 The odor control gas treatment system shall be a once-through activated carbon odor removal system treating the odorous air from the contaminated process areas. The system shall be designed for continuous and automatic operation as well as manual operation as required.

203.400.11.1.2 FRP vessel, activated carbon media, exhaust fan, exhaust stack, control panel and all other required appurtenances shall be pre-assembled and mounted on a skid. The entire system shall be pre-assembled on a skid, piped, wired, and factory tested prior to shipment.

203.400.11.2 FRP VESSEL

203.400.11.2.1 The activated carbon vessel shall be designed for the following design criteria:

Description	
Vessel Diameter, ft	4.5
Vessel Straight Side Height, ft	5.0
Wall Thickness, in	0.25
Wind load, mph	As Required
Seismic Zone	As Required
Internal Positive Pressure, in WC	+ 10"
Maximum Operating Temperature, °F	150
Carbon Bed Depth, ft.	3.0

203.400.11.2.2 The activated carbon odor control system shall consist of a round fiberglass reinforced plastic (FRP) vessel.

203.400.11.2.3 The activated carbon odor control system shall be manufactured with the following material of construction according to following fabrication method:

- A. The vessel shall be fabricated from premium grade vinyl ester resin FRP
- B. Resin used in fabrication shall be a premium vinyl ester resin such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal. The resin shall be reinforced with an inner veil of suitable synthetic organic fiber such as Nexus 111-00010. Any material of construction other than FRP with premium grade resin shall not be acceptable.
- C. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistant borosilicate glass.
- D. Fabrication:
  - i. General: Fabrication shall be in accordance with NBS PS 15-69, ASTM D 3299 and ASTM D-4097. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat.
  - ii. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. The total corrosion liner thickness shall be a minimum of 100 mils.

- iii. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat of chopped glass and 24 oz per sq. yard woven roving applied to reach a designed thickness. The exterior shall be surface coated with white gel coat containing ultraviolet light inhibitors.

203.400.11.2.4 Fittings: The vessel shall be fitted with the following:

Description	Size (in)	Type	Qty.
Gas Inlet	10	Flanged	1
Gas Outlet	10	Flanged	1
Drain	1	NPT	1
Pressure Taps	1	NPT	2
Outlet Air Sample	1	NPT	1

203.400.11.2.5 Removable Top: The vessel shall be provided with a completely removable top.

203.400.11.2.6 Exhaust stack: The carbon adsorber system shall be provided with an exhaust stack manufactured of FRP. The exhaust stack shall be contact molded and manufactured in accordance with NBS PS15-69 and ASTM D-4097 for contact molding. The resin used in the fabrication of the exhaust stack shall be the same as that used for the main vessel such as such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal. The exhaust stack shall extend up to an elevation of 12 feet above the equipment pad elevation.

203.400.11.2.7 Media support and screen: The carbon adsorber vessel shall be provided with an FRP support grating system with polypropylene screen to accommodate three (3) feet (954 mm) of carbon media bed. The screen and the support system shall be removable through the top cover. The support system shall consist of removable grating. Pall rings or other dumped packing media as a means of carbon support will not be acceptable. The support system shall be designed to withstand a load of at least 150 lbs/ft<sup>2</sup> with a minimum deflection of 6 mm under all conditions.

203.400.11.2.8 Grounding Rod: A stainless steel rod shall be provided to adequately ground each carbon bed. Rods shall be grounded via a 10-gauge wire.

203.400.11.2.9 Differential Pressure Gauge: A Series 2000 differential pressure gauge as manufactured by Dwyer Instruments shall be provided to continuously monitor the pressure drop across the carbon bed. The differential pressure gauge shall be isolated with isolation valves and shall be mounted on the vessel.



203.400.11.2.10 Hardware and Gaskets: All hardware and anchor lugs shall be 316 stainless-steel. All bolts shall be designed for the specified loads. Gaskets shall be a minimum of 1/8" thick, full face, EPDM, suitable for the intended service.

203.400.11.2.11 Anchor Bolts: The carbon adsorber shall be provided with adequately sized epoxy HILTI anchor system.

#### 203.400.11.3 ACTIVATED CARBON MEDIA

203.400.11.3.1 TYPE: The activated carbon shall be virgin, pelletized, derived from high grade bituminous coal, vapor phase type, suitable for the control of sewage odors. It shall be high H<sub>2</sub>S capacity.

203.400.11.3.2 The activated carbon media shall meet the following specifications:

Iodine Number, mgI <sub>2</sub> /g	1050 min
MPD, mm	3.9-4.1
Apparent Density, g/cc	0.48
Hardness No.	95 min
Butane Activity	26 min
H <sub>2</sub> S Capacity, gH <sub>2</sub> S/cc	0.30 min

#### 203.400.11.4 EXHAUST FAN

203.400.11.4.1 General. Fan shall be centrifugal design manufactured of FRP with a radial blade wheel. The wheel shall be statically and dynamically balanced. The fan inlet and outlet shall have a flanged nozzle. The shaft shall be 304 stainless-steel with Teflon shaft seal.

203.400.11.4.2 Fan shall be supplied with a TEFC motor with 1.15 service factor suitable for three-phase, 60 Hz, 480V service. The fan shall be belt driven.

203.400.11.4.3 Fan housing shall be constructed of fiberglass and reinforced with rigid bracing to increase structural integrity. The fan shall include graphite impregnation for grounding.

A. A fan noise enclosure shall be provided to reduce noise and ensure that the fan is protected from the environment. The fan enclosure shall be provided with sound attenuation foam. Louvers on the top and side of the enclosure shall allow for ventilation. The fan enclosure shall be capable of reducing the fan noise level to 75 dBA at 10 ft.

B. The fan enclosure shall be contact molded and manufactured in

accordance with NBS PS15-69 and ASTM D-4097 for contact molding. The resin used in the fabrication of the fan enclosure shall be the same as that used for the vessel such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal.

203.400.11.4.4 Performance. The fan shall be tested and rated in accordance with AMCA and shall bear the AMCA seal.

203.400.11.4.5 The fan shall be New York Blower, Hartzell or approved equal.

203.400.11.4.6 The fan shall be designed for the following performance:

<b>Model Number</b>	<b>MCS-054</b>
Airflow Rate, cfm	900
S.P. up to System Inlet, in W.C	1.0
Total Pressure Drop, in W.C	5.5
Motor, HP	3.0

203.400.11.5 SYSTEM ELECTRICAL CONTROL PANEL

203.400.11.5.1 The electrical control panel shall house all required controls for the entire system. The electrical control panel is pre-mounted on the system and pre-wired at the factory.

203.400.11.5.2 The control panel enclosure shall be rated NEMA 4X and shall be made of FRP. The control panel shall be factory tested to full operation with all other components prior to shipment.

203.400.11.5.3 The control panel shall provide electrical control for the entire system with as a minimum the following switches, alarms and accessories:

- A. "Hand-Off" switch for exhaust fan
- B. "Exhaust Fan Running" indicator light
- C. Exhaust fan motor starter
- D. Power disconnect switch
- E. Control transformer (480V to 120V)
- F. The power supply shall be 480V, 3 ph, 60 Hz.

203.400.11.6 EQUIPMENT SKID - The entire system shall be factory assembled on an unpainted 304 stainless steel equipment skid to minimize field installation requirements.

- 203.400.11.7 PIPING - All equipment skid piping shall be SCH 80 PVC.
- 203.400.11.8 INTERCONNECTING DUCTWORK AND DAMPER - The carbon adsorber manufacturer shall provide the required FRP transition piece between the fan outlet and the adsorber vessel inlet. The vessel inlet shall include a volume control damper with lockable louver for flow adjustment.
- 203.400.12 Equipment shall be furnished complete with all accessories and appurtenances specified or otherwise required for proper operation. All parts shall be installed and adjusted by the contractor. The manufacturer shall furnish necessary drawings and detailed installation, operation and maintenance instructions for all components. It shall be the contractor's responsibility to handle, store, and install all parts, including parts and sheaves, as required in accordance with the manufacturer's detailed written recommendations.
- 203.400.13 Factory Assembly and Testing: Each system shall be pre-assembled at the manufacturing location.
- 203.400.13.1 System(s) shall be tested at the location of assembly to assure they are in full operational and working mechanical order.
- 203.400.13.2 Factory testing shall include visual inspection of all equipment, complete assembly and functional operating testing of components including piping and equipment check, and verification of control panel wiring and operation.
- 203.400.14 TAGGING: New equipment shall be tagged from the manufacturer with a permanent and visible tag showing the new equipment number using the City of Tulsa Equipment ID numbering system. Refer to Specification Section 204.3.6 for requirements. The equipment shall be labeled as follows: (item numbers in parentheses are old notation and should not be placed on tag)
- (Odor Control System) - S110-LFT1-OCF01
- 203.400.15 TESTING: The odor control system and all associated new equipment and/or appurtenances shall be installed in strict conformance with the manufacturer's recommendations, which are to be submitted with the shop drawings. After completion of the installation, the equipment shall be tested by the Contractor under actual operating conditions to achieve the flow specified. The test shall be conducted under the supervision of the manufacturer's technical representative and in the presence of the owner's representative. Three (3) copies of test results shall be submitted to the Engineer. The equipment manufacturer shall furnish

the services of a factory field representative to inspect the installation, testing and start up the equipment.

203.400.16 OPERATION AND MAINTENANCE: The manufacturer shall provide information to the Owner's representative regarding the operation and maintenance of the equipment.

203.400.17 PRODUCT DELIVERY AND STORAGE: All equipment and components shall be delivered in ample time so as not to delay the Work. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, and other supports. Protect steel members and packaged materials from corrosion and deterioration by keeping in covered storage and off of the ground.

END OF SECTION

203.600 All materials, labor, equipment, and supervision required for installing one (1) new submersible pump at the Spunky Creek Lift Station per these specifications

- 203.600.1 The work consists of installing one (1) submersible pump and associated piping, fittings, valves, bases, rails, supports, variable drive, electrical and control improvements at the Spunky Creek Lift Station. The project includes the correct and complete installation of new components specified herein in conformance with the manufacturer's instructions and recommendations for installation, subsequent testing of the new units and ensuring all components are in proper operation.
- 203.600.2 Pump to be replaced is identified as Raw Sewage Pump No. (L102-LFT1-RSP01) on Drawings 203.600.A and B.
- 203.600.3 The new check valves shall be manufactured by DeZurik APCO, series 100 Rubber Flapper Swing Check Valve, Val-Matic Model 500A Swing-Flex Check Valve, or an approved equivalent manufacturer and model meeting criteria including but not limited to the following details:
- The Rubber Flapper Swing Check Valve shall have a heavily constructed cast or ductile iron body and cover. The body shall be long pattern design (not wafer) with integrally cast-on end flanges. The flapper shall be Buna-N having an O-ring seating edge and be internally reinforced with steel.
  - Flapper to be captured between the body and the body cover in a manner to permit the flapper to flex from closed to fully open position. Flapper shall be easily removed without the need to remove the valve from line. Check Valves to have full pipe size flow area. Seating surface to be on a 45° angle requiring the flapper to travel only 35° from closed to fully open position for minimum head loss, and non-slam closure characteristics.
  - Valve shall be designed for 175 psi differential pressure for sewage applications.
  - Provide port and external backflow device to allow prime or backflush of a clogged pump.
  - Provide a Disk Position Indicator device complete with an un-installed limit switch for each valve supplied.
  - Valve shall be serviceable from the top of the valve and allow for disks to be replaced without removal of the entire valve body.

Provide one complete rebuild kit as spare parts for each size valve installed.

- Materials of Construction:

Body and Cover:

Cast iron                      ASTM A126 GR.B

Bronze                        ASTM 584

Stainless steel              ASTM A296 or 351

Ductile iron                ASTM A536 Gr.65-45-12

Flapper:                      Buna-N or other elastomers

Exterior paint:              Universal Metal Primer

203.600.4    Coordinate work with the installation of a new variable drive (L102-LFT1-VFD01). Refer to Drawings and Specifications for requirements. Existing disconnects shall be reused. Electrical work shall be in accordance with the General Electrical Section 204.4. See Drawings for additional electrical requirements

203.600.5    Contractor shall be knowledgeable about and shall field verify all elevations and dimensions of existing piping, conduit, valves and equipment that in any way, directly or indirectly, relates to the removal of existing equipment and/or installation of new equipment. Work shall be based on field measurements. The Authority will make information on file that pertains to the existing equipment available for review.

203.600.6    Project work shall include all materials, equipment, labor, and supervision, necessary to complete the project as specified herein including, but not limited to, any and all crane work, rigging, delivery and complete installation of components to fully operational and warrantable condition.

All work requiring flow stoppage or equipment removed from service must be scheduled 48 hours in advance with Plant Superintendent. Contractor shall have valves, temporary pumps and any other necessary materials and equipment at the installation site prior to flow stoppage. It is the contractor's responsibility to prepare the impacted system and any related systems for disassembly. This includes closing of upstream/downstream valves and pumping down any reservoirs as necessary.

203.600.7    Submersible pumps shall be of a centrifugal design intended for

unscreened wastewater service. The integral pump/motor units shall be designed to operate at a continuous full load duty completely submerged in liquid without the need for external cooling. Designs that incorporate cooling jackets are not considered equal to the equipment described in this specification and shall not be acceptable.

- 203.600.8 Furnish and install one (1) Submersible Pumping Unit complete with all accessories, controls and appurtenances as shown in the plans and specified herein or as required for a complete operating system. Each Pumping Unit shall be rated for handling unscreened sewage wastewater in accordance with the operating conditions defined in these specifications. The design shall be such that the pumping units will be automatically connected to the discharge piping when lowered into place on the discharge connection. The pump shall be easily removable for inspection or service without the need for removal of nuts, bolts or other fasteners and without the need for personnel to enter the wet-well. Each pump shall be fitted with a 316 stainless steel chain of adequate strength and length to permit raising the pump for inspection and removal.
- 203.600.9 Pumps shall be Model D5436MV as manufactured by Fairbanks Morse, or pre-approved equal.
- 203.600.10 Pumps shall be sized to meet the following design criteria. Operating points shown shall be within the pumps allowable operating range (AOR). Reduced speed curves showing AOR limitations shall be provided in pump submittals:

Service:	Raw, Unscreened Municipal Wastewater
Drive Type:	Variable Speed Drive
Rated Design Point  One pump in operation, Maximum Speed:  Flow, GPM:  Total Dynamic Head, Feet:  Minimum Efficiency, %:	   2420 122 65

Secondary Operating Condition  Two pumps in operation, Maximum speed. Each at:  Flow, GPM:  Total Dynamic Head, Feet:	   1950  154
Secondary Operating Condition  One pump in operation, reduced speed:  Flow, GPM:  Total Dynamic Head, Feet:	   1400  100
Minimum Shutoff Head, Feet	240
Minimum Discharge Size, In:	5
Maximum Pump RPM:	1780
Minimum Motor Horsepower:	135
Enclosure Type:	NEMA Type B, Submersible  Explosion proof

203.600.11 Submersible Cable: Supply a minimum of 50 feet of submersible cable (SUBCAB) suitable for each submersible pump application. Contractor to confirm length of cable required before ordering. Splices are not allowed. The power cable shall be sized according to NEC and ICEA standards and also meet with P-MSHA Approval.

203.600.12 Pump Design Configuration: The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor.



- 203.600.13 Pump Construction: Major pump components shall be of grey cast iron, ASTM A-48, Class 30, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All metal surfaces coming into contact with the pump, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
- 203.600.14 Cooling System: Each unit shall be provided with an integral motor cooling system. A stainless steel motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F (40°C). Operational restrictions at temperatures below 104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.
- 203.600.15 Cable Entry Seal: The cable entry seal design shall preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal.
- 203.600.16 Motor: The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of

multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The motor and the pump shall be produced by the same manufacturer. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out. The motor construction shall be of explosion proof, TENV-TEXP design and capable of being certified for use in Class 1, Groups C & D hazardous locations by either Factory Mutual (F.M.) or Underwriters Laboratories (U.L). Motors to be capable of running for 15 minutes in air (unsubmerged).

- 203.600.17 Bearings: The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

203.600.18 Mechanical Seal: Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary ceramic seal ring and one positively driven rotating carbon seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.

The following seal types shall not be considered acceptable nor equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry at 100% duty cycle without damage while pumping under load.

Seal lubricant shall be FDA Approved, nontoxic.

203.600.19 Pump Shaft: Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be stainless steel – ASTM A479 S43100-T.

If a shaft material of lower quality than stainless steel – ASTM A479 S43100-T is used, a shaft sleeve of stainless steel – ASTM A479 S43100-

T is used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided in the lubricant housing and above. Therefore, the use of stainless steel sleeves will not be considered equal to stainless steel shafts. Deflector Nut: The impeller shall be secured to the shaft using a deflector nut made from 410 Stainless Steel hardened to 400 BHN. The nut shall be designed to protrude in front of the cutter bars and deflect stringy materials and prevent binding.

- 203.600.20 Impeller: The impeller shall be of one-piece, single suction, enclosed two-vane, radial flow design with well-rounded leading vane edges and thick hydrofoil shape with large openings to prevent the accumulation of solids and stringy material through the impeller. The impeller shall be made of close-grained cast iron conforming to ASTM A48 Class 30. It is to be balanced and secured to a to a straight fit on the shaft by means of a key and fastener. Wiper vanes are not allowed. The impeller waterways and clearance between the impeller periphery and volute cutwater shall be capable of passing a minimum 3" sphere and is to be matched to a constant velocity equalizing pressure volute. Impeller shall be trimmed to specifically meet the conditions of operation. The impeller shall be adjustable by use of shims to restore the wear ring clearance in the field.
- 203.600.21 Volute: The volute shall be one-piece cast with side centerline flanged discharge. The volute shall be made of close-grained cast iron conforming to ASTM A48 Class 30. It is to be one-piece, constant velocity equalizing pressure with smooth fluid passages large enough to pass any size solid that can pass through the impeller. Diffusion vanes are not permitted. The sliding bracket assembly shall be a part of the pumping unit constructed so that when lowered to the discharge base/elbow, the knifing action of the vertical metal-to-metal seal provides a self-cleaning, non-clogging, UL Listed, non-sparking assembly. Volute shall be fitted with an axial stainless steel wear ring with a minimum 410-484 Brinell hardness.
- 203.600.22 Protection: Two moisture detection probes shall be installed so that they will detect moisture in either the seal or stator cavity measuring resistivity between the probes. They shall be wired internally to the control cable connection at the top of the motor. Float type devices located in the rotor/stator area or single probe-to-ground moisture detectors measuring continuity are not acceptable. O-ring sealed inspection plugs shall be

provided in the mechanical seal oil chamber for ease in inspection, draining, and filling of oil.

- 203.600.23 Guide Bracket & Rail System: The pump shall be provided with a guide system to allow easy removal without entering the wet well. The main base fixture shall be bolted to the floor and shall include a 90 degree Cast Iron elbow and mounts for two 316 stainless steel rails of standard schedule 40 pipe. The base fixture shall be designed to receive the connecting pump slide bracket without the need for bolts, nuts, or clamps. The pump discharge will connect to a Cast Iron slide bracket that seals against the base fixture by the weight of the pump.
- 203.600.24 Lifting Bail: Contractor shall provide and install a custom 316SS lifting bail. Top of bail height shall be at least 7'-6" above wet well floor.
- 203.600.25 Pumping units shall be furnished complete with all accessories and appurtenances specified or otherwise required for proper operation. All parts shall be installed and adjusted by the contractor. The manufacturer shall furnish necessary drawings and detailed installation, operation and maintenance instructions for all components. It shall be the contractor's responsibility to handle, store, and install all parts, including parts and sheaves, as required in accordance with the manufacturer's detailed written recommendations.
- 203.600.26 All pumps, material and equipment to be salvaged shall be removed carefully to prevent damage, and then delivered to an area designated by the Plant Superintendent on site. The contractor shall dispose of all parts of the existing pump deemed unnecessary to the plant. The Plant Superintendent shall specify which parts of the existing pump are to be salvaged.
- 203.600.27 All piping, pipe supports and hangers, valves and fittings shall be installed to tie into the existing piping system. When attaching piping to pump, special care shall be taken to align pipe so that stresses are not transmitted to or imposed upon such connections. All pipe supports and attachment hardware, existing or new, shall be 316 SS and shall be secured to surrounding structure by mechanical means.
- 203.600.28 PAINTING: All pump discharge piping within wet well shall be painted. Coordinate with Plant Superintendent for color selection. Refer Section 204.5 for additional requirements.

203.600.29 TAGGING: New equipment shall be tagged from the manufacturer with a permanent and visible tag showing the new equipment number using the City of Tulsa Equipment ID numbering system. Refer to Specification Section 204.3.6 for requirements. The equipment shall be labeled as follows: (item numbers in parentheses are old notation and should not be placed on tag)

(RAW SEWAGE PUMP No. 1) - L102-LFT1-RSP01

203.600.30 INTEGRATION: Provide controls improvements and software integration services at the Spunky Creek Lift Station to accomplish the following work:

- A. Incorporate the new Raw Sewage Pump #1 into the lift station control system including run/off/auto status, VFD operation with speed control and feedback, and alarms. Show information graphically on existing HMI screens similar to other existing pumps.
- B. Match existing features, controls and alarms present on existing Raw Sewage Pumps #2 and #3.
- C. Contractor shall provide PLC expansion card(s) to expand the existing CTI 2500-C200 PLC if required to incorporate new I/O.

203.600.31 TESTING: The pumps, VFDs, valves, electrical disconnect, conduit and all associated new equipment and/or appurtenances shall be installed in strict conformance with the manufacturer's recommendations, which are to be submitted with the shop drawings. After completion of the installation, the equipment shall be tested by the Contractor under actual operating conditions to achieve the flow specified. The test shall be conducted under the supervision of the manufacturer's technical representative and in the presence of the owner's representative. Three (3) copies of test results shall be submitted to the Engineer. The equipment manufacturer shall furnish the services of a factory field representative to inspect the installation, testing and start up the equipment.

203.600.32 OPERATION AND MAINTENANCE: The manufacturer shall provide information to the Owner's representative regarding the operation and maintenance of the equipment.

203.600.33 SPARE PARTS: Provide one spare pump seal for each pump supplied transmitted to the City on or before training.

203.600.34 PRODUCT DELIVERY AND STORAGE: All equipment and components shall be delivered in ample time so as not to delay the Work. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, and other supports. Protect steel members and packaged materials from corrosion and deterioration by keeping in covered storage and off of the ground.

END OF SECTION

203.601 All materials, labor, equipment, and supervision required for one (1) new Variable Frequency Drive at the Spunky Creek Pump Station per these specifications:

- 203.601.1 The project includes the correct and complete installation of new components specified herein in conformance with the manufacturer's instructions and recommendations for installation, subsequent testing of the new unit and ensuring all components are in proper operation. The project also includes furnishing and installing new surge protective devices on new VFD. Work shall be coordinated with the replacement of Raw Sewage Pump RSP01. Refer to Specification 203.600 for requirements.
- 203.601.2 Contractor shall receive, store and protect equipment in its original shipping containers marked with appropriate Equipment ID numbers. Contractor to protect equipment from weather and construction debris.
- 203.601.3 Systems to be installed are identified on Drawing 203.601A and 203.601B with Equipment ID numbers L102-LFT1-VFD01. New VFD shall be a new NEMA 1G 6 pulse VFD meeting the following requirements:

Performance Data					
Equipment ID Tag No.	Amps	RPM	Power Supply Volts/Phase	HP	Remarks
L102-LFT1-VFD01	180	1750	480/3	135	Size VFD at 115% motor nameplate Full Load Amps

- 203.601.4 Provide labor, equipment, supervision and materials for the installation, testing and start-up of 6-pulse Variable Frequency Drive controllers (VFD). Provide a factory trained technician to start-up each VFD. The technician shall be present during the field acceptance testing. Start-up service shall include overtime charges, travel and living expenses and replacement parts.
- 203.601.5 Furnish and install a 5% heavy duty drive input line reactor (model KLR as manufactured by TCI, or equal). Match VFD carrier frequency to reactor manufacturer recommendations (i.e., 2 to 4 kHz).
- 203.601.6 Provide 8 hours of on-site instructions on VFD operation for the Owner's personnel.
- 203.601.7 The VFD manufacturer shall verify that the motor to be used is suitable for use with the VFD. Size VFD at 115% of motor FLA.
- 203.601.8 Variable frequency drives shall utilize a field proven design. The VFD



manufacturer shall demonstrate at least 3 years of continuous field operating experience with equipment of similar size and design.

- 203.601.9 A factory authorized service and parts organization shall be located within 100 miles of the project location. Provide the name and address of the factory authorized service and parts organization nearest to the project location at the time of the bid.
- 203.601.10 Equipment shall be UL labeled.
- 203.601.11 Package the equipment for maximum protection during delivery and storage.
- 203.601.12 Store the equipment indoors in a clean, dry, heated storage facility until ready for installation. Do not install the equipment in its final location until the facilities are permanently weather tight. Furnish, install and wire temporary electric space heaters in the equipment until the permanent heating equipment is operational. Protect the equipment at all times from exposure to moisture, chemicals, hydrogen sulfide and chlorine gas.
- 203.601.13 Input power: Voltage as shown plus 10 percent, minus 5 percent, 3 Phase, 60 Hz.
- 203.601.14 Input frequency: 57 to 63 Hz.
- 203.601.15 Ambient temperature: 0 to 40 degrees C.
- 203.601.16 Elevation: Up to 3300-ft above mean sea level.
- 203.601.17 Relative humidity: Up to 90 percent non-condensing.
- 203.601.18 Minimum drive efficiency: 97 percent or better at 4/4 motor base speed and rated torque.
- 203.601.19 Displacement power factor: 95 percent or higher throughout the entire speed range, measured at drive input terminals.
- 203.601.20 Drive output: 100 percent rated current continuous, suitable for operation of the driven equipment over the required speed range without overloading. Drives shall be capable of a continuous overload up to 110 percent rated current for variable torque loads and 150 percent rated current for constant torque loads. Starting torque shall be matched to the load.
- 203.601.21 Voltage regulation: plus, or minus 1 percent of rated value, no load to full load.

- 203.601.22 Output frequency drift: No more than plus or minus 0.5 percent from setpoint.
- 203.601.23 Drives shall withstand five cycle transient voltage dips of up to 15 percent of rated voltage without an undervoltage trip or fault shutdown, while operating a variable torque load.
- 203.601.24 The VFDs shall utilize a digital pulse width modulated (PWM) design to convert the fixed AC input to a variable voltage, variable frequency AC output. Construction shall be modular, using plug-in type component mounting or keyed ribbon cable connections wherever possible to minimize downtime during repair.
- 203.601.25 The VFD operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10 percent total harmonic voltage distortion and commutation notches up to 36,500 volt microseconds, or when other VFD's are operating from the same bus. The drive shall include transient voltage suppression to allow reliable operation on a typical commercial power distribution system.
- 203.601.26 The VFD shall consist of a full-wave diode bridge converter to convert incoming fixed voltage/frequency to a fixed DC voltage. Provide a DC link choke smoothing reactor to limit fault throughput. The PWM strategy shall be of the space-vector type implemented through a microprocessor which generated a sine coded output voltage.
- 203.601.27 The output shall be generated by power transistors which shall be controlled by six identical, optically isolated base driver circuits. The VFD shall have an output voltage regulator to maintain correct output Volt/Hz despite incoming voltage variations. The VFD shall have a continuous output current rating equal to or greater than the motor full load nameplate current.
- 203.601.28 Each VFD shall have a molded case, circuit breaker type main power disconnect switch, with an external operating handle. The circuit breaker shall have a short circuit rating of 65,000 Amps, RMS symmetrical and shall be labeled in accordance with UL 489.
- 203.601.29 Provide the following safety features:
- 203.601.30 Provision to padlock main disconnect handle in the OFF position.
- 203.601.31 Mechanical interlock to prevent opening cabinet door with disconnect in the

ON position, or moving disconnect to the ON position while the unit door is open.

203.601.32 Barriers and warning signs on terminals that are energized with the power disconnect OFF.

203.601.33 Provide an equipment ground bus or lug connectors in each enclosure, suitable for connection to the copper grounding conductors shown on the Drawings.

203.601.34 Operator Interface: Provide a door-mounted digital keypad/display, capable of controlling the drive and setting drive parameters. The digital display shall normally display:

- a. Speed demand in percent
- b. Output current in amperes
- c. Frequency in Hz

203.601.35 The digital keypad shall allow operators to enter exact numerical settings in English engineering units. A user menu shall be provided as a guide to parameter settings. Coded messages on keypad will not be acceptable. Parameters are to be factory set in EEPROM and resettable in the field. Parameters shall be password protected. The EEPROM stored variables shall be transferable to new and spare boards.

203.601.36 The keypad/display module shall have a key switch to control operation of the keypad. The key shall be removable in either the "Enabled" or "Disabled" positions. The keypad module shall contain a "self-test" software program that can be activated to verify proper keypad operation. The keypad display shall contain a full alphanumeric character set.

203.601.37 The following controls and indicators shall be provided, either separately or as part of the keypad/display:

- A. POWER ON, RUN AND FAULT indication.
- B. FAULT RESET control.
- C. MANUAL-AUTO control mode selector.
- D. Manual START/STOP controls.
- E. Manual speed adjust capability.
- F. Others as shown on the drawings.

203.601.38 Auxiliary Contacts

- A. Provide one set of Form C auxiliary dry contacts for remote indication of VFD running status.
- B. Provide set of Form C auxiliary dry contacts for remote indication of VFD fault.
- C. All equipment with motors shall have timers.
- D. Others as shown on the drawings.

203.601.39 Marking and Identification

- A. Provide 1-in by 3-in, nominal, engraved lamicoid equipment nameplates on each VFD fastened with stainless steel screws or rivets. Nameplates shall be black with white core, 3/8-inch high lettering.
- B. Provide permanent warning signs as follows.
- C. "Warning - Hazard of Electric Shock - Disconnect power before opening or working on this unit" on main power disconnect.

203.601.40 Make provisions for field adjustment of the following parameters through the keypad/display:

- A. Current limit and boost.
- B. Voltage (Volts/Hz)
- C. Frequency (Minimum/Maximum)
- D. Independently adjustable acceleration and deceleration rates.
- E. Auto restart delay.

203.601.41 Make provisions to accept a remote dry contact closure to start and stop the drive with the drive control system in the AUTO mode.

203.601.42 Make provisions to accept a remote dry contact closure for pump and motor vibration shutdown.

203.601.43 Provide TCP/IP communication card.

203.601.44 Make provisions to accept a 4-20 mADC input signal for remote speed control. Input shall be isolated at the drive and active with the drive control system in the AUTO mode. Zero and span adjustability shall be provided.

- 203.601.45 Provide a 4-20 mA DC isolated output signal proportional to speed for remote speed indication.
- 203.601.46 Provide the following short circuit and input protective features.
- A. High speed current limiting input fuses and line reactors.
  - B. Solid state instantaneous overcurrent trip.
  - C. Undervoltage protection with automatic restart.
  - D. Ground fault protection.
- 203.601.47 Provide the following internal protective features.
- A. Transient surge protection.
  - B. Transistor overcurrent protection.
  - C. Current limit, inverse time type.
  - D. DC bus fuse protection and discharge circuit.
  - E. DC bus overvoltage trip.
- 203.601.48 Provide the following output protective features.
- A. Inverse time motor overload protection.
- 203.601.49 The following conditions shall cause an orderly drive shutdown and lockout.
- A. Incorrect phase sequence.
  - B. Blown input fuse or single phasing of supply.
  - C. Control power supply failure.
  - D. Instantaneous overcurrent.
  - E. Sustained overload.
  - F. Transistor overcurrent.
- 203.601.50 Provide complete built-in diagnostic and test capability to enable maintenance personnel to rapidly and accurately identify the cause of equipment failure.
- 203.601.51 All non-current carrying metal parts of the equipment cabinet shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pre-treatment to inhibit rust.
- 203.601.52 Equipment shall be finish painted with one coat of manufacturers standard

electro-coated, heat cured enamel.

203.601.53 Unpainted non-current carrying parts shall receive a protective zinc plating to prevent corrosion. Printed circuit boards shall be coated with a protective conformal epoxy. All device contacts shall be silver cadmium plated.

203.601.54 Perform manufacturers' standard production testing and inspection.

**203.601.55 VFD shall be Square D Altivar 660, or Eaton equal.**

203.601.56 Install the equipment in accordance with the manufacturer's instructions.

203.601.57 Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.

203.601.58 Make the following minimum test and checks before the manufacturer's representative is called in for testing and adjustment.

- A. Verify that all connections are completed in accordance with shop drawings.
- B. Verify supply voltage and phase sequence are correct.
- C. Check mechanical interlocks for proper operation.
- D. Test ground connections for continuity and resistance.
- E. Check control circuit interlocking and continuity.

203.601.59 The manufacturer's service technician shall perform start-up and adjustment of the drive(s).

203.601.60 Make all VFD internal adjustments and all adjustments necessary for manual and automatic operation of the entire system of driven equipment.

203.601.61 Transient Voltage Surge Suppressors (TVSS) shall be provided as follows:

- A. TVSS unit shall be a hybrid device utilizing a linear array of balanced MOV (Metal Oxide Varistors) and a series assembly of silicon avalanche diodes.
- B. The TVSS unit shall be tested and labeled in accordance with the following standards: ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits, Category C; ANSI/IEEE C62.45, Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits; NEMA 4X (1992),

Low-Voltage Surge Protective Devices; UL 1449-Current Edition;  
UL 1283 for noise attenuation devices and NEC Article 285.

- C. Unit shall have:
- D. Parallel Line-Neutral, Line-Ground and Neutral-Ground connection configuration.
- E. One Nanosecond or less response time.
- F. Extend noise filtration with a 10 kHz to 100 MHz range.
- G. Fused internal disconnect switch with 60 Amps, 300,000 AIC rating.
- H. Surge current rating of 100,000 Amps per mode at service entrance
- I. Surge current rating of 80,000Amps per mode at distribution panels
- J. Surge current rating of 65,000Amps per mode at branch panels
- K. LED indications
- L. Six digit surge counter
- M. Form C output contacts
- N. System voltage shall be 120/240 grounded neutral, 120/208 grounded wye, 277/480 grounded wye, 240 delta, or 480 delta as indicated on the Drawings
- O. NEMA 4X enclosure (steel type)
- P. The Maximum Continuous Operating Voltage (MCOV) for all voltage configurations shall be 125 percent of nominal or greater.
- Q. The fusing system shall be capable of allowing the rated maximum surge current to pass through without fuse operation.
- R. TVSS devices at distribution panels or switchboards shall be mounted integral to the equipment with leads as short as possible (not to exceed 24-in) and the lead size shall be a minimum of 6 AWG or larger. The TVSS shall include an integral disconnect switch which has been tested to the surge current rating of the TVSS and shall match or exceed the fault current rating of the board. The disconnect switch shall switch the phases and neutral.
- S. TVSS devices at branch panels shall be direct bus-to-bus connected with leads as short as possible (not to exceed 24-in) and

lead size shall be a minimum of 6 AWG or larger.

T. TVSS shall be Model PDX3 as manufactured by United Power Corporation; Transtector Systems; Current Technology or equal.]

203.601.62 Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

203.601.63 Contractor shall be knowledgeable about and shall field verify all equipment that in any way, directly or indirectly, relates to the removal of existing equipment and/or installation of new equipment. Work shall be based on field measurements. The Authority will make information on file that pertains to the existing equipment available for review.

203.601.64 Project work shall include all materials, equipment, labor, and supervision, necessary to complete the project as specified herein including, but not limited to, any and all work, rigging, delivery, complete installation of components and testing to fully operational and warrantable condition.

203.601.65 The Contractor shall treat each system in whole and shall provide a fully functional, tested and accepted system to the satisfaction of the Owner/Engineer. Contractor shall make all final connections in accordance with manufacturer's recommendations and approved shop drawings. Contractor shall replace all interconnecting control wiring associated with system. Control wiring shall be enclosed in conduit. Any and all mounting brackets and accessories shall be replaced to match new units.

203.601.66 Equipment shall be furnished complete with all accessories and appurtenances specified or otherwise required for proper operation. All parts shall be installed and adjusted by the Contractor. The manufacturer shall furnish necessary drawings and detailed installation, operation and maintenance instructions for all components. It shall be the Contractor's responsibility to handle, store, and install all parts, including parts and sheaves, as required in accordance with the manufacturer's detailed written recommendations.

203.601.67 No cutting, drilling or welding of the new equipment or part thereof as delivered from the manufacturer, for the purpose of adapting or modifying said unit to facilitate its installation, will be permitted without written prior



approval by the authority. If the equipment assembly is of differing dimensions than the existing unit, the Contractor shall relocate all services as required.

203.601.68 TAGGING: New equipment shall be tagged with a permanent and visible tag showing the new equipment number using the City of Tulsa Equipment ID equipment numbering system. Nameplate shall indicate manufacturer's name, model number and serial number of the equipment along with electrical data.

203.601.69 TESTING: The equipment shall be installed in strict conformance with the manufacturer's recommendations, which are to be submitted with the shop drawings. After completion of the installation, the equipment shall be tested by the Contractor/Installer under actual operating conditions. Contractor shall supply complete O&M manuals in 3 ring binders and on CD.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes the following types of LED luminaires:

1. Cylinder.
2. Downlight.
3. Lowbay.
4. Recessed linear.
5. Strip light.
6. Surface mount, linear.
7. Surface mount, nonlinear.
8. Suspended, linear.
9. Suspended, nonlinear.
10. Materials.
11. Finishes.
12. Luminaire support.
13. Exit and Emergency Lighting

### 1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, arranged by designation.
- B. Product Schedule: Refer to light fixture schedule on the plans.

### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

## 1.5 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Product Schedule: Refer to light fixture schedule on the plans.
- B. Metal Parts:
  - 1. Free of burrs and sharp corners and edges.
  - 2. Sheet metal components shall be steel unless otherwise indicated.
  - 3. Form and support to prevent warping and sagging
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- D. Diffusers, and Globes:
  - 1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

### 2.2 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

### 2.3 LUMINAIRE SUPPORT

- A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- B. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- C. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

- D. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports: Sized and rated for luminaire weight.
- E. Exit Signs: Exit signs shall be roughed-in to be centered over or above door they are indicating as exit, or in hallways they are installed in. Exit signs in hallways shall be aligned with other lights in the area. Exit signs observed to be installed and not centered with doors or hallways shall be relocated at no additional cost.
- F. Flush-Mounted Luminaire Support: Secured to outlet box.
- G. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls.
  - 2. Do not attach luminaires directly to gypsum board.
- H. Ceiling-Mounted Luminaire Support:
  - 1. Ceiling mount per manufacturer's recommendations.
- I. Suspended Luminaire Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing, rod, or wire support for suspension for each unit length of luminaire chassis, including one at each end.
  - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- J. Ceiling-Grid-Mounted Luminaires:
  - 1. Secure to any required outlet box.
  - 2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

- K. Where 0-10V dimming is indicated in controls requirements, contractor shall furnish and install 0-10V dimming cabling to each fixture to accomplish dimming control.
- L. Where a light fixture is indicated via plan or fixture schedule to be an emergency fixture, contractor shall route unswitched power to light fixture in addition to normal circuit such that fixture will sense an outage and automatically illuminate in an emergency situation.
- M. All site lighting pole lights shall be installed to maintain 36" clear from back of curb to edge of concrete pole-base. Field verify final locations with final civil plan and edge of parking lots.

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

203.998 Mobilization Bid Item – A mobilization bid item is included to help cover initial costs of bonds, insurance, permits, submittal preparation and other incidental costs.

203.998.1 Payment shall be made for a Mobilization Bid Item which is intended to cover the costs of bonds, insurance, permits, submittal preparation and other incidental costs. Payment of the Mobilization Bid Item may be requested in full on the first payment application. The Mobilization Bid Item shall not exceed five percent (5%) of the **sum of all Base Bid Items excluding the Mobilization Bid Item**. Add Alternate Items are not part of the Base Bid Items.

END OF SECTION

203.999 Mechanical, Electrical, Plumbing, and Unforeseen Circumstances Allowance – \$100,000.00 Lump Sum Allowance for various mechanical, electrical, plumbing, or unforeseen circumstances work not shown on the Construction Drawings or specified in the Contract Documents.

- 203.999.1 The allowance shall be used for cost of materials, labor, installation, and overhead and profit for additional MEP/Unforeseen Circumstances work that is not shown on the Construction Drawings or specified in the Contract Documents.
- 203.999.2 The allowance shall be used only at the discretion of the City of Tulsa. Any allowance balance remaining at the completion of the contract will be credited back to the City of Tulsa on the final Application for Payment submitted by the contractor.
- 203.999.3 The contractor shall provide to the City of Tulsa representative a written request for the use of any of the allowance with a schedule of values and all associated backup information.
- 203.999.4 The contractor shall proceed with work included in the allowance only after receiving a written order from the City of Tulsa representative authorizing such work. Proceeding with work expected to be covered in the allowance without a written order from the City of Tulsa representative will be at the contractor's risk. Contractor may not be paid for unapproved work/materials at the discretion of the City of Tulsa representative.
- 203.999.5 Any additional costs for bonds and insurance shall not be included in any MEP allowance because this cost is already included in the contract.

END OF SECTION

204 ANCILLARY EQUIPMENT & WORK

The cost of items in this Section and other Sections of these specifications shall be equitably included in the appropriate Bid items.

204.1 Prior to disposal of any material or equipment that is City of Tulsa property and removed as part of the contract work, Contractor shall contact the appropriate **WWTP Plant Superintendent** and explicitly offer to the Authority first right to claim and retain such materials or equipment as City of Tulsa property. Contractor shall be responsible for the disposal of all such equipment and materials not claimed by the Authority. Items identified for salvage shall be removed carefully, protected, palletized and delivered to the Northside or Southside Maintenance Department. A copy of the Contractor's transmittal shall be provided to the Engineer after delivery.

204.2 Contractor shall field verify all elevations and dimensions of existing piping, valves, and equipment to be demolished. Contractor work shall be based on field measurements and shall include field adjustments and additions for the proper installation of equipment. The contractor shall take note of all objects in the vicinity of equipment being installed to ensure that there are no issues with interference. It is the responsibility of the contractor to make modifications necessary to adjacent objects such as pipe supports and similar to install the new equipment unless such objects are not reasonably visible during the site visit. It is the responsibility of the contractor to review all field conditions and take necessary field measurements prior to ordering equipment. The City of Tulsa will make available the information it has pertaining to the existing equipment.

204.3 General Equipment Requirements:

204.3.1 Approved Equal Equipment: The manufacturers and models specified in the equipment specifications are considered pre-approved. The winning contractor may, at their discretion, submit for approval equipment that has not been approved prior to the bid opening. When doing this, the contractor should be aware that the submitted equipment must not only meet the performance requirements stated in the equipment specifications, but it also must meet or exceed the manufacturing, material, and quality specifications of the pre-approved equipment even though those specifications are not expressly listed in the section. The Engineer will review any non pre-approved equipment through the submittal process and compare it with the pre-approved equipment to determine that the equipment is or is not equal. Contractor should be



prepared to supply technical data, material information, standards conformance information, and other related information as requested by the Engineer. If the requested information is not supplied, the equipment will be deemed to be not equal. Approval of non pre-approved equipment will be at the sole discretion of the Engineer.

204.3.2 Equipment Demolition: All equipment shall be demolished in accordance with each bid item section. No existing equipment is to be abandoned in place unless specifically noted otherwise. All equipment being removed during demolition shall either be set aside for determination of surplus value or disposed of by the contractor per each bid item specification. If after removing the old equipment and installing the new equipment there are unused items still in place, it shall be the responsibility of the contractor to remove these items in a manner that will not affect adjacent equipment or systems. All removed electrical and fluid components shall be properly capped off at the point of removal. Removal shall be performed in a manner that will allow re-installation/replacement of the removed items at a later date if necessary.

204.3.3 Gauges: Each pump shall be provided with a combination pressure/vacuum gauge in the suction piping and a pressure gauge in the discharge piping. Gauges shall conform to ANSI/ASME B40.1 and shall be indicating dial type, with C-type phosphor bronze Bourdon tube and stainless steel rotary geared movement, or direct drive type with stainless steel helical-wound capillary tube pressure sensing element. The gauge shall have a phenolic open front turret case, and adjustable pointer, a stainless steel or phenolic ring, and an acrylic or shatterproof glass window. The dial shall be 4 ½ inches in diameter, with white background and black markings. Pointer travel shall span not less than 200 degrees or more than 270 degrees. All gauges shall be Accuracy Grade A or better. Pressure gauges shall read in pounds per square inch. Compound gauges shall read in inches of mercury vacuum and pounds per square inch. The range of each gauge shall be per pump manufacturer's recommendation.

All gauges shall be installed with a diaphragm seal, brass flushing port and brass isolation valve of appropriate size.

204.3.4 Mechanical Seals and Seal Water:

- 204.3.4.1 All pumps shall be equipped with cartridge mounted double mechanical seals recommended by the pump manufacturer and compatible with Pump Seal Water Support Systems (PSWSS) installed at each pump. Refer to Construction Drawings and pump specifications for additional requirements.
- 204.3.4.2 The new seal water conditioning station (SWCS) and PSWSS may contain components that were not originally part of an existing seal water system. It is the responsibility of the contractor to supply and install all necessary electrical components including wiring, conduit, connectors, contactors, etc.... for a complete installation of the new seal water system. It may also be necessary to integrate the new seal water system components into the existing equipment control system. The contractor shall be responsible for all labor and materials required to integrate new components into the existing control system. All electrical work on the seal water station shall conform to the General Electrical Requirements herein. Contractor shall demolish and remove all existing seal water components not reused in construction.
- 204.3.4.3 Seal water piping and accessories shall not utilize rigid PVC piping. Seal water lines connected directly to the mechanical seals shall be PEX. All other piping in the seal water station shall be of a non-corrosive metal material such as stainless steel, or painted copper. Valves and other components shall be bronze unless otherwise required.
- 204.3.4.4 Some existing pumps do not have mechanical seals. Contractor shall determine from field investigations the location of seal water for those pumps. It is the responsibility of the contractor to supply and install all seal water piping, electrical work and materials, and control work and materials required to add a seal water station where one was not used for existing equipment. Locations are to be approved by the engineer.

204.3.4.5 If a new pump is installed that does not require seal water and there are existing seal water lines at the pump location, it is the responsibility of the contractor to remove existing water lines. Lines shall be removed as far up stream as possible to a point that will not interfere with water supply to other equipment. No existing lines shall be abandoned in place.

204.3.5 Valves:

204.3.5.1 All valve parts and surfaces shall be of corrosion resistant materials or have a factory applied epoxy coating sufficient to prevent corrosion in a wastewater environment. See painting/coating section for coating thickness requirements.

204.3.5.2 Plug Valves and Check Valves: Plug valves and check valves shall be of the same size, style and construction as the units being replaced. It is the responsibility of the contractor to review the existing valves and provide correct similar units. Acceptable manufacturers are Pratt, DeZurik, Clow, Val-Matic, or an approved equal.

204.3.5.3 Butterfly Valves: Butterfly valves shall be of the same size, style, and construction as the units being replaced. It is the responsibility of the contractor to review the existing valves and provide correct similar units. Acceptable manufactures are DeZurik, Clow, Val-Matic, or an approved equal.

204.3.5.4 Gate Valves: Gate valves shall be of the same size, style and construction as the units being replaced. It is the responsibility of the contractor to review the existing valves and provide correct similar units. Acceptable manufacturers are Wey, DeZurik, or approved equal.

204.3.5.5 Plug and butterfly valves supplied with hand wheel operators that are installed more than 6'-0" above floor level shall be supplied with chain wheels and chains to allow for valve operation from the floor.

204.3.5.6 Valves and operators shall be selected by the contractor such that when installed in close proximity to one another

the operators will be a sufficient distance apart to allow for uninhibited use by personnel.

204.3.5.7 All Valve placement and orientation shall be installed per Manufacture's recommendations. Systems operation and valve orientation layout (drawing) shall be included in the submittals for review with valve submittal(s).

204.3.6 Equipment Tagging: New equipment shall be tagged, according to the requirements listed below, with a permanent and visible tag showing the new equipment number using the City of Tulsa Equipment ID numbering system. All tags should be visible to anyone without the need to remove covers or otherwise "hunt" for the tag. See individual equipment sections for Equipment ID numbers for each item. Tags shall conform to the following specifications.

204.3.6.1 Requirements:

- Any equipment valued over \$1,000
- All Valves greater than 6"
- All relief and motorized valves that are smaller than 6"
- Any equipment that requires preventive maintenance
- Any equipment that is critical to the process of the plant
- Any equipment that is considered a Safety item
- Emergency Eyewash/Showers
- Fire Extinguishers
- All Ladders
- Hoists
- Detectors
- Overhead Doors
- Fire Alarms/Sprinklers
- Emergency Lights

204.3.6.2 Equipment ID tag numbering shall meet the following requirements:

## **PRODUCTS**

### **Equipment ID Number Plates**

All equipment tagged on the drawings, except for buried submerged equipment shall be provided with an Equipment ID Number Plate bearing the equipment tag number identified on the drawings. Equipment ID Number Plates shall be rectangular 3.5"x .75" and 1/16" thick laminated blue phenolic plastic engraving stock that is U/V stable. Lettering shall be 1 line of text, centered, and white capitalized block letters .25" high and engraved to a depth of 0.08mm.

Equipment ID Number Plates must follow the Equipment ID numbering scheme. Each equipment or systems should also include an additional tag noting the general name of the equipment or system adjacent to the equipment ID numbering tag (i.e., "Final Clarifier #3", VFD for Pump #2, etc.).

Equipment ID Number Plates shall be attached with permanent adhesive.

Additional Number Plates shall be provided for ancillary devices associated with each piece of new tagged equipment. Additional tags shall be provided for all electrical disconnects, variable frequency drives and Motor Control Centers whether new or existing.

### **VALVE, BUTTERFLY AND GATE EQUIPMENT ID NUMBER PLATES**

#### **Equipment ID Number Plates**

All valves and gates, except buried or submerged valves, that have been assigned an Equipment ID number on the Drawings or in the valve or gate schedule, shall be provided with a permanent number plate. Equipment ID Number Plates shall be round 1.5" and 1/16" thick laminated blue phenolic plastic engraving stock that is U/V stable. Lettering shall be in 3 sections, centered, and white capitalized block letters 3/16" high and engraved to a depth of 0.08mm.

Example: 1<sup>st</sup> line XXXX-

2<sup>nd</sup> line XXXX-

3<sup>rd</sup> line XXXXX

Equipment ID Number Plates must follow the Equipment ID numbering Scheme.

Equipment ID Number Plates shall be attached with permanent stainless cable ties or stainless fasteners.

See contract drawings for buried valves concrete collar details and tagging requirements.

204.3.7     Equipment Coatings: All equipment shall be supplied with a factory applied coating sufficient to withstand a wastewater environment. Factory applied coating shall be in accordance with the painting/coating section.

204.3.8     Equipment Installation: All anchor bolt connections shall include the use of a washer, lock washer, and nut (without nylon or similar insert).

204.3.8.1    Installation of all equipment and related items shall be performed as directed in the manufacturer's installation instructions.

204.3.8.2    No cutting, drilling or welding of new equipment or part thereof as delivered from the manufacturer for the purpose of adapting or modifying said unit to facilitate its installation will be permitted without written prior approval by the authority.

204.3.8.3    The Contractor shall be responsible for any and all concrete modifications that may be required to install the new equipment. This shall include modifications or replacement of equipment pads and supports. All modifications shall be designed and constructed to conform to the recommendations of *ACI 302.1R-04 Guide for Concrete Floor and Slab Construction* and *ACI 301-10 Standard Specifications for Structural Concrete*. All concrete modifications and repairs shall be coated per the painting/coating section herein.

204.3.9     Equipment Start Up and performance:

- 204.3.9.1 All new equipment installed by the contractor must be started up and be in operational service for 48 hours with no performance issues prior to demolishing and installing like, adjacent equipment in the same system. If the new equipment exhibits any performance issues, the contractor shall repair the equipment/installation as required and begin a new 48 hour observation period.

END OF SECTION

#### 204.4 General Electrical Requirements

- 204.4.1 Electric Code Compliance: All electrical work shall be performed in compliance with current electrical code.
- 204.4.2 Electrical Disconnects: All equipment installed or worked on with an electrical portion in the scope of work shall have a new local disconnect switch installed. All local disconnect switches shall be of stainless steel construction meeting NEMA 4X standards. In the event a Class 1, Division 1 rating is required for explosion proof service, the disconnect shall meet all required ratings for Class 1, Division 1 service. Control panels that incorporate an integral disconnect will not be required to have an external disconnect.
- 204.4.3 Electric Motors: All electric motors shall be premium efficiency, suitable for operating the intended equipment per the equipment manufacturer's recommendations.
- 204.4.4 Electrical Wiring, Conduit & Related Items: Contractor shall use caution to avoid damage to existing power cables. These cables shall be reused in new equipment installation provided their reuse meets current code requirements. Contractor shall be responsible for any damage to existing electrical equipment or power cables. The contractor shall be responsible for removing the existing control system and replacing it with the new control system. No unused remnants of the existing control system shall be abandoned in place. Unless noted specifically otherwise, minimum requirements are that all new conduiting shall be threaded rigid connections and sealed between spaces. All conduits shall be sealed with "duct seal" in control panels, motor heads, transitions between spaces in junction boxes and other end device locations for corrosion protection.
- 204.4.5 Identification: Conduits in manholes, hand-holes, building entrance pull boxes, junction boxes and equipment shall be provided with identification tags. Identification tags shall be 19 gage stainless steel with ½ inch stamped letters and numbers as indicated on the drawings. Identification tags shall be attached to conduits with nylon tie wraps and shall be positioned to be readily visible.
- 204.4.6 Rigid Steel Conduit shall be heavy wall, plated/hot-dip galvanized, shall conform to ANSI C80.1, and shall be manufactured in accordance with UL 6. Not applicable to this contract unless specifically noted otherwise.



- 204.4.7 Liquid tight Flexible Metal Conduit shall be hot-dip galvanized steel, shall be covered with a moisture proof polyvinyl chloride jacket, and shall be UL labeled.
- 204.4.8 Rigid Nonmetallic (PVC) Conduit - PVC conduit shall be heavy wall, Schedule 40, UL labeled for aboveground and underground uses, and shall conform to NEMA TC-2 and UL651. Not acceptable and not applicable to this contract.
- 204.4.9 Aluminum Rigid Conduit system:
  - 204.4.9.1 The conduit shall be rigid aluminum, threaded, T-1 temper as part of electrical of an all-aluminum conduit system with couplings, bends and fittings as required. Any fasteners and other hardware shall be 316 stainless steel as required and applicable. In the event a Class 1, Division 1 rating is required for explosion proof service, the conduit system shall meet all required ratings for Class 1, Division 1 service. Provide in all interior and exterior installation locations.
  - 204.4.9.2 The conduit system shall be UL 6A and ANSI C80 5 rated for application.
  - 204.4.9.3 Provide "seal-off" corrosion protection at all and panels, device outlets and equipment as recommended by conduit Manufacture.
  - 204.4.9.4 Acceptable manufactures are Wheatland Tube, Republic Conduit, and American Conduit by Sapa or equal.
  - 204.4.9.5 Unless a Manufacture requirements, code or other governing requirement specifically require something other than aluminum conduits, all conduits and accessories shall be aluminum
- 204.4.10 Conductors. All conductors in power, control and instrumentation circuits shall be identified and color coded as described herein.
  - 204.4.10.1 Conductor Identification Number. Except for lighting and receptacle circuits, each individual conductor in power, control and instrumentation circuits shall be provided with wire identification markers at the point of termination.
  - 204.4.10.2 The wire numbers shall be of the heat-shrinkable tube type, with custom typed identification numbers.
  - 204.4.10.3 The wire numbers shall be as indicated on the equipment manufacturer's drawings.

204.4.10.4 The wire markers shall be positioned to be readily visible for inspection.

204.4.11 Conductor Color Coding. Power conductors shall be color coded as indicated below. For conductors 6 AWG and smaller, the color coding shall be insulation finish color. For sizes larger than 6 AWG, the color coding may be by marking tape. The equipment grounding conductor shall be green or green with one or more yellow stripes if the conductor is insulated.

204.4.11.1 The following color coding system shall be used for Power conductors:

204.4.11.1.1 120/240V, single-phase – black, red and white

204.4.11.1.2 120/208V, three-phase – black, red, blue and white

204.4.11.1.3 120/240V, three-phase – black, orange, blue and white

204.4.11.1.4 277/480V, three-phase – brown, orange, yellow and gray

204.4.11.1.5 Where 120/240 and 120/208 volt system share the same conduit or enclosure, the neutral for either the 120/240 volt system or the 208 volt system shall be white with a permanent identifiable violet stripe.

204.4.11.2 Control and instrumentation circuit conductors shall be color coded as indicated below:

204.4.11.2.1 Multi-conductor Control Cable: 600 Volt Multi-conductor 14 AWG Control Cable

204.4.11.2.2 REFERENCE: UL 83, UL 1277, ICEA S-73-532, ICEA S-58-679.

204.4.11.2.3 CONDUCTOR: 14 AWG, 7 OR 19 strands, concentric-lay, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.

204.4.11.2.4 INSULATION: Polyvinyl chloride, not less than 15 mils average thickness; 13 mils minimum thickness, UL 83 Type THHN and THWN.

204.4.11.2.5 SHIELD: None.

- 204.4.11.2.6 JACKET: Conductor: Nylon, 4 mils minimum thickness, UL 83.
  - 204.4.11.2.7 Cable assembly: Black, flame-retardant polyvinyl, UL 1277, applied over tape-wrapped cable core.
  - 204.4.11.2.8 COLOR IDENTIFICATION: ICEA S-58-679, Method 1, Table 2 or ICEA S-58-679, Method 3, Table 2. White or green conductors shall not be provided. A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches. Marking shall include manufacturer's name, Type THWN or THHN, conductor size, number of conductors, and voltage class.
- 204.4.12 Signal Control Cable:
- 204.4.12.1 REFERENCE: UL 62, UL 1277.
  - 204.4.12.2 CONDUCTOR: 16 AWG, 7-strand, concentric-lay, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.
  - 204.4.12.3 INSULATION: Polyvinyl Chloride, not less than 15 mils average thickness: 13 mils minimum thickness, UL 62, Type TFN.
  - 204.4.12.4 LAY: Twisted pair with 1-1/2 inch to 2-1/2 inch lay.
  - 204.4.12.5 SHIELD: Cable assembly, combination aluminum-polyester tape and 7-strand, 20 AWG minimum size, tinned copper drain wire, shield applied to achieve 100 percent cover over insulation conductors.
  - 204.4.12.6 JACKET: Conductor. Nylon, 4 mils minimum thickness, UL 62.
  - 204.4.12.7 Cable assembly: Black, flame-retardant polyvinyl chloride, UL 1277, applied over tape-wrapped cable core.
  - 204.4.12.8 CONDUCTOR IDENTIFICATION: One conductor black, one conductor white.
- 204.4.13 Single Conductors: 600 Volt, Single Conductor Power Cable

- 204.4.13.1 REFERENCE: UL 83, ICEA S-95-658 (NEMA WC 70).
- 204.4.13.2 CONDUCTOR: Stranded, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.
- 204.4.13.3 INSULATION: Polyvinyl, UL 83, type THHN and THWN, ICEA S-95-658.
- 204.4.13.4 SHIELD: None
- 204.4.13.5 JACKET: Conductor. Nylon, 4 mils minimum thickness, UL 83.
- 204.4.14 Sump Pump Control Panels – Unless otherwise noted, Contractor shall provide each unit with the following system components to conform to the following specifications:
  - 204.4.14.1 Input Disconnect: Furnish an input circuit breaker with an interrupting rating of 65,000 rms symmetrical amperes.
  - 204.4.14.2 Control Devices: Include door mounted control and monitoring devices for each sump pump as follows:
    - A. "Manual-OFF-Auto" control selection
    - B. Power disconnect
    - C. Elapsed time meter; shall be non-resettable, rollover at 9999 hours showing resolution of 0.1 hours
    - D. Phase loss monitor
    - E. Indicator lamps for Power On, Run, Phase Loss and Overload.
  - 204.4.14.3 NEMA contactors size 1 or larger rated to handle the connected load.
  - 204.4.14.4 Refer to Drawings for control panel schematics for additional requirements.
  - 204.4.14.4 Coil Voltage: 120-volts, 60-hertz.
- 204.4.15 Variable Frequency Drives (VFD):

- 204.4.15.1 Enclosures: New VFD units shall be supplied with and installed in a new enclosure. All component enclosures shall be NEMA 12 compliant, and shall fit in the location of replaced equipment.
- 204.4.15.2 System Features: Contractor shall provide each unit with the following system components to conform to the following specifications:
- 204.4.15.3 Input Disconnect: Furnish an input circuit breaker with an interrupting rating of 65,000 rms symmetrical amperes
- 204.4.15.4 The VFD units must comply with all requirements of the existing pumps. The new VFD units shall be 18 pulse "clean power ", low harmonic in compliance with IEEE 519 guidelines for harmonic mitigation and have a continuous output current of approximately 30% more than the motor full load nameplate current.
- 204.4.15.5 New VFD units shall be installed with No cutting, drilling or welding of the new equipment or part thereof as delivered from the manufacturer, for the purpose of adapting or modifying said unit to facilitate its installation, will be permitted without written prior approval by the authority.
- 204.4.15.6 Control Devices: Include door mounted control and monitoring devices for each drive as follows:
- Start push button
  - Stop push button
  - "Local-OFF-Remote" control selection
  - Maintained Emergency shutdown button – Palm press and red in color
  - Speed selection – Door mounted potentiometer operating single turn 0% - 100%
  - Frequency meter with hertz and 0-100 scales
  - Output ammeter

Elapsed time meter shall be non-resettable, rollover at 9999 hours showing resolution of 0.1 hours

Diagnostic package with fault indication and reset push button

Indicator lamps for the ON, OFF, Auto, Vibration and FAULT unit status conditions

Vibration sensors shall be installed and operated such that when a vibration alarm is triggered, the VFD/Pump shuts down automatically

Vibration sensors shall have the operating capacity of sending a 4-20 mA signal to an analog PLC input and a dry set of contacts for the relay logic

204.4.15.7 PLC Control Features: Furnish a control system for each drive to allow the following Auto/PLC functions:

Remote, isolated 4-20 mA speed control input

Isolated 4-20 mA speed output

PLC Remote Run command

Alarm outputs

ON/OFF status output

Additional features and controls specified with the drive equipment

Local/Auto status output

204.4.15.8 New and replacement VFDs shall be installed such that all 4-20mA features are available. If a VFD being replaced is not currently configured to communicate with the SCADA system, the replacement unit shall communicate with the SCADA system in the same manner of a new VFD installation. On new VFD installations, all 4-20mA communication features shall be installed in the VFD for future connection to the SCADA system

- 204.4.15.9 General Purpose Contactors: Provide general purpose contactors in accordance with NEMA ICS 2 meeting the following:
- Coil Voltage: 120-volts, 60-hertz
- Poles: Provide three-pole contactors, unless otherwise indicated.
- 204.4.15.10 Electrical Wiring: Contractor shall be responsible for verifying or replacing all wiring from existing breakers and/or disconnects to the new equipment including replacing breakers as required. All wiring and electrical construction shall meet current electrical code.
- 204.4.15.11 Complete O&M Manuals and operating parameters shall be supplied on CD. Record drawing shall include PDF drawings showing final routing of power and controls. Reference 204.400.
- 204.4.15.12 Electrical Wiring & Related Items:
- 204.4.15.13 All wire to wire connections shall be made using insulated mechanical connectors. All shielded cable shall use heat shrink to cover cable outer cover and shield for termination. No wire nuts or butt splices are to be used unless previous authorization is given by the engineer. Insulated mechanical connectors shall be manufactured by Penn-Union, Galvan Industries, Polaris Electrical Connectors, or an approved equal manufacturer.
- 204.4.15.14 Power and control wiring will follow the NFPA 79 Chapter 13 standard.
- 204.4.15.15 Control wiring labeling shall follow NFPA 79 Chapter 13 standard. Control wiring identification tags shall be a thermal transfer print. A Brady TLS2200 or equivalent.

END OF SECTION

#### 204.5 Equipment Painting/Coating

204.5.1 Surface Preparation and Shop Prime Painting: All equipment and disturbed surfaces shall be cleaned and shop primed per equipment manufacturer's recommendation as part of the work. Equipment nameplates and similar information tags shall be masked off for removal after finish coat applications. All surface preparation for applying a specified coating system shall be done in accordance with the appropriate "Application Bulletin" from the manufacture for the specific product specified. Provide minimum SP-10 Near white blasting unless Manufacture requirements are more stringent. Equipment vendors/manufactures shall be consulted concerning the required final coating system to ensure that it will be compatible with the primer coat applied at the factory, in the event that the shop applied primer coat is not removed prior to the coating installation.

204.5.2 Final Coat: Unless otherwise specified, all new equipment shall be shop or field painted with a final coat, provided all shop painted finish surfaces shall receive matching field touch-up painting as final treatment, all with a finish coat per the equipment manufacturer's recommendation. All disturbed surfaces shall be field painted after equipment installation with a finish coat per the equipment manufacturer's recommendation.

204.5.2.1 Disturbed surfaces will be defined as including piping between suction and discharge valves on pump assembly replacements and pipe to either side of valves on individual valve replacements. All other disturbed surfaces will be defined as existing materials adjacent to new equipment.

#### 204.5.3 Coating Systems

204.5.3.1 The Coating System for painting structural steel, piping, valves, etc. not exposed to sunlight shall be Sherwin-Williams Coating System Identification A-1, Alkyd 2-coat system. This system has a primer "KemKromik, Univ. Primer" and a finish coat "Industrial Urethane, Alkyd Enamel" or an approved equal. Contractor shall submit supplier information for approval prior to painting.



204.5.3.2 The Coating System for painting structural steel, piping, valves, etc. non-immersed, mildly corrosive, wet environments and not exposed to sunlight shall be Sherwin-Williams Coating System Identification E-1, Polyamide Epoxy system. This system has a primer "Macropoxy 646" and a finish coat "Macropoxy 646" or an approved equal. Contractor shall submit supplier information for approval prior to painting.

204.5.3.3 The Coating System for painting metal surface for exterior weathering exposure in a corrosive environment shall be Sherwin-Williams Coating System Identification EU-2,Urethane Finish, Corrosive Areas 3-coat system or equal. This system has a primer "CorothaneGalvapac", second coat "Macropoxy 646" and a finish coat "Hi-solids Polyurethane" or an approved equal. Contractor shall submit supplier information for approval prior to painting.

204.5.3.4 Coating System for painting metal surface for full or partial immersion service shall be Sherwin-Williams Coating System Identification E-3, Amine Epoxy Glass Flake Reinforcement or equal. This is a two-coat system using Sher-Glass Epoxy FF. The first coat shall have a red oxide color with a minimum dry film thickness of 10-15 mils. The second coat shall have a haze gray color. Total dry film thickness shall be a minimum 20-25 mils. Application and total dry film thicknesses shall be installed per Manufacture's recommendations.

204.5.3.5 Paint color code shall adhere strictly to DEQ code requirements. Paint Color Schedule (All colors and codes are Sherwin Williams. A crossover for Tnemec and Carboline is available on request.):

- |                               |   |
|-------------------------------|---|
| a. Potable                    | WaterFlyway SW6794                                |
| b. Plant Effluent Water (PEW) | Pantone 522, DEQ                                  |
| c. Chilled Water              | French Roast SW6069 w/<br>Heartthrob SW6866 bands |
| d. Heating Water Supply       | Gray Screen SW7071 w/<br>White bands              |

e. Heating Water Return	Gray Screen SW7071 w/ Black bands
f. Compressed Air	Supreme Green W6442
g. Instrument Air	Supreme Green SW6442
h. Blower Air	Supreme Green SW6442
i. Natural Gas	Heartthrob SW6866
j. Sludge Return	Bagel SW6114
k. Sludge Waste	Sensational Sand SW6094
l. Digested Sludge	French Roast SW6069
m. Sludge Sample	Web Gray SW7075 w/ Heartthrob SW6866 bands
n. Drain/Sump	Web Gray SW7075
o. Raw Sewage	Software SW7074

204.5.3.6. If the equipment or piping being painted does not fall under any of these categories, the contractor shall make the best color match to the materials being replaced and adjacent like materials after submittal of color selection for acceptance.

204.5.3.7. PEW System specific requirements: All PEW System piping, valves, supports, operators, couplings and miscellaneous shall be color coded and marked as follows.

- a. Color Coding: Topcoat shall be Purple (Pantone 522) per the Oklahoma Department of Environmental Quality (DEQ) Title 252, Chapter 656, Section 252:656-27-4. In addition, piping shall have orange bands that are six (6) inches wide and spaced along the pipe at five (5) foot intervals.
- b. Lettering: The following language: "CAUTION: RECLAIMED WATER-DO NOT DRINK." shall be provided on the pipe near the equipment served, adjacent to valves, at each branch or tee, and at least every 50 feet in straight runs of pipe and be per Department of Environmental Quality (DEQ) Title 252, Chapter 656, Section 252:656-27-4. Lettering shall be painted or stenciled on piping or shall be applied as snap-on markers.

Snap-on markers shall be plastic sleeves, Brady "Bradysnap-On B-915" or Seton "Setmark" Lettering shall be white. Reference Table 1 for lettering size requirements.

c. Flow Arrows: PEW System piping shall not have flow arrows.

204.5.3.8 After painting, any labeling or tags covered by the paint shall be re-applied, updated or uncovered such that all labels are readable and clearly identifies the system. In the event of new piping or equipment replacing piping or equipment with labeling, the new equipment shall be labeled to match the existing. Marking and signage shall be applied once area painting is complete as part of the schedule of value item.

204.5.3.9 Equipment supplied from the manufacturer with an epoxy coating or manufactured from a corrosion resistant material (stainless steel, etc...) shall not be painted/coated after installation.

204.5.3.10 Factory applied epoxy coating systems shall be in the following thicknesses unless noted otherwise per Manufacture's recommendations:

- |                |                  |
|----------------|------------------|
| a. Primer Coat | *3.0 to 5.0 mils |
| b. Finish Coat | *4.0 to 6.0 mils |

\*Note – Per manufactures Recommendations.

## 204.6 Concrete Coating

204.6.1 Materials: Concrete coating shall be Sikagard 62, Raven 405, Sauereisen SewerGard No. 210, or an approved equal to protect concrete and concrete repairs from H<sub>2</sub>S and other corrosive elements found in wastewater process facilities. Epoxy coating to be applied according manufacturer's installation instructions and shall extend beyond repair areas by a minimum of 6". All concrete coating products shall be handled and stored in the manner set forth in the manufacturer's installation instructions.

204.6.2 Surface Preparation: Concrete surfaces to receive coating shall be inspected prior to surface preparation to determine the condition of the surfaces specified to receive the coating product(s) and the appropriate method or combination of methods to be used for surface preparation to meet the requirements of the coating system(s) to be applied per manufacturer's instructions. Minimum metal

surface preparation for the project in areas to receive paint or coatings shall be SP 10, near white blasted.

- 204.6.2.1 Oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate shall be removed per ASTM D-4258.
- 204.6.2.2 Efforts shall be made to minimize the change of holidays and coating thin areas by this contract. Concrete fins, protrusions, burrs, sharp edges and concrete spatter shall be corrected by grinding or scraping. Concrete bug holes and other small voids shall be filled with a non-shrink grout limited to each hole or void. A full grout rub of the wall is not allowed unless specifically approved by the Engineer.
- 204.6.2.3 Unless otherwise submitted and approved by the Engineer, surfaces to receive coating shall be abrasive blasted per ASTM D-4259 to remove laitance and weak concrete to expose subsurface voids, open honeycomb and air pockets. After blasting, surfaces shall be cleaned of all loose blast grit, dust and other debris by sweeping, vacuuming, air blasting and washing as necessary.
- 204.6.2.4 Surface preparation method(s) used shall be performed in a manner that provides a uniform, sound clean neutralized surface suitable for the specified coating product(s).
- 204.6.2.5 Infiltration shall be stopped by using a material which is compatible with the repair products and is suitable for top coating with the coating product(s). **Manufacture shall provide overcoat analysis testing report and top coat compatibility information to be included in the submittal process for areas of new work.** The Contactor shall bid the specified product(s) and, if a compatibility issue is found. The Manufacture will provide additional recommendations for the application and environment during the submittal process.

204.6.2.6 Where defective concrete is encountered requiring repair at the direction of the Engineer refer to Specification Section 204.7 Concrete Rehabilitation for requirements.

204.6.3 Application of coating products: Application procedures shall conform to the recommendations of the coating product(s) manufacturer, including environmental controls, product handling, mixing, application equipment and methods.

204.6.3.1 Prepared surfaces shall be primed by application of the waterborne epoxy primer described herein at an application rate of 200 square feet per gallon (8 mils wet film thickness). The primer shall be allowed to dry to a tack free state. The solvent-free epoxy topcoat described herein shall then be spray applied to a minimum wet film thickness of 80-100 mils.

204.6.3.2 No more than 12 hours shall be permitted to pass between each application of the waterborne epoxy, the solvent-free epoxy primer and the epoxy topcoat. Subsequent top coating or additional coats of the coating product(s) shall occur within the products recoat window as adjusted for temperature extremes. Additional surface preparation procedures will be required if this recoat window is exceeded.

204.6.3.3 Coating product(s) shall interface with adjoining construction materials throughout the structure to effectively seal and protect concrete substrates from infiltration and attack by corrosive elements. Procedures and materials necessary to affect this interface shall be as recommended by the coating product(s) manufacturer.

204.6.4 Submittals: The Contractor shall submit the following to the Engineer, in accordance with this Specification:

- Product data sheets and installation procedures for proposed concrete repair mortar(s).

- Detailed design notes, calculations and Shop Drawings for any temporary works, including formwork and falsework.

## 204.7 Concrete Rehabilitation

### 204.7.1 Description: The Work shall consist of:

- Removing the deteriorated concrete as shown and described on the Drawings and in this Specification, including saw cutting the perimeter of the repair area.
- Preparing the surface of the concrete for the repair, including abrasive cleaning, cleaning of existing reinforcement, and applying bonding agent to the surface.
- Supplying materials and the mixing and placing of concrete repair mortar or concrete as shown and described on the Drawings and in this Specification including vibrating, finishing and curing.
- Supplying, fabricating, constructing, maintaining and removing temporary works, including falsework and formwork.

### 204.7.2 Submittals: The Contractor shall submit the following to the Engineer, in accordance with this Specification:

- Product data sheets and installation procedures for proposed concrete repair mortar(s).
- Detailed design notes, calculations and Shop Drawings for any temporary works, including formwork and falsework.

### 204.7.3 Materials: The Contractor shall supply all materials necessary for the repair and restoration of deteriorated concrete areas as follows:

#### 204.7.3.1 Acceptable Manufacturers:

- a. Sika MonoTop 611, as manufactured by Sika Corporation, Lyndhurst, New Jersey, and Quadex QM-1s Restore, as manufactured by Quadex, North Little Rock Arkansas, are considered to conform to the requirements of this specification

and has performed satisfactorily for patching or overlaying for a minimum of three years.

b. Substitutions: The use of other than the specified product will be considered providing the contractor requests its use in writing to the Engineer. This request shall be accompanied by:

- A certificate of compliance from an approved independent testing laboratory that the proposed substitute product meets or exceeds the specified performance criteria, tested in accordance with the specified test standards; and
- Documented proof that the proposed substitute product has a three year proven record of performance of patching or overlaying, confirmed by actual field tests and five successful installations that the Engineer can investigate.

Certification from the manufacturer demonstrating compliance with the ISO 9000 quality standard in the development, manufacture, and sale of the product.

#### 204.7.3.2 Performance Criteria Typical Technical Data

a. Typical Properties of the mixed polymer-modified portland cement mortar:

- Working Time: approximately 30 minutes
- Finishing Time: 30-60 minutes
- Color: concrete gray

b. Typical Properties of the cured polymer-modified portland cement mortar:

- Compressive Strength (ASTM C-109)
  - 1 day: 3,000 psi
  - 7 day: 5,500 psi
  - 28 day: 6,500 psi
- Splitting Tensile Strength (ASTM C-496) at 28 days: 500 psi

- Flexural Strength (Modulus of Rupture) (ASTM C-78) at 28 days: 720 psi
- Bond Strength (ASTM C-882 Modified) at 28 days: 2200 psi
- Chloride ion permeability (AASHTO T-277): < 600 coulombs
- The silica fume, polymer-modified portland cement mortar shall not produce a vapor barrier.

#### 204.7.3.3 Materials

a. Silica-fume, Polymer-modified portland cement mortar:

- The mortar shall be a silica fume-enhanced, polymer-modified composition containing a blend of selected cements, plasticizing/water-reducing admixtures and shrinkage compensating agents.
- The material shall be non-combustible, either before or after cure.
- The silica fume, polymer-modified portland cement mortar shall be supplied in a factory proportioned unit.
- The silica fume, polymer-modified portland cement mortar must be placeable from 3 inches in depth and extendable in greater depths.

b. To prepare the silica fume, polymer-modified portland cement concrete (for pumping): the factory proportioned unit maybe extended with 34-36 lbs. of a minus 1/4 in. clean, well-graded, saturated surface dry aggregate, having low absorption and high density. Aggregate shall conform to ASTM C-33.

c. Materials for forming, as required for the designated work, shall be approved by the Engineer.

#### 204.7.4 Construction Methods

204.7.4.1 Surface Preparation Prior to any concrete repairs, the Contractor shall remove all dust, dirt, water and debris from the surface of the concrete in a manner that will not result in the material being



deposited into the channel or onto the underlying ground surface below. The Contractor shall supply and erect appropriate protection barriers/shrouding or other approved means as required on the bridge deck or piers so as to completely contain all loose or flying debris from the surface removal preparations. The means of containment shall be subject to the approval of the Engineer. No debris shall fall into the channel or onto any underlying roadway or ground surfaces.

204.7.4.2 Concrete Removal All areas of unsound concrete to be repaired will be marked by the Engineer once the Contractor has cleaned the existing surface as per Section 204.6.2 of this Specification. The Contractor shall saw cut the outer perimeter of the repair areas 1" deep or as directed by the Engineer. Feathered edges will not be acceptable. The Contractor shall take care to ensure that the existing reinforcing steel or prestressing strands (if applicable) are not damaged during saw cutting. Any damage caused by the Contractor to any portion of the structure not intended for repair shall be repaired by the Contractor, at the Contractor's expense, to the satisfaction of the Engineer. The Contractor shall remove all areas of unsound concrete by chipping or other approved methods. Only chipping hammers of the 20 lb class or less shall be used, and operated at an angle of 45 degrees or less from the horizontal. The Contractor shall exercise caution and take care not to damage any existing reinforcing steel intended to remain in place.

204.7.4.3 Types of Repairs Concrete repairs will be classified as follows:

- a. Type A Partial Depth Concrete Repair – A Type A repair is defined as removal of unsound concrete to a depth not greater than the top of the existing reinforcing steel. The Contractor shall remove all unsound concrete from the areas as determined by the Engineer until a sound concrete substrate is exposed.
- b. Type B Partial Depth Concrete Repair – A Type B repair shall be defined as removal of unsound concrete to a depth a

minimum of 1" beyond the existing outer mat of reinforcing steel.

For substructure, girder or mass concrete repairs the maximum depth shall be 2" beyond the existing outer mat of reinforcing steel or as directed by the Engineer. For slab repairs the maximum depth shall be mid depth of the slab.

- 204.7.4.4 The Contractor shall supply and place additional reinforcing steel as directed by the Engineer when the existing reinforcing steel has a section loss of 25% or greater. The reinforcing steel shall be of the same type and size as the existing, and spliced with a minimum lap length of 30 bar diameters. Exposed reinforcing steel shall be sandblasted clean and maintained to a near white condition. The Contractor shall roughen all areas of the existing sound concrete substrate to a ¼" amplitude using methods acceptable to the Engineer. All resulting material and by-products from demolition operations shall be collected, loaded, hauled, and disposed of by the Contractor at an approved waste disposal facility. Costs for reinforcing steel shall be considered incidental and included in other portions of the work.
- 204.7.4.5 Surface Preparation Immediately prior to placing the repair mortar or concrete, the Contractor shall thoroughly clean the existing concrete surfaces and formed repair areas, and apply a low resistivity bonding agent or cement slurry as recommended by the repair mortar manufacturer or as directed by the Engineer.
- 204.7.4.6 Repair Mortar Placement and Finishing The concrete repair mortar shall be handled, stored, mixed and applied in accordance with the manufacturer's instructions. Immediately prior to placing the repair mortar, the Contractor shall thoroughly clean the existing concrete surfaces and formed repair areas, and apply a low resistivity bonding agent or cement slurry as recommended by the repair mortar manufacturer or as directed by the Engineer. The Contractor shall place the repair mortar such that the existing profile and cross section are restored to their original dimensions. Any deviations of ¼" or greater from the repaired areas to the existing surface shall be repaired by the Contractor at his expense to the satisfaction of the Engineer. If the existing or repair concrete surface is damaged in

any way by construction operations, or if the concrete repair shows signs of distress or scaling prior to final acceptance, it shall be repaired or replaced by the Contractor at his own expense. The Contractor shall finish the repair surface in accordance with the concrete coating manufacturer's requirements.

204.7.4.7 Curing shall be in accordance with the manufacturer's instructions or as otherwise directed by the Engineer.

#### 204.7.5 Quality Management

204.7.5.1 General Concrete repair mortar that is not stored, handled, prepared, placed, or cured in accordance with the manufacturer's instructions will be rejected by the Engineer and his/her decision shall be considered final. The Engineer reserves the right to require immediate removal of any concrete from rejected batches that may have already been placed in the structure. Quality assurance testing will be carried out by the Engineer and all associated costs will be paid for by the Owner. There shall be no charge to the Owner for materials taken by the Engineer for testing purposes.

#### 204.7.6 Method of Measurement

204.7.6.1 Concrete Repairs Concrete repairs will be measured on a surface area basis. The area to be paid for will be the total number of square feet of concrete repaired in accordance with this specification as computed from measurements made by the Engineer.

#### 204.7.7 Basis of Payment

2.4.7.7.1 Type A Partial Depth Concrete Repair – Type A Partial depth concrete repairs will be paid for at the Contract Unit Price per square foot for "Type A Partial Depth Concrete Repair", measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.

204.7.7.2 Type B Partial Depth Concrete Repair – Type B Partial depth concrete repairs will be paid for at the Contract Unit Price per square foot for "Type B Partial Depth Concrete Repair", measured as specified herein, which price will be payment in full for performing all

operations herein described and all other items incidental to the  
Work.

END OF SECTION

## PART 1 - GENERAL

### 1.1 STANDARDS

- A. Concrete work shall conform to all requirements of ACI 301-89 "Specifications for Structural Concrete for Buildings", ACI 350 "Code Requirements for Environmental Engineering Concrete Structures", ACI 318-89 "Building Code Requirements for Reinforced Concrete" except as modified herein.
- B. All referenced standards shall be the latest editions.

### 1.2 SCOPE

- A. Work consists of furnishing all plant, labor, materials, equipment and appliances, and performing all operations in connection with installation of the concrete work, complete, in strict accordance with the Specifications and Drawings.

### 1.3 INSPECTION

- A. Embedded items must be inspected and tests for concrete and other materials shall have been completed and approved by the Engineer before concrete is placed.

### 1.4 SLAB ON EARTH

- A. Before proceeding to construct concrete slabs on earth, all pipes under concrete floor on earth shall have received the required tests. All backfill and fill material under slabs on grade shall be compacted in 6" layers to 95% maximum density as measured by AASHTO T99 test method. Unsuitable material encountered in subgrade shall be removed and replaced with material approved by the Engineer. Subgrade shall be brought to true, even plane and compacted to solid bearing. Gravel drainage fill shall be placed and compacted where shown on Drawings.

## PART 2 - MATERIALS

- 2.1 All concrete materials shall conform to the latest revised ASTM Designations listed below and shall be subject to the approval of the Engineer:

- A. Coarse Aggregate shall be crushed stone conforming to ASTM C-33 with a maximum size of 1".
- B. Fine Aggregate shall conform to ASTM C-33 and shall be washed river sand composed of clean, uncoated grains of strong materials.
- C. Cement shall be Portland cement conforming to ASTM Specification C-150, Type V. Only one brand of cement shall be used for exposed concrete.
- D. Water: Clean, fresh and free from oil, acids, alkali, vegetable, sewage, organic or other deleterious matter.
- E. Air-Entraining Admixtures shall conform to ASTM C-260.
- G. Premolded Expansion Joint Filler Strips shall be non-extruding type conforming to the current AASHTO Designation M213.
- H. Non-Shrink Grout shall be Pre-mixed "Embeco" as manufactured by Master Builder's, "Ferrolith G" as manufactured by Sonneborn-Contech, or approved equal. Type as recommended by the manufacturer for the particular applications.
- I. Liquid Curing Compound/Sealer shall be "MC 429" as manufactured by Master Builder's, "Kure-N-Seal" as manufactured by Sonneborn-Contech, "Thompson's Water Seal" as manufactured by E. A. Thompson, Inc. or approved equal.
- J. Granular Drainage Fill: Required under all interior building concrete slabs on grade and where noted on the drawings. It shall be either:
  - 1. Clean, washed gravel with particle sizes grading from maximum of 1" down to not more than 5% passing a No. 4 sieve.
  - 2. Clean, washed coarse sand with particular sizes ranging from pea gravel down to largest grains permitted in concrete sand.
- K. Joint Waterproofing for existing structures or as required on the plans shall be Ironite (Metallic) Waterproofing as manufactured by the Ironite Company of Chicago, Illinois or approved equal.

- L. Vapor Barrier required under all interior concrete slabs on grade and where noted in drawings shall be polyethylene sheet, 6 mil thickness conforming to ASTM E-154.
- M. Liquid Chemical Hardener shall be the magnesium fluosilicate and zinc fluosilicate type "Lapidolith" as manufactured by Sonneborn-Contech, Inc., "Symons Quad Cure" as manufactured by Symons Corp., "Hornolith" as manufactured by W. R. Grace & Co., or approved equal.
- N. Cementitious Waterproofing and Finish Compound shall be "Thoroseal Plaster Mix" with "Acryl 60" as manufactured by Standard Dry Wall Products or equal.

## 2.2 QUALITY AND CONTROL

### A. Design

Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate and water. All concrete shall be designed by an independent testing laboratory, approved by the Engineer, in accordance with the A.C.I. Standard "Recommended Practice for Selecting Proportions for Concrete" (ACI 211) to produce the strength for each class of concrete specified, and with slumps and maximum sizes of coarse aggregate in accordance with the requirements outlined below. The concrete shall be so designed that the concrete materials will not segregate and excessive bleeding will not occur. Submit laboratory trial mix designs and test results for each class of concrete to be used to the Engineer for approval before any concrete is placed. Any costs of the testing laboratory for designing concrete mixes shall be borne by the Contractor. Concrete strengths shall be as follows:

Class A Concrete - 4000 psi minimum @ 28 days (Air entrained) - six (6) sacks cement minimum

Class B Concrete - 3000 psi @ 28 days - five (5) sacks cement minimum

Class C Concrete - 2000 psi @ 28 days

Class D Concrete - 3000 psi @ 28 days (3/8" Max. Aggregate Size "Pea Gravel")

MAXIMUM SLUMPS FOR VARIOUS  
TYPES OF CONSTRUCTION

<u>Types of Construction</u>	Hand Placed	High
	<u>Maximum</u>	Frequency Vibrator <u>Used - Maximum</u>
Reinforced Foundation, Footings and Base Slabs of Tanks	5"	3"
Slabs, Beams and Reinforced Walls	6"	5"
Building Columns	6"	5"
Pavements, curb and sidewalks	3"	3"

The slump shall not exceed the maximum specified above for the type of construction for which it is to be used. The 28 day compressive strength determined in accordance with current ASTM Specifications C-39 and C-31 and with specimens cured in accordance with C-31 shall not be less than that shown above for the specified class of concrete. No water will be added after the amount specified by the mix design.

B. Production of Concrete

All ready-mix concrete shall be batched, mixed and transported in accordance with "Specifications for Ready-Mixed Concrete (ASTM C-94)". Plant equipment and facilities shall conform to the "Check List for Certification of Ready-Mixed Concrete Production Facilities" of the National Ready-Mixed Concrete Association. Site mixed concrete shall conform to the requirements of "Specifications for Structural Concrete" (ACI 301). The Contractor may elect to use either ready-mixed or site mixed concrete for this project provided he informs the Engineer of his choice.

C. Laboratory Testing

The Owner shall engage an independent testing laboratory to conduct concrete tests. Contractor will be responsible for sampling concrete for test cylinders, recording, and delivering them to the laboratory, providing all materials required, and for making all slump tests in the field directed by the Engineer. All costs in connection with work performed by the laboratory will be paid by the Owner. The Contractor shall be responsible for the costs of work performed by the laboratory required for redesign of concrete proportions and additional testing of in place concrete when cylinders indicate



low strength concrete has occurred.

At least one test shall be made on fresh concrete for each one hundred (100) cu. yds. of each class of concrete (or fraction thereof) placed on any one day and in any event, not less than one test for each class of concrete each day it is used. Testing shall be done in accordance with the following ASTM Specifications, latest edition:

C172- Standard Method of Sampling Fresh Concrete

C31 - Standard Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field

C39 - Standard Method of Test of Compressive Strength of Molded Concrete Cylinders

C143- Standard Method of Slump Test for Consistency of Portland Cement Concrete

Before any concrete is poured, the Contractor shall construct a storage box in accordance with ASTM Specification C31. Each set of tests shall consist of one slump test and four compression test cylinders. All cylinders shall be kept in the storage box for the first 24 hours. The four cylinders shall be laboratory cured and tested for adequacy of the design for strength of the concrete in accordance with ASTM Specification C31. One cylinder shall be tested at 7 days and two at 28 days.

The fourth cylinder will be retained for subsequent testing if required by the Engineer.

- D. Failure of Concrete to Meet Strength Requirements: The concrete shall be considered acceptable if, for any one class of concrete, the average of all tests of any five consecutive sets is equal to or greater than the specified strength, provided that no more than one test in ten falls between 90% and 100% of the specified strength. The only cylinders to be used for determination of concrete acceptability will be those laboratory cured and tested at 28 days. When it appears the tests of laboratory-cured cylinders will fail to meet these requirements, the Engineer may require changes in the proportions of concrete for the remainder of the work in order to meet the strength requirements. In addition, the Engineer may also require additional curing on portions of the concrete already poured.

The Engineer may also require tests in accordance with Methods of Securing, Preparing

and Testing Specimen from Hardened Concrete for Compressive and Flexural Strengths (ASTM Specifications C42) when the concrete cylinder tests fail to meet strength requirements. In the event there still is question as to the quality of the concrete in the structure, the Engineer may require load tests for that portion where the questionable concrete has been placed. Such load tests will be made as outlined in American Concrete Institute Building Code, (ACI 318), and shall be at the expense of the Contractor. In-place testing shall be at the expense of the Contractor.

- E. Removal of Under Strength Concrete: If the above tests indicate that a particular batch of previously placed concrete is under strength, the Engineer may direct that the under strength batch be removed and replaced. The removal of the under strength concrete shall also include the removal of concrete that has obtained the required strength if the Engineer deems this necessary to obtain structural or visible continuity when the concrete is replaced.

The removal, and replacement of any under strength concrete, shall be made at no additional cost to the Owner. This shall include any new formwork required or any reinforcing steel that may be required. The Owner shall not be charged any additional costs for any extra work that is required because of the failure of any concrete to meet the minimum test requirements.

- F. Concrete Strengths: The various strengths of concrete shall be installed as follows:
1. Class A, 4000 psi, Air-Entrained shall be used for all liquid containing and non-liquid containing structures, (footings, driveways, slabs, walls, columns and roofs.)
  2. Class B, 3000 psi shall be used for sidewalks, curbs and thrust blocking.
  3. Class C, 2000 psi shall be used for all non-structural fill concrete, mud slabs, over excavation concrete and other selective backfill conditions as approved by the Engineer.
  4. Class D, 3000 psi pea gravel concrete (maximum aggregate size of 3/8") shall be used for all masonry fill, masonry columns cells, and masonry bond beams.

### PART 3 - INSTALLATION

### 3.1 PREPARATION BEFORE PLACING

- A. Water shall be removed from excavations before concrete is deposited. Hardened concrete, wood chips, shavings, and other debris shall be removed from interior of forms and inner surfaces of mixing and conveying equipment. Wood forms shall be oiled or, except in freezing weather, wetted with water in advance of pouring. Reinforcement shall be secured in position, inspected and approved by the Engineer before starting pouring of concrete.

### 3.2 CONVEYING

- A. Concrete shall be conveyed from mixer to forms as rapidly as practicable and by methods, which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Chutes used shall be such that concrete slides in them and does not flow. Chutes, if permitted, shall have a slope of less than 1 on 2. Where a vertical drop greater than five (5) feet is necessary, placement shall be through elephant trunks or similar devices to prevent segregation. Ready-mixed concrete shall be delivered with a load ticket showing mix proportions and the time mixing began for each load. The load ticket shall be furnished to the Engineer.

### 3.3 PLACING

- A. Concrete shall be placed before initial set has occurred and in no event after it has contained its water content for more than 30 minutes for site mixed concrete or 1 hour for ready-mixed concrete. Unless otherwise specified, all concrete shall be placed upon clean, damp surfaces free from running water, or upon properly consolidated fills, but never upon soft mud or dry, porous earth. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section.
- B. If a section cannot be placed continuously, provide construction joints as herein specified. The concrete shall be compacted and worked in an approved manner into all corners and angles of the forms and around reinforcement and embedded fixtures as to prevent segregation of the coarse aggregate. Construction of forms for the lifts of vertical walls shall be such as to make all parts of the walls easily accessible for the placement, spading, and consolidation of the concrete as specified herein.

- C. No "finished water" shall be surface applied during finishing efforts.
- D. Curing methods shall be submitted to the Engineer and applied per manufacture's recommendations.

### 3.4 VIBRATION

- A. All concrete shall be placed with the aid of mechanical vibration equipment as approved by the Engineer. Vibration shall be transmitted directly to the concrete; in no case shall it be transmitted through forms. The duration of vibration at any location in the forms shall be held to the minimum necessary to produce thorough compaction. Vibrations shall be supplemented by forking or spading by hand, and adjacent to the forms on exposed faces in order to secure smooth, dense and even surfaces, with particular care being taken to prevent coarse aggregate from becoming set too near any surfaces that are to receive rubbed finish.

### 3.5 CONSTRUCTION JOINTS

- A. Construction joints shall be formed as indicated on the drawings or as approved or directed by the Engineer. Contractor shall submit a joint location plan for each structure to the Engineer for approval 28 days prior to commencing concrete operations on that structure. Where indicated or required, dowel rods shall be used. All concrete at the joints shall have been in place not less than 12 hours, and longer if so directed by the Engineer, before concrete resting thereon is placed. Before placing is resumed, or commenced, excess water and laitance shall be removed, and concrete shall be cut away, where necessary, to insure a strong dense concrete at the joint. In order to secure adequate bond, the surface of concrete already in place shall be cleaned, roughened, and then spread with a one-half ( $\frac{1}{2}$ ) inch layer of mortar of the same cement-sand ratio as is used in the concrete, immediately before the new concrete is deposited. The unit of operation is not to exceed 40 feet in any horizontal direction, unless otherwise required by the Drawings. Construction joints, if required, shall be located near the mid-point spans for slabs, beams or girders. Joints in columns or piers shall be made at the underside of the deepest beam or girder at least five (5) hours before any overhead work is placed thereon. Joints not shown or specified shall be so located as to least impair strength and appearance of work. Vertical joints in wall footings shall be reduced to a minimum. Placement of concrete shall be at such a rate that surfaces of concrete not

carried to joint levels will not have attained initial set before additional concrete is placed thereon.

- B. Girders, beams and slabs shall be placed in one operation. To ensure a level straight joint in exposed vertical surfaces, a strip of dressed lumber may be tacked to the inside of the forms at the construction joint. The concrete shall be poured to a point one (1) inch above the underside of the strip. The strip shall be removed one (1) hour after concrete has been placed and any irregularities in the joint line leveled off with a wood float and all laitance removed. Waterstops shall be installed in all construction joints below grade or in liquid containing structures as noted on the Plans. Install as per SECTION 3.3, CONSTRUCTION JOINTS, EXPANSION JOINTS, & WATERSTOPS.

### 3.6 PATCHING

- A. Any concrete which is not formed as shown on the Plans, or for any reason is out of alignment or level or shows a defective surface shall be considered as not conforming with the intent of these Specifications and shall be removed from job by Contractor at his expense, unless the Engineer grants permission to patch defective area, which shall be done in accordance with the following procedure. Permission to patch any such area shall not be considered a waiver of the Engineer's right to require complete removal of defective work if patching does not, in his opinion, satisfactorily restore quality and appearance of surface. Suitable non-shrink, latex or epoxy mortar shall be used for patching and repairing defective surface if permitted by the Engineer.
- B. After removing forms, all concrete surfaces shall be inspected and any poor joints, voids, stone pockets, all tie holes, or other defective areas shall be patched, if permitted by the Engineer. Where necessary, defective areas shall be chipped away to a depth of not less than one (1) inch with edges perpendicular to the surface. Area to be patched and a space at least six (6) inches wide entirely surrounding it shall be wetted to prevent absorption of water from the patching mortar. A grout of equal parts Portland cement and sand, with sufficient water to produce a brushing consistency, shall then be well brushed into the surface followed immediately by the patching mortar. The patch shall be made of the same material and of approximately the same proportions and shall not be richer than 1 part cement to 3 parts sand. White Portland cement shall be substituted for a part of the gray Portland cement to match color of the surrounding concrete. The proportion of white and gray cements shall be determined by making a trail patch. The amount of mixing water shall be as little as consistent with the requirements of handling and placing.

The mortar shall be retempered without the addition of water by allowing it to stand for a period of one (1) hour during which time it shall be mixed occasionally with a trowel to prevent setting.

- C. The mortar shall be thoroughly compacted into place and screened off so as to leave patch slightly higher than surrounding surface. It shall then be left undisturbed for a period of 1 to 2 hours to permit initial shrinkage before being finally finished. The patch shall be finished in such a manner as to match the adjoining surface. On surfaces where unlined forms have been used, the final finish shall be obtained by striking off the surface with a straightedge spanning the patch and held parallel to the direction of the form marks.
- D. Tie holes left by withdrawal of rods or the holes left by removal of ends of ties shall be filled solid with non-shrink grout after first being thoroughly wetted within 7 days of placement and prior to any area backfill.

### 3.7 SLAB FINISHES

- A. Exterior Concrete Walks:

After thoroughly consolidating the concrete the top surface shall be struck off with a straight edge and tamped or vibrated sufficiently to bring mortar to the surface. Finish with a wood float to a smooth, even surface and lightly broomed to provide "slip resistant" surface. Edges shall be rounded with a 1/4" radius.

- B. Interior slabs to receive grout fill or mortar setting bed shall be finished by tamping concrete with special tools to force coarse aggregate below the surface, and screened with straightedges to bring surface to finish plane with a tolerance not exceeding 1/8" in 2 feet. Surface shall be left roughened sufficiently to produce good bond with topping material. Use stiff brushes, brooms or rakes as necessary to provide 1/8 inch deep grooves at maximum of 1/2 inch on center.
- C. Top and bottom slabs of all structures and water carrying conduits except as noted otherwise on the Plans shall be finished as follows: The top of the slab shall be screened to grade and cross section; lightly tamped as required to bring up a good bed of mortar for finishing and re-screened as necessary. The surface shall then be finished with a wood float and leveling darby. No further finish will be required on top slabs of structures

or conduits, which are to be buried. In the case of all exposed top slabs of structures and conduits, they shall be given a final wood float and a lightly broomed, slip resistant finish to a uniform surface, which conforms with accuracy to required shape, slope and grade. Slabs shall be edged as appropriate. No liquid hardener is to be applied to these surfaces.

- D. Interior floor slabs that are not to receive any finish floor covering shall be "slip resistant finish" as follows: The top surface shall be steel troweled and have a final finish applied by brushing lightly with a soft bristle brush to form a slightly roughened surface.
- E. Liquid Hardener shall be applied to the floors where scheduled to be exposed concrete. Concrete surfaces to be treated must be thoroughly set and dry, clean and free of dust. Three applications of the liquid hardener are required, using one gallon per 100 square feet for the complete treatment. Apply hardener strictly according to the manufacturer's printed instructions. Liquid floor hardener is not required when a minimum of two (2) coats of Thompson's Waterseal or equal has been used as a curing and/or separating compound. Submit material and method to be used for Engineer's approval.

### 3.8 FINISH OTHER THAN SLABS

- A. All top surfaces, other than slabs, not covered by forms, and which are not to be covered by additional concrete or fill shall receive a wood float finish without additional mortar. Care shall be taken that no excess water is present when the finish is made. Other surfaces shall be brought to finished elevations and left true and regular. All exposed top surface interior concrete shall be grouted smooth and given a cement wash of one part light colored Portland cement and two parts fine aggregate mixed with water to consistency of thick paint. Grout shall be cork or wood floated to fill all pits, air bubbles, and surface holes. Excess grout shall be scraped off with a trowel and rubbed with burlap to remove any visible grout film. Surface shall be kept damp during setting period. The finish for any area shall be completed in the same day and the limits of a finished area shall be made at natural breaks in finished surface. Painting of exposed-to-view concrete surfaces is specified under SECTION 9.1 - PAINTING of these Specifications.

- B. Rubbed Finish:

Unless otherwise indicated, all faces (except top surfaces of slabs) exposed to view, such as walls, grade beams, columns, beams, walls of water carrying conduits to a point 1'-0"

below normal water level, canopy soffits and fascias, etc. shall be finished as follows:

Forms shall be removed, as specified in SECTION - CONCRETE FORMWORK, and all fins removed, off-sets leveled, damaged places and depressions resulting from the removal of metal ties or other causes shall be carefully pointed with a mortar of sand and cement in the proportion which has been employed for the particular class of concrete treated. The surface film of all such pointed places shall be carefully removed before setting occurs. After the point has set sufficiently to permit it, all exposed surfaces shall be dampened and rubbed with a No. 16 Carborundum stone, to a smooth even plane. Final rubbing shall be done with a No. 30 Carborundum stone, or an abrasive of equal quality, to obtain an entire surface of a smooth texture and uniformity in color. Mortar or grout worked up during rubbing shall be promptly removed by sacking with burlap or other suitable means so that no visible grout film or paste will remain. A cement wash or plaster coat shall not be used. All surfaces shall be finished uniformly smooth and washed clean. The rubbed finish for any area shall be completed in the same day and the limits of a finished area shall be made at natural breaks in the finished surface. If the Contractor does not provide suitable surface finish using Carborundum stones specified above, the Engineer, without additional cost to the Owner, may require the use of a power operated grinding machine or other methods to produce the desired finish.

C. Cementitious Waterproofing and Finish:

As an option to the rubbed finish, as specified herein, all faces (except top surfaces of slab) exposed to view, such as walls, grade beams, columns, beams, canopy soffits and fascias, etc., shall be finished using "Thorseal" coating or approved equal as described in the following paragraphs.

1. General

Forms shall be removed, as specified in SECTION 3.4 - CONCRETE FORMWORK, and all fins removed, off-sets leveled, damaged places and depressions resulting from the removal of metal ties or other causes shall be carefully pointed with a mortar of sand and cement in proportion which has been employed for the particular class of concrete treated. The surface film of all such pointed places shall be carefully removed before setting occurs. After the point has set sufficiently to permit it, all exposed surfaces shall receive the following treatment.



2. Mixing

Thorseal plaster mix shall be prepared using a solution composed of not less than one part Acryl 60 (approximately two quarts Acryl 60 per bag) and three parts of clean, potable water (for ceilings, use 1 part Acryl 60 to 2-1/2 parts of the water). This solution shall then be added to the Thorseal plaster mix slowly in sufficient quantity so that the mixture is the consistency of a heavy batter suitable for application by method specified. Color to be selected by the Owner.

3. Application

At Contractor's option, one of the following methods of application shall be selected:

- a. Sprayed-on finish should be applied with plaster-type spray gun, not high pressure paint type. Spray on evenly distributed coat of Thorseal plaster mix. To spot-fill deep holes, float or brush first coat before starting second spray application.

Thorseal plaster mix shall be applied on average surfaces in two coats at the rate of 5 to 6 lbs. per square yard for concrete walls, 6 to 9 lbs. per square yard for masonry walls; but sufficient material shall be applied to fill all holes and voids.

- b. Trowel and float finish - Apply light trowel coat of Thorseal plaster mix over entire surface to be treated. The workman shall make sure the material is firmly pressed into all voids and leveled. Allow this coat to cure thoroughly before applying the regular trowel application. When surface is set so it will not roll or lift, float uniformly using a sponge float.

Thorseal plaster mix shall be applied on average surfaces at the rate of 4 to 6 lbs. per square yard for concrete walls, 6 to 9 lbs. for masonry walls. If concrete is rough or untrue, 6 to 9 lbs. per square yard may be required, but sufficient material shall be applied to fill and seal all pores and voids. This application will be approximately 1/8" thick. Leveling uneven surfaces will require more material per square yard.

To prevent shadowing of struck or deep masonry joints, or areas of unequal absorption (like some form marks), after key coat has cured for 5 days, apply a light trowel coat of Thoroseal plaster mix with Acryl 60 in the mixing water over the entire surface to be treated. Allow this coat to set thoroughly before applying the regular trowel application as outlined above.

Do not apply when temperatures are 40°F or due to fall below 40°F within 24 hours or to frozen or frost-filled surfaces.

### 3.9 CURING

- A. General - Immediately following placing, all Class A and Class B concrete shall be protected from premature drying, hot and cold temperatures, rain, flowing water and mechanical injury. Maintain above 50°F and in moist condition for at least seven (7) days after placing for normal concrete and three (3) days for high early strength concrete. Comply with "Recommended Practice for Curing Concrete" ACI 308, unless otherwise indicated. Curing compound of satisfactory composition and characteristics may be used except on surfaces to which new concrete is to be bonded or surfaces scheduled to be painted or to receive other coating and provided such compound does not stain or discolor any surface which will be exposed. Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- B. Cold Weather Procedures - Protect concrete work from physical damage or reduced strength, which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306, "Cold Weather Concreting", and as herein specified.
  - 1. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 55°F, and not more than 80°F at point of placement.

2. Do not use frozen materials or materials containing ice, frost or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
4. Contractor shall obtain and keep on the Project site a copy of the current edition of ACI 306, "Recommended Practice for Cold Weather Concreting", for reference during all concrete operations in cold weather.

C. Hot Weather Procedures:

When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305, "Hot Weather Concreting", and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Wet forms thoroughly before placing concrete.
4. Do not use retarding admixtures unless otherwise accepted in mix designs.
5. Contractor shall obtain and keep on the project site a copy of ACI 305R, "Hot Weather Concreting" for reference during all concreting operations in hot weather.

D. Protection from the Sun:

All concrete shall be adequately protected from injurious action of sun in a manner satisfactory to the Engineer.

E. Temperature Control:

During and at the conclusion of the specified curing period, means shall be provided to ensure that the temperature of the air immediately adjacent to the concrete does not fall more than 3°F in any 1 hour nor more than 30°F in any 24 hours.

3.10 NON-SHRINKING GROUT

- A. Where non-shrinking grout is called for on the Plan, it shall be mixed in strict accordance with the manufacturer's directions. It shall be of a type as recommended by the manufacturer for the particular application.

END OF SECTION

## PART 1 – GENERAL

### 1.1 SCOPE

- A. The extent of concrete reinforcement is shown on the drawings and in schedules.
- B. The work includes fabrication and placement of reinforcement for cast-in-place concrete, including bars, welded wire fabric, ties and supports.

### 1.2 QUALITY ASSURANCE

- A. Codes and Standards:

Comply with requirements of the latest edition of the following codes and standards, except as herein modified:

American Welding Society (AWS), AWS D1.4 "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction".

Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice". (Current Ed.)

American Concrete Institute (ACI), ACI 318 "Building Code Requirements for Reinforced Concrete".

American Concrete Institute (ACI), ACI 350 "Code Requirements for Environmental Engineering Concrete Structures

- B. Submittals:

Mill Certificates; Concrete Reinforcement: Submit steel producer's certificates of mill analysis, tensile and bend tests for reinforcing steel.

Shop Drawings: Reinforcing number, sizes, spacing dimensions, configurations, locations, mark numbers, lap splice lengths, concrete cover and reinforcing supports. Sufficient reinforcing details to permit installation of reinforcing without reference to contract drawings.

### 1.3 DELIVERY, HANDLING AND STORAGE

- A. Deliver reinforcement to the project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Store concrete reinforcement materials at the site to prevent damage and accumulation of dirt or excessive rust.

### 1.4 MATERIALS

- A. Steel reinforcement shall conform to the "Specification for Deformed Billet Steel Bars for Concrete Reinforcement," ASTM A615, Grade 60.
- B. Wire fabric reinforcement shall conform to the current "Specifications for Welded Steel Wire Fabric for Concrete Reinforcement," ASTM A-185, or "Specifications for Welded Deformed Steel Wire Fabric for Concrete Reinforcement," ASTM A-497.
- C. Supports for Reinforcement shall be bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place. Use only wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, and other unacceptable materials.

### 1.5 SPLICES

- A. No splices of bars, except when shown on the Plans, will be permitted without the approval of the Engineer. Minimum lap splice shall be 48 bar diameters unless specifically detailed or noted otherwise on drawings. Splices in adjacent bars shall be staggered a minimum distance equal to the lap splice length. Bars shall be rigidly clamped or wired at all splices in a manner approved by the Engineer. Welding may not be used except with the specific approval of the Engineer. Welding, when approved, shall conform to the AWS D1.4. Welded wire fabric shall be lap spliced a minimum of 2 inches plus the wire spacing at edge laps and end laps.

### 1.6 DETAILING & FABRICATION

- A. Furnish Shop Detail and Field Placing Drawings for all reinforcing steel for approval of the Engineer. Shop Drawings shall include reinforcing, placing plans and details indicating size, location, arrangement, splice locations, bending diagrams, placing sequence, etc. Placing Drawings shall be in sufficient detail to allow field personnel to accurately place reinforcing. Shop and Placing Drawings shall be prepared in accordance with "Manual of Standard Practice for Detailing Reinforced Concrete Structures" ACI 315, current edition. Photographic copies of engineering drawings shall not be used as placing drawings.
- B. Reinforcement bars shall be bent cold to the shapes indicated on the Plans. Fabrication tolerances, fabrication, and detailing of steel reinforcement shall conform to the "Manual of Standard Practice for Detailing Reinforced Concrete Structures" (ACI-315).
- C. Steel reinforcement shall be of the type and size, cut to lengths and bent to shapes as indicated on the Plans. Unless otherwise indicated, hooks, lap splices, embedment lengths, and other details of reinforcement shall be provided as set forth in the ACI Building Code (ACI 318) to develop the full tensile strength of the bar.

#### 1.7 PLACING REINFORCEMENT

- A. All reinforcement at the time concrete is placed shall be free from mud, oil, paint, excessive rust and excessive mill scale or any other coating that would destroy or reduce its bond with the concrete.
- B. All reinforcement shall be secured in place true to lines and grades indicated by use of metal or concrete supports, spacers, or ties as approved by the Engineer. The bars and mesh shall be tightly secured against displacement by ties of annealed wire, or suitable clips at intersections. Wall reinforcement shall be supported and held securely against displacement in its proper position clear of the forms as indicated on the Plans. Placing tolerance shall conform to ACI 318.
- C. Nails shall not be driven into the wall forms to support reinforcement nor shall any other device used for this purpose come in contact with the form on the liquid side of any liquid containing structure. Metal devices used to provide the required clear distances from reinforcing steel to liquid side of concrete surfaces shall be galvanized, or shall be as approved by the Engineer.

- D. The main reinforcement of slabs in contact with the ground shall be supported in its proper position, as indicated on the Plans, by means of precast cement mortar blocks, of approved dimensions, resting on the slabs' subbase. Such precast blocks shall be made of mortar composed of 1 part cement to 2 parts sand and shall have a loop of No. 16 black annealed wire cast into each block. The length of the wire loop shall be sufficient to allow the block to be tied to the reinforcement. Blocks shall be spaced at the intervals required to maintain the reinforcement in its required position in the slab during the placing of the concrete. The slab reinforcement shall not be used to support planking or runways used in placing concrete.
- E. Bending of bars embedded in hardened concrete will not be permitted except when specifically approved by the Engineer for the field condition encountered. Field cutting of bars will only be permitted when specifically approved by the Engineer.
- F. In the case of exposed finish surfaces of floor slabs, galleries, deck slabs, and beams, metal chairs, spacers and other metal accessories necessary to provide the required clear distances and proper alignment and spacing between bars shall be galvanized or shall have plastic protective covering over portions in contact with forms.

#### 1.8 CONCRETE PROTECTION FOR REINFORCEMENT

- A. Steel reinforcement shall be placed and held in position so that the concrete cover, as measured from the surface of the bar shall be the following, except as otherwise shown, on the drawings:
  - 1. Slabs:
    - 1½ inches, in general, top and bottom.
    - 1½ inches at surfaces troweled as floor finish, walkway, or driveway.
    - 2 inches on bottom for slabs over water and where exposed to the weather.
  - 2. Footings:
    - 2 inches at top of footings.
    - 3 inches at bottom, sides, and end of footings.



3. Walls:

2 inches on surfaces against earth.

1½ inches on interior surfaces.

2 inches on interior surfaces contacting water.

4. Beams and Girders in Contact with Water:

2 inch minimum to stirrup steel.

2½ inch minimum to main longitudinal steel.

5. Columns:

2 inches, in general, to main vertical reinforcement.

2½ inches, to main reinforcement on surfaces in contact with water.

6. Beams and Girders: General:

1½ inch minimum to stirrup steel.

2 inches minimum to longitudinal steel.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

- A. Construction joints, expansion joints, and the placing of waterstops where such are indicated on the plans.
- B. Construction joints shall be of the type indicated on the drawings and shall be located as shown on the plans unless otherwise approved by the Engineer. Contractor shall submit a joint location plan as specified in 204.8 CAST IN PLACE CONCRETE.

### 1.2 WATERSTOPS

- A. Waterstops shall be installed in construction joints as required by the Plans. All waterstops shall be continuous throughout their length.
- B. The waterstops shall be heavy duty polyvinyl waterstop conforming to Corps of Engineers Specification CRD-C-572, latest edition, as manufactured by Serviced Products Division of W.R. Grace and Company: Vinylstops by Sonneborn- Contech; Sealtight Duo-PVC Waterstops by W. R. Meadows, Inc.; Vinylex Corporation; "labyrinth" waterstop, Type B-2 as manufactured by Water Seals, Inc.; or an approved equal of the same type and material and approximately equal in dimensions and weight but not necessarily of exactly the same shape. Waterstops shall be of the size and type designated on the Plans.
- C. "Rib Type" waterstops shall be of ribbed construction with a center bulb, 5" wide, capable of resisting a maximum pressure load of 65 feet of water.
- D. All waterstops shall be installed so that one-half its width will be embedded on one side of the joint and one-half on the other. The Contractor shall employ a method of holding the waterstop in position for the first pour that is satisfactory to the Engineer. The method selected must ensure that the waterstop will be held securely in true vertical or horizontal position and in straight alignment in the joint.
- E. Care shall be exercised to ensure that the waterstop is completely encompassed in good mortar.

F. Preformed Plastic Waterstops:

Preformed Plastic Waterstop, when approved by the Engineer, shall meet or exceed all requirements of Federal Specifications SS-S-00210, "Sealing Compound, Preformed Plastic for Expansion Joints", Type I or Type II. Such plastic waterstop shall be equal to SYNKO-FLEX as manufactured by Synko-Flex Products Company, Houston, Texas, or "CenSeal GS-231" by Concrete Sealants, Inc., New Carlisle, Ohio and shall meet the following requirements:

The plastic waterstop shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes or obnoxious odors. The plastic waterstop shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded form of suitable cross-section and of a size to seal the joint areas of concrete sections. The plastic waterstop shall be protected by a suitable removable two-piece wrapper. The two-piece wrapper shall be so designed that one-half may be removed longitudinally without disturbing the other half, to facilitate application of the sealing compound.

1.3 JOINTS IN WATERSTOPS

- A. All waterstops shall be continuous and so joined at all points of contact in the same plane, or at intersections with waterstops in different planes, as to form a complete barrier to the passage of water through any construction or contraction joint.
- B. Joints in the waterstops, whether made for the purpose of continuity in a straight strip or for the purpose of securing a watertight junction between strips in different planes, shall be made by heat welding as hereinafter specified.
- C. Joints in PVC waterstops shall be made by heating the two surfaces to be jointed until the material has softened to the point where it is just short of being fluid and then bringing the two softened surfaces together with a slight rubbing motion followed by firmly pressing them together so that a solid and tight bond is made.

- D. The joints in strips of waterstop made in the above manner shall be such that the entire cross section of the joint shall be dense, homogeneous and free of all porosity. All finished joints shall have a tensile strength of not less than 75 percent of the material of the strip as extruded.
- E. The heating of the surfaces to be joined shall be done by means of an electric splicing iron designed for the specified purpose and controlled by means of a voltage regulator.
- F. In use, the heat of the hot plate shall be so regulated as to prevent too rapid melting and accompanying charring of the waterstop material.
- G. The use of makeshift hot plates will not be permitted nor will other means of heating the strips to be joined be allowed except in a case of emergency, as determined by the Engineer.
- H. The Contractor shall provide such jigs as will assist in making the joints in a proper and workmanlike manner and in holding the strips so that the alignment of jointed strips is correct and angles are true to those required.
- I. Prior to embedment all joints in the waterstop strips will be inspected by the Engineer and any found defective shall be remedied without delay.

#### 1.4 PROTECTION OF WATERSTOP BETWEEN POURS

- A. The Contractor shall take such steps as are necessary to protect exposed waterstops in the interim period between concrete pours. This would include damage from construction equipment, tools and concrete "slobbers". In the event the waterstop receives small amounts of construction debris and/or concrete "slobbers" while concrete is "green", the Contractor shall fully clean waterstop directly following the stripping of formwork and prior to the placement of future reinforcement.

#### 1.5 EXPANSION JOINTS

- A. Expansion joints of the size and type shown on the plans, or specified herein, shall be placed in concrete pavement or structure as shown on the plans.

1. Materials:

a. Preformed Asphalt Fiber Joint Material

Asphalt fiber sheet filler shall consist of preformed strips of inert material impregnated with asphalt. It shall be of the thickness shown on the Plans or indicated in these Specifications.

The sheet filler shall conform to the requirements of AASHTO Specification M-213 with the following additional provisions.

The sheet filler shall be of such character that it will not be deformed by ordinary handling during hot weather nor become hard and brittle in cold weather. It shall be of a tough, resilient, durable material not affected by weathering.

b. Hot Poured Rubberized Tar Joint Sealer

Hot poured rubberized mastic joint sealer shall consist of a mixture of durable, elastic rubber, coal tar pitch and other materials which will form a resilient and adhesive compound capable of effectively sealing concrete joint surfaces against repeated expansion and contraction. The material shall be installed in accordance with the manufacturer's directions. Hot poured tar sealer shall be used for pavement and sidewalk expansion joints.

B. Joint Surface Preparation:

1. Clean joint surfaces immediately before installation of sealant or caulking compound. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant or caulking compound.
2. For all sealants, do not proceed with installation of sealant over joint surfaces which have been painted, lacquered, waterproofed or treated with water repellent

or other treatment or coating unless a laboratory test for durability (adhesion), in compliance with Paragraph 4.3.9 of FS TT-S-00227, has successfully demonstrated that sealant bond is not impaired by coating or treatment. If laboratory test has not been performed, or shows bond interference, remove coating or treatment from joint surfaces before installing sealant.

3. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless sealant manufacturer's printed instructions indicate that alkalinity does not interfere with sealant bond and performance. Etch with 5% solution of muriatic acid; neutralize with diluted ammonia solution, rinse thoroughly with water and allow to dry before sealant installation.

C. Installation:

1. Comply with sealant manufacturer's printed instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.
2. Prime or seal joint surfaces where shown or recommended by sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.
3. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.
4. Install sealants to depths as shown or, if not shown, as recommended by sealant manufacturer but within the following general limitations, measured at center (thin) section of bead.
5. For sidewalks, pavements and similar joints sealed with elastomeric sealants and

subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75% of joint width, and neither more than 5/8" deep nor less than 3/8" deep.

6. For normal moving joints sealed with elastomeric sealants, but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2" deep nor less than 1/4" deep.
7. Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either primer/sealer or the sealant.
8. Remove excess and spillage of compounds promptly as the work progresses. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes.
9. Placement of expansion joint material shall fully cover joint area(s) between concrete placements. No gaps or joint material opens which permit fresh concrete to flow to existing concrete surface will be allowed.

D. Cure and Protection

1. Cure sealants in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Do not cure in a manner which would significantly alter material's modules of elasticity or other characteristics.
2. Installer shall advise Contractor of procedures required for curing and protection of sealants during construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at time of Owner's acceptance.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SCOPE

- A. Work in this section includes all labor, plant and material necessary to furnish and install all concrete formwork required by the project. Concrete formwork shall conform to all requirements of current editions of ACI 301 "Specifications for Structural Concrete for Buildings" and ACI 318 "Building Code Requirements for Reinforced Concrete" and ACI 347 "Recommended Practice for Concrete Formwork" and ACI 350 "Code Requirements for Environmental Engineering Structures" except as modified herein.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Forms shall be of wood, metal, highly water resistant plywood, or other material approved by the Engineer. Forms for sections greater than 18" thick shall be of wood. Form surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed surfaces. Bolts and rods used for internal ties shall be so arranged that, when the forms are removed, all metal will not be less than two (2) inches from any concrete surface. Wire ties will not be permitted where concrete surface will be exposed to weathering, and discoloration would be objectionable. Exposed concrete shall have approved form liners of Masonite or plywood, or shall be constructed of smooth surfaced plywood.
- B. Corner forms forming 3/4 inch chamfers or as otherwise specified on plans, shall be used on all outside corners that are to be exposed in the finished structure. Chamfer forms shall be of molded plastic or polyvinyl chloride chamfer strips. Use one style of form throughout the project. The type to be used shall be submitted to the Engineer for approval.
- C. Rustication and Score Line Strips shall be a non-absorbent material such as extruded polyvinyl chloride, plastic, fiberglass or metal or they may be milled from a good quality lumber and well sealed to prevent moisture absorption, wood strips may not have protruding splinters which may become embedded in the concrete. Sealing wood shall be accomplished by emersion or brushing on two coats of form coating.



- D. Form Ties for concrete shall have an approved waterstop barrier to prevent seepage of moisture along the ties. The ends of the metal after breaking off shall be minimum of 2 inches from the finished wall face. Submit samples to the Engineer for review. All temporary tie components of tie system shall be removed from placement once placement is completed and prior to backfilling. Non-shrink grout shall be placed at all voids created by ties.
- E. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.
- F. Cylindrical Columns and Supports: Form round-section members with paper or fiber tubes, constructed of laminated plies using water-resistant type adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation.
- G. Inserts: Provide metal inserts, anchor bolts and other embedded items for anchorage of materials or equipment to concrete construction, not supplied by other trades and as required for the work.
- H. Provide sheet metal reglets formed of the same type and gauge as the flashing metal to be built into the reglets, unless otherwise indicated. Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gauge galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.
- I. Side forms of footings may be omitted and concrete placed directly against excavation only when requested by Contractor and accepted by Engineer. When forms are omitted, provide additional concrete required beyond the minimum design profiles and dimensions of the footings as indicated to provide minimum concrete coverage for reinforcement. Contractor shall maintain the earth form to proper alignment with no sloughing of material into the minimum design profile shown on the drawings.
- J. Dovetail Anchor Slots at surfaces to receive masonry veneer to be Heckman #100 or equal.

- K. Formwork used for exposed finished concrete surface placements shall be in like new condition and designed to provide flat and true surfaces.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Design and engineering of formwork, shoring and reshoring as well as its construction is the responsibility of the contractor. Design formwork for loads, lateral pressures and allowable stresses outlined in ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local Building Code. Where conflicts occur between these two standards, the more stringent requirements shall govern.
- B. Forms shall be built true to line and grade, and be mortartight and sufficiently rigid to prevent displacement or sagging between supports. All formwork and shoring shall be designed for the construction loads to be placed on them, and the design and construction of said forms shall be in accordance with ACI Standard "Recommended Practice for Concrete Formwork" (ACI 347). The structural adequacy of the formwork shall rest with the Contractor. All forms shall be so constructed that they can be removed without hammering or prying against the concrete.
- C. Before concrete placement check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.
- D. During concrete placement check formwork and related supports to ensure that forms are not displaced and that completed work will be within specified tolerances.
- E. Provide temporary openings in wall forms, columns forms and at other locations necessary to permit inspection and clean-out.

#### 3.2 EMBEDDED ITEMS

- A. Before placing concrete, care shall be taken to determine that any embedded metal or wood parts are firmly and securely fastened in their correct location as indicated. Use setting drawings, diagrams, instruction and directions provided by suppliers of items

attached thereto. They shall be thoroughly clean and free from coating, rust, scale, oil, or any foreign matter. Embedding of wood in concrete shall be avoided whenever possible, metal being used instead. If wood is allowed, it shall be thoroughly wetted before concrete is placed.

- B. All aluminum embedded items shall be coated with epoxy paint where in contact with concrete.

### 3.3 FORM REMOVAL

- A. Forms shall not be removed without approval of the Engineer. Forms shall not be removed before the minimum times given below, or longer if job control tests indicate the concrete has not attained strength specified below, except when specifically authorized by the Engineer.

Beams and Slabs	14 days or proof of strength requirements met.
Walls up to 12" Thick and Vertical Surfaces	1 day if minimum daily temperature is above 50°F, 3 days otherwise
Columns	5 days or proof of strength requirements met.
Walls greater than 12" Thick	3 days if minimum daily temperature is above 50°F with proof of strength requirements met, 7 days otherwise.

- B. In general, forms or shores for supported slabs and beams shall not be removed until the concrete, so supported, has acquired 70% of its design strength; except where loads other than the dead weight of the concrete are added, the shores shall not be removed until 24 hours after the concrete has obtained 90% of its design strength. Forms shall be removed immediately after expiration of the lapsed times specified above or sooner, if required by the Engineer, where concrete is to receive a rubbed finish.

END OF SECTION

I. CARPENTRY

A. SUMMARY

This Section includes the following:

Framing with dimension lumber.

Wood grounds, nailers, and blocking.

Wood furring.

Sheathing.

Underlayment.

B. SUBMITTALS

1. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

a. Product data for the following products:

Underlayment.

Insulating sheathing.

Air infiltration barrier.

Metal framing anchors

Construction adhesives.

b. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use as well as design values approved by the Board of Review of American Lumber Standards Committee.

c. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material:

For each type of preservative treated wood product include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

For water-borne treated products include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to product site.

Warranty of chemical treatment manufacturer for each type of treatment.

C. QUALITY ASSURANCE

1. Single-Source Responsibility for Engineered Wood Products: Obtain each type of engineered wood products from one source from a single manufacturer.

D. DELIVERY, STORAGE AND HANDLING

1. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

E. LUMBER, GENERAL

1. Lumber Standards: Furnish lumber manufacture red to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

Inspection Agencies: Inspection agencies and the abbreviations used to referenced them with lumber grades and species include the following:

SPIB – Southern Pine Inspection Bureau.

WCLIB – West Coast Lumber Inspection Bureau.

WWPA – Western Wood Products Association.

Grade Stamps: Provide lumber with each piece factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content and at time of surfacing, and mill.

2. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

Provide dressed lumber, S4S, unless otherwise indicated.

Provide lumber with 15 percent maximum moisture content at a time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

F. DIMENSION LUMBER

1. For light framing provide "Stud," "No. 2," lumber for stud framing (2 to 4 inches thick, 2 to 4 inches wide, 10 feet and shorter) and "Study" or "No. 2" grade for the light framing (2 to 4 inches thick, 2 to 6 inches wide), any species. Number #3 lumber is not acceptable for use as installed work in this project.

2. For structural framing (2 to 4 inches thick, 5 inches and wider), shall be No. 1 or No. 2 grade Southern Pine graded under SPIB rules. Structural framing shall be used for the bearing walls supporting the roof trusses.

G. MISCELLANEOUS LUMBER

Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

Moisture content to be 19 percent maximum for lumber items not specified to receive wood preservative treatment and grade to be; "Standard" grade light-framing-size lumber of any species or board-size lumber as required. "No. 2 Common" grade boards per WCLIB or WWPA rules or "No. 2 Boards" per SPIB rules.

H. CONSTRUCTION PANELS, GENERAL

Construction Panel Standards: Comply with PS 1 "U.S. Product Standard for Construction and Industrial Plywood" for plywood construction panels and, for products not manufactured under PS 1 provisions, with APA PRP-108. Trademark: Furnish construction panels that are each factory-marked with APA trademark evidencing compliance with grade requirements.

I. CONCEALED PERFORMANCE-RATED CONSTRUCTION PANELS

Where construction panels are indicated for the following concealed types of applications, provide APA Performance-Rated Panels complying with the requirements designated under each application for grade designation, span rating, exposure durability classification, edge detail (where applicable), and thickness.

1. Wall Sheathing: APA RATED SHEATHING, Exterior Grade, thickness noted on drawings.
2. Roof Sheathing: APA RATED SHEATHING, Exterior Grade of thickness shown on drawings.
3. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade designation, APA C-D PLUGGED EXPOSURE 1, in thickness indicated, or, if not otherwise indicated, not less than 15/32 inch.

J. FASTENERS

General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

Where rough carpentry is exposed to weather, in ground contact. Or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.

Nails, Wire, Brads, and Staples: FS FF-N-105.

Power Driven Fasteners: National Evaluation Report NER-272.

Wood Screws: ANSI B18.61.

Lag Bolts: ANSI B18.2.1.

Bolts: Steel Bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.

K. METAL FRAMING ANCHORS

General: Provide metal framing anchors of type, size, metal, and finish indicated that comply with requirements specified including the following:

Current Evaluation/Research Reports: Provide products for which model code evaluation/research reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with the building code in effect for this Project.

Allowable Design Loads: Provide products for which manufacturer publishes allowable design loads that are determined from empirical data or by rational engineering analysis and that are demonstrated by comprehensive testing performed by a qualified independent testing laboratory.

Galvanized Steel Sheet: Steel sheet zinc-coated by hot-dip process on continuous lines prior to fabrication to comply with ASTM A 525 for Coating Designation G60 and with ASTM A 446, Grade (structural quality); ASTM A 526 (commercial quality); or ASTM A 527 (lock-forming quality); as standard with manufacturer for type of anchor indicated.

L. PRESERVATIVE WOOD TREATMENT BY PRESSURE PRODUCTS

General: Where lumber or plywood is indicated as preservative-treated wood or is specified herein to be treated, comply with applicable requirements of AWP Standards C2 (Lumber) and C9 (Plywood). Mark each treated item with the AWPB or SPIB Quality Mark Requirements.

Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items and the following:

Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

Wood framing members less than 18 inches above grade.

Wood floor plates installed over concrete slabs directly in contact with earth.

If cut after treatment, coat cut surfaces to comply with AWP M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

M. INSTALLATION, GENERAL

Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.

Set rough carpentry to required levels and lines, with members plumb and true to line and cut and fitted.

Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

Securely attach rough carpentry to substrate by anchoring and fastening as indicated.

Countersink nail heads on exposed carpentry work and fill holes.

Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate member where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

N. WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

Install wood grounds, nailers, blocking, and sleepers where shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

Attach substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

O. WOOD FRAMING, GENERAL

Framing Standard: Comply with N.F.P.A. "Manual for Wood Frame Construction," unless otherwise indicated.

Install framing members of size and spacing indicated.  
Anchor and nail as shown, and to comply with the following:

National Evaluation Report No. NER-272 for pneumatic or mechanical driven staples, P-Nails, and allied fasteners.

Publish requirements of manufacturer of metal framing anchors.

"Recommended Nailing Schedule" of referenced framing standard and with N.F.P.A. "National Design Specification for Wood Construction."

"Table 2304.9.1 – Fastening Schedule," of the International Building Code.

Do not splice structural members between supports.

Firestop concealed spaces of wood framed walls and partitions at each floor level and at the ceiling line of the top story. Where firestops are not automatically provided by the



framing system used, use closely fitted wood blocks of nominal 2-inch-thick lumber of the same width as framing members.

P. TERMITE CONTROL

New construction will require the foundation to be pre-treated for termites. If a soil treatment is used, it must be done after compaction. Disturbed areas must be re-treated. Forms and traps must be plastic or metal. A vapor barrier must be installed. Applications must be made within one foot of the foundation under adjoining slabs.

A licensed pest control contractor will be required to provide preventive treatment for termites. Preventative treatment must be provided by a registered pesticide approved by the local building officials. A certificate of pre-treatment will be presented to the Owner as part of the close-out documentation.

II. CAULKING

A. SCOPE

The work covered by this section includes the furnishing of all labor, materials and equipment for all caulking of doors, and for all joint sealants where required. All materials shall be brought on the job in labeled original containers and shall show quality, kind and manufacturer's name.

B. SUBMITTALS

Within sixty (60) days after award of Contract, and before any material are delivered to the job site, submit to the Engineer a complete list of all materials proposed to be furnished and installed under this portion of the work, making the submittal in accordance with the provisions of the General Conditions of these Specifications.

C. MATERIALS

Caulking Compound shall be an elastic waterproof acrylic latex caulking compound. Caulking compound shall be "Sonolac" as manufactured by Sonneborn Building Products Division, Contech, Inc., Minneapolis, Minnesota; "AC-20 Acrylic Latex" by Pecora Corp., Harleysville, Pennsylvania, or approved equal.

Color shall match adjacent work. Deliver caulking compound in manufacturer's original sealed containers.

Sealant: Polysulfide base sealant based on liquid polysulfide polymer manufactured by Thiokol Chemical Corporation, bearing Thiokol Chemical Corporation's "Tested and Approved Seal". Sealant shall be delivered to the job site in sealed containers, each bearing a "Tested and Approved" seal, manufacturer's name, and product designation. Sealant shall be two (2) part polysulfide base sealant conforming to Thiokol's Building Trade Performance Specification as follows:

- Class A (self-leveling) for joints in horizontal surfaces.
- Class B (non-sag) for joints in vertical surfaces.

Type I (Hardness: 20 35 Shore A) for caulking, glazing and sealing vertical surfaces and non traffic bearing horizontal surfaces.

Type II (Hardness: 35 45 Shore A) for caulking and sealing horizontal surfaces subject to foot and light vehicular traffic, or abrasion.

Thiokol shall be "Synthacaulk GC-5" by Pecora Corp., Harleysville, Pennsylvania; "Sonolastic Two Part" by Sonneborn Building Products Division, Contech, Inc., or approved equal. Color shall match the adjacent materials as closely as possible. Colors shall be selected by the Engineer. Where stock colors are not acceptable, special colors shall be prepared and furnished, as approved by the Engineer. Submit cured samples for Engineer's color selection.

Joint Filler: Back-up material for caulking and sealant shall be compressible in nature and shall have a proven record of compatibility with the sealant used. Glassyrod, PVC, Butyl or neoprene rod is acceptable -- expanded polyethylene foam, polyurethane foam, and similar gas-expanded foams are not acceptable.

D. INSTALLATION

Location: Polysulfide sealant shall be used for caulking all exterior joints of any type and elsewhere as indicated. Elastic caulking may be used for interior joints not requiring polysulfid sealant. Set all exterior thresholds in caulking. Caulk all joints in masonry walls; between masonry and concrete intersections; around all windows, door frames, louvers, pipes and other penetrations through walls, floors, and ceilings; joints in metal panels, fascias, etc., and all other joints required for a weathertight and/or neat workmanlike installation.

Application: Thoroughly clean all surfaces to be caulked so they will be clean, free from loose dirt, grease, etc., and dry. Surfaces that are to be caulked with polysulfide sealant must first be cleaned with Methyl-Ethyl- Keytone in strict accordance with manufacturer's directions. Install joint filler back-up material to provide proper caulking depth to width ratio according to sealant manufacturer's recommendations. Apply caulking with a gun with proper size nozzle. Use sufficient pressure to fill all voids and joints solidly. Remove excess caulking and leave surfaces neat, even, smooth, and clean; free of sags, blisters and irregularities. Application shall be according to manufacturer's directions and at least three (3) weeks ahead of painting.

E. CLEAN-UP

Upon completion of the work, all caulking and sealing compounds shall be removed from surrounding areas and all joints checked for watertightness and touched up as required. It shall be the Contractor's responsibility to provide a weathertight building.

END OF SECTION

## 205 SUBMITTALS

All submittals shall be accompanied by a transmittal letter and/or cover letter that includes the project name and number, the contract specification number under which the equipment is being supplied, the Equipment ID number of the equipment being referenced, and the submittal revision number as appropriate.

- 205.1 Contractor shall submit, for each bid item, the manufacturer's instructions and recommendations for installation, for subsequent testing of the units, and for ensuring they are in proper operation. These instructions shall be part of these specifications and binding on the contractor.
- 205.2 Contractor shall include, for each bid item, a work plan acceptable to the Engineer describing the duration and sequence of work. Plan shall be approved prior to commencement of work. All work requiring flow stoppage or removing equipment from service must be scheduled 48 hours in advance with Plant Superintendent. When flow stoppage is required for equipment installation, contractor shall have all necessary materials at the installation site prior to any flow stoppage, and shall proceed with installation of equipment to minimize downtime.
- 205.3 Contractor shall, within 15 days of issuance of Work Order, submit four (4) copies of the following items for review and approval - one (1) copy to be returned to Contractor following review, two (3) copies to be retained by Authority:
  - 205.3.1 Product Data and Information: Submit catalog data including rating and descriptive literature of all components and systems for approval by Authority. This shall include items required by 204.
  - 205.3.2 Itemized list with manufacturer's part numbers, part descriptions and a schedule of values (unit prices) for the equipment proposed for each location.
  - 205.3.3 Shop Drawings: Submit the following shop drawings for approval by Authority:
    - 205.3.3.1 Bill of materials including manufacturers' name and catalog number
    - 205.3.3.2 Outline drawing showing dimensions, arrangement, and identification of components and nameplate schedule for all units
    - 205.3.3.3 Individual schematic control diagrams for each unit.

205.3.3.4 Submittals should clearly identify items intended to be incorporated into the project. Mark or circle items clearly. Line through items or sizes that do not apply. Clearly identify where and what portion of the project the items are intended for use. Minimize "bundling" and separate important long lead time items out to coordinate and facilitate a review. Electrical and controls shall be submittal separately from related equipment.

205.3.4 Manufacturer's start up, certifications and training requirements:

Manufacturer's certification that the equipment is suitable and will perform within specification and manufacturer's design operating parameters for the locations and conditions herein specified. Manufacturer's services shall also include site visits by the Manufacturer's *Technical Representative's* prior to construction, during installation and for start-up, as necessary for an inspection, detailed start up report and Manufacturer's certification of proper installation. Submit the Manufacturer's start-up report(s) and certification(s) of proper installation when they become available to the Engineer and during the week the equipment being put into service. Included final copies of the Manufacturer's Start-up Certificates in the final O&Ms. Start-up report/Manufacturer's Certification should include pertinent start up details, equipment description, location, project information, complete initial set points, initial operational readings, equipment numbers and date and other pertinent system information for future operations and maintenance.

Training shall also be provided for the equipment and systems installed. Submit a draft training agenda, draft handouts, power point/video and a Manufacturer's Technical Representative's resume for acceptance prior to scheduling the start-up and training. Provide two separate training days, as coordinated with the Plant to accommodate both day and night shifts. The duration of the training should be a minimum of 4 hours per training day of classroom and field training or more, if recommended by the Manufacturer. A professional video services shall also be provided to cover both complete class room and field training sessions. Deliverables are to Include; the full training video on DVD with the final

O&Ms to the City. Provide additional standard Manufacturer's videos if available on the same DVD in the final O&M.

- 205.3.5 Safety Plan: This submittal will be checked for general conformance with Section 211 Safety requirements and applicable OSHA and local regulations. Notwithstanding, it is the Contractors responsibility to ensure that the plan is comprehensive and in full conformance with all applicable OSHA, federal, state and local regulations.
- 205.3.6 Work Plan: Submit for approval by Authority, the work plan clearly showing the work task sequencing plan and time requirements, including downtime durations. This shall include items required by 204.
- 205.3.7 Submit for approval by Authority, plans and specifications for any concrete pad, support, piping, or other construction modifications from original installation.
- 205.3.8 Warrantee Equipment Log: Submit within 90 calendar days from the issuing of the Notice to Proceed, a Warrantee Equipment Log draft spreadsheet complete with project equipment information and equipment numbers for review. From that point on, the log will be updated each month by the Contractor and be a handout in the Monthly Meetings. Upon project completion, the spread sheet shall be completed with all required information such as equipment numbers, start up dates, training dates, O&M dates and other relevant information and transmitted to the Owner for their future use in maintaining the equipment. A sample spread sheet is available upon request. The warrantee log will be used as the tool to establish and agree on equipment warrantee period start date(s).
- 205.3.9 Schedule of values: Submit for approval by the Authority prior to and for the pay application process a proposal bid item based schedule of values with appropriate breakdowns. Contractor will be required to make appropriate and sufficient breakdown based on bid items, areas of work, scope, Subcontractor efforts and such relevant information that the pay application process can be reviewed more easily, as directed by the Authority.

205.4 Operations and Maintenance Manuals:

- 205.4.1 Contractor shall furnish to the Engineer two (2) hard copies and one soft searchable PDF of a preliminary Operation and Maintenance Manual complete for each piece of equipment and associated control systems furnished and installed.
- 205.4.2 Contractor shall furnish to the Engineer four (4) copies of all final O & M manuals on CDs/jump drives. CDs or jump drives shall be formatted in searchable pdf and shall contain all printed material included in the hard copies. A separate pdf folder shall be created for each **Equipment** numbered piece of equipment, within which all files pertaining to that piece of equipment shall be located.
- 205.4.3 Prior to each area of work reaching 80 percent completion, Contractor shall submit to the Engineer for approval two (2) copies of the O&M manual with all specified materials and contents. Submittal of the approval copies shall be made with the partial payment request for the specified completion. Within 30 days after the Engineer's approval of the two-copy submittal, Contractor shall furnish to the Engineer the remaining four (4) hard copies of the manual and the two searchable PDF copies on CD/jump drives. Contractor shall submit any missing material for the manual prior to requesting certification of substantial completion. On equipment with and requiring O&Ms, training and start-up, the last 10% of payment shall be for those items completed prior to applying for full payment of that item (100% payment).
- 205.4.4 Format and Contents: Each O & M manual shall include the following:
  - 205.4.4.1 One copy of a completed **EQUIPMENT NAMEPLATE AND SUMMARY DATA** form.
  - 205.4.4.2 One copy of the equipment Start-Up report and Manufacture's certification of proper installation.
  - 205.4.4.3 One copy of the manufacturer's operating and maintenance instructions. Operating instructions include equipment start-up, normal operation, shutdown, emergency operation and troubleshooting. Maintenance instructions include equipment installation, calibration and adjustment, preventive and repair maintenance, troubleshooting, parts

list and recommended spare parts.

- 205.4.4.4 List of electrical relay settings and control and alarm contact settings.
- 205.4.4.5 Electrical interconnection wiring diagram for equipment furnished including all control and lighting systems
- 205.4.4.6 Record drawings showing as-built schematic control diagrams for each unit and one-line diagrams.
- 205.4.4.7 Cross-references where required between the appropriate sections of the Contractor's O&M manual and the manufacturers' manuals.
- 205.4.4.8 The Contractor shall provide all required warrantee paperwork completed and filled in by the Contractor for the City's use. The complete warrantee paperwork shall be specifically transmitted to the Plant Superintendent at time of start-up equipment being put into service and a separate copy be provided within the Final O&Ms also transmitted to the City.

205.5. Equipment Nameplate Information – Contractor shall, upon startup of each piece of equipment, complete the form, titled **EQUIPMENT NAMEPLATE AND SUMMARY DATA**, found at the end of this section, and shall include the completed form in the front of that equipment's respective O & M manual. The form shall be included with each O & M manual copy submitted. Equipment ID nameplate requirements are found in specification section 204.3.6 of these specifications.

205.6 Submittals shall be sent to the following address:

Stephen Tolar, P.E.

Holloway, Updike and Bellen, Inc.

905-A South 9<sup>th</sup> Street.

Broken Arrow, OK 74012

(918) 251-0717

stolar@hubengineers.com

## EQUIPMENT NAMEPLATE AND SUMMARY DATA

Equipment Number: \_\_\_\_\_

Description (Include size): \_\_\_\_\_

Project #: \_\_\_\_\_

Spec. #: \_\_\_\_\_

Vendor: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Model #: \_\_\_\_\_

\*Item or Drawing # \_\_\_\_\_

\*Serial #: \_\_\_\_\_

Purchase Price: \$ \_\_\_\_\_

Date Placed in Service (for 1-yr Warranty): \_\_\_\_\_

Manufacturer's Warranty Period and End Date: \_\_\_\_\_

Parts / Associated Details: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### Maintenance Schedule

(May be an attached sheet from O&M Manual; do not use "See O&M Manual")

✓ Initial: \_\_\_\_\_

✓ Weekly: \_\_\_\_\_

✓ Monthly: \_\_\_\_\_

✓ Semi-Annual: \_\_\_\_\_

✓ Annual: \_\_\_\_\_

### Applicable Motor Information:

N.A. (Circle if not applicable)

Vendor: \_\_\_\_\_

Manufacturer: \_\_\_\_\_

Model #: \_\_\_\_\_

Item #: \_\_\_\_\_

Serial #: \_\_\_\_\_

Frame: \_\_\_\_\_ Insul. Class: \_\_\_\_\_

Volts/Hz/Amps: \_\_\_\_\_

HP / RPM / SF: \_\_\_\_\_

Manufacturer's Warranty Period and End Date: \_\_\_\_\_

**\*Item or Drawing #** may not be unique. For example, it may be the same for a group of same size valves or gates, each one having this same number that is unique to the group. The **Serial #** should be listed only when unique to this individual piece of equipment, otherwise it is N.A.



## 206 MONTHLY PROGRESS REPORTS AND PROGRESS MEETINGS

- 206.1 The Contractor shall submit monthly written project progress reports detailing the project's progress to date, problems encountered or anticipated which impact project schedule, and plans for the next two weeks' work.
- 206.2 Project progress reports shall be due as agreed upon during pre-work meeting.
- 206.3 Monthly progress meetings shall be scheduled on a weekday mutually agreeable to the Authority and the Contractor and shall be specified at the pre-work conference. The Contractor shall run the Monthly Meetings for the duration of the project and provide a meeting agenda including work completed, work planned, project, updated project schedule and other pertinent project status information.
- 206.4 The contractor shall submit a work progress and planned completion schedule for each bid item at the monthly progress meeting. The pre-work conference will constitute the first monthly progress meeting.
- 206.5 The Contractor shall maintain, update and submit an Equipment Log at each monthly meeting that lists each piece of equipment by Equipment ID number and lists Startup Date, Warranty Start Date and O&M Manual Submittal Date, among other project details. The spread sheet document shall be a shared document and submitted to the City at the end of the project for City's future use. A sample Equipment log is available upon request.

## 207 SECURITY

- 207.1 Each project site where work is to be performed under this Contract is a secured site. The Contractor shall be responsible for security as described in this section.
- 207.2 Site Access: The Contractor shall respect all existing security measures at each project site, and shall implement the following measures to apply to all work performed under this Contract. Coordination for Plant access and City of Tulsa security pass access will be required.
  - 207.2.1 Work at both Northside and Southside shall be restricted to the hours defined by TMUA GC-19 unless otherwise authorized by the Plant Superintendent.
- 207.3 Common Requirements
  - 208.3.1 Identification Badges: An Identification Badge, issued by the City of Tulsa Security Office, is required for the following people:

- The driver of each vehicle that will be entering the facility multiple times or on a regular basis.

- Sub-contractors and foremen that will be supervising other workers.

The Identification Badge also functions as an Access Card to allow access through the front gate of the facility. One year is the maximum time that an Access Card is active.

208.3.2 Contractor will coordinate with the Engineer to request Identification Badges. Application for an Identification Badge will require a background investigation. Each person that is applying for an Identification Badge will need to complete the following two (2) forms:

- City of Tulsa Access Card / Identification Card Request Form
- City of Tulsa Security, Background and Prescreen Investigation Form

A current soft copy of the forms can be obtained from the Engineer.

208.3.3 The Contractor will send the completed forms as required. Approved individuals will coordinate with the City of Tulsa Security Office to complete the process and obtain their Identification Badge.

208.3.4 The Contractor will coordinate with the Engineer to request reactivation of Access Cards. Reactivation may require re-application and additional background investigation.

207.4 Contractor shall maintain a log book listing as a minimum the names of all persons admitted to each secured site by the Contractor, the purpose of the site visit, the dates and times of arrival at the site, entry to the secured site, and departure from the site.

207.5 Contractor and Authority acknowledge that Contractor shall not solely be responsible for all secured access to the site, that City personnel will have access and will be performing their regular duties pertaining to the operation and maintenance of the site facilities, and that security at the site shall require the cooperation of all persons authorized to access the site for the performance of their work. To the extent the Contractor is responsible for and has control of secured access, Contractor shall restrict site access to only persons essential to the performance or inspection of the work being performed under this Contract.

- 207.6 Contractor shall provide Engineer twenty-four (24) hours advance notification of any delivery of equipment or materials to the site, and shall make arrangements with Engineer to provide for inspection of such delivery.
- 207.7 Any observation by the Contractor of activity at or associated with the project site that Contractor observes and considers to be unusual or suspicious in nature, or that Contractor believes poses a threat to the integrity or welfare of the project site or associated facilities, shall be duly noted at the time of the observation in the log book identified in item B above. Any such observation shall be immediately reported to the Engineer.
- 207.8 No statement pertaining to security in these Specifications shall constitute a contract between Contractor and Authority for the performance of security services.

## 208 SAFETY

- 208.1 Contractor shall be responsible for performing all work under this contract in a safe manner and in compliance with all applicable local, state, and federal safety and health regulations. All of the following requirements shall apply:
- 208.2 Contractor shall submit a site safety plan prior to start of work. Contractor's attention is directed to safety regulations applicable to the work under this contract, which include but are not limited to the following:
  - 208.2.1 OSHA Standards 29CFR1910.147, the control of hazardous energy (Lockout/Tagout)
  - 208.2.2 Fire Prevention and Protection: The Contractor shall take all necessary measures to prevent fire, and shall provide satisfactory firefighting means at the location of work.
  - 208.2.3 Condition of Equipment and Materials: All equipment, tools, and 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.
  - 208.2.4 Confined Space Entry: Contractor shall determine if any work areas in this contract are considered permit spaces for entry, as defined in OSHA regulations, and shall perform all work so determined in accordance with all applicable state and federal labor, safety, and health regulations. The Contractor shall transmit with each pay application all the months copies of the Contractors confined space permits to the City and at the end of

the project with final pay application submittal a complete package of a copy of all the project's Contactor confined space permits.

- 208.2.5 Combustible - Explosive Atmospheres: Contractor shall determine if any work areas in this contract are considered combustible and explosive spaces for entry, as defined in OSHA regulations, and shall perform all work and employ equipment in accordance with all applicable state and federal labor, safety, and health regulations.

## 209 PROTECTION OF PROPERTY

- 209.1 The protection of City, State and Government equipment, fences, gates, signs, and other City property is of prime importance, and if 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 which controls it.
- 209.2 No valve or other control on any utility main or building service line shall be operated for any purpose by the Contractor.
- 209.3 At places where the Contractor's operations are adjacent to, or crossing, the plane of railway, telegraph, telephone, 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 then (10) days nor later than forty-eight (48) hours prior to start of work, excluding Saturdays, Sundays, and legal holidays.
- 209.4 The Authority 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.
- 209.5 It shall be the responsibility of the contractor to follow all rules and regulations set forth by the Oklahoma Department of Environmental Quality with regards to storm water runoff associated with construction activities involving the disturbance of

land. The contractor shall review the regulations and determine if a DEQ storm water discharge permit is required. If a permit is required, it is the responsibility of the contractor to apply for and obtain the permit prior to disturbance of soil. If a permit is not required, the contractor shall still take all necessary action to comply with DEQ rules.

- 209.6 In the event the contractor in any way fails to comply with the requirement of protecting, repairing, and restoring of any utility or utility service, the Engineer may, upon forty-eight (48) hours' 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.

## 210 PROTECTION OF MATERIALS

- 210.1 All materials and equipment delivered to the work site shall be adequately housed and protected against damage or deterioration as required by the equipment manufacturer. The Contractor shall keep his storage yard(s) in good order, arrange his materials neatly, and protect them from damage.

## 211 REFERENCES TO OTHER SPECIFICATIONS

- 211.1 Where a referenced American Society for Testing Materials (ASTM), National Electric Code (NEC), National Electrical Manufacturers Association (NEMA), American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE), or other agency designated specification is specified for a material, component, or device, that designated specification shall be the current revision, either tentative or adopted. If a referenced specification is in disagreement with these specifications, the Tulsa Metropolitan Utility Authority specifications shall govern.

## 212 CLEAN-UP

- 212.1 Immediately upon completion of the work at each site in the contract, the Contractor shall remove all excess materials, equipment, tools, and debris, and restore the site to a condition and in a manner satisfactory to the Engineer.

## 213 PLACING WORK IN SERVICE

- 213.1 If desired by the Authority, portions of the work may be returned to 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. Any

such return to service shall comply with Section GC-38 of the General Conditions of these Contract Documents and Specifications.

213.2 Warranty: All equipment and work shall have a one (1) year factory warranty from date of acceptance, which shall include all materials and labor.

214 PAYMENT

214.1 Contractor shall submit a schedule of values for all major items of work as a basis for each partial payment. Payments will be made in accordance with section GC-29 of the General Conditions of these Contract Documents and Specifications. Contractor shall submit the SOV in sufficient time prior to the first pay application for the Engineer's review. Contractor should anticipate a typical submittal review durations for the projects SOV review.

214.2 Contractor's attention is directed to the Sales Tax Exemption Document in these Contract Documents and Specifications. Contractor shall have the option of instructing vendors to directly bill the Authority for materials the Contractor purchases while performing work under the terms of this Contract.

END OF SECTION

