

# PROJECT MANUAL

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NEW RIVER CANAL TILTING WEIR  
ASCENSION PARISH  
HDCA PROJECT NO. 2021-14

Prepared For:



ASCENSION PARISH GOVERNMENT  
DEPARTMENT OF PUBLIC WORKS  
42077 CHURCHPOINT ROAD  
GONZALES, LA 70737

Prepared By:



H. Davis Cole &  
Associates, LLC  
Consulting Engineers

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100% DESIGN SUBMITTAL

**REVISION HISTORY**

<b>Date</b>	<b>Description</b>
<b>01/2022</b>	<b>50% Submittal</b>
<b>03/2022</b>	<b>100% Submittal</b>

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**PUBLIC WORKS BID FORM**

**TO:** *Ascension Parish Government*    **BID FOR:**    **NEW RIVER TILTING WEIR**  
*P.O. Box 2392*  
*Gonzales, Louisiana 70707*

The undersigned bidder hereby declares and represents that she/he; a) has carefully examined and understands the Bidding Documents, b) has not received, relied on, or based his bid on any verbal instructions contrary to the Bidding Documents or any addenda, c) has personally inspected and is familiar with the project site, and hereby proposes to provide all labor, materials, tools, appliances and facilities as required to perform, in a workmanlike manner, all work and services for the construction and completion of the referenced project, all in strict accordance with the Bidding Documents prepared by: H. Davis Cole & Associates, LLC (HDCA) and dated: January, 2022 .  
*(Owner to provide name of entity preparing bidding documents.)*

Bidders must acknowledge all addenda. The Bidder acknowledges receipt of the following **ADDENDA:** (Enter the number the Designer has assigned to each of the addenda that the Bidder is acknowledging)  
\_\_\_\_\_.

**TOTAL BASE BID:** For all work required by the Bidding Documents (including any and all unit prices designated "Base Bid" but not alternates) the sum of:

\_\_\_\_\_ Dollars (\$ \_\_\_\_\_)

**ALTERNATES:** For any and all work required by the Bidding Documents for Alternates including any and all unit prices designated as alternates in the unit price description.

**Alternate No. 1** *(Owner to provide description of alternate and state whether add or deduct)* for the lump sum of:

\_\_\_\_\_ N/A \_\_\_\_\_ Dollars (\$ \_\_\_\_\_ N/A \_\_\_\_\_)

**Alternate No. 2** *(Owner to provide description of alternate and state whether add or deduct)* for the lump sum of:

\_\_\_\_\_ N/A \_\_\_\_\_ Dollars (\$ \_\_\_\_\_ N/A \_\_\_\_\_)

**Alternate No. 3** *(Owner to provide description of alternate and state whether add or deduct)* for the lump sum of:

\_\_\_\_\_ N/A \_\_\_\_\_ Dollars (\$ \_\_\_\_\_ N/A \_\_\_\_\_)

**NAME OF BIDDER:** \_\_\_\_\_

**ADDRESS OF BIDDER:** \_\_\_\_\_

**LOUISIANA CONTRACTOR'S LICENSE NUMBER:** \_\_\_\_\_

**NAME OF AUTHORIZED SIGNATORY OF BIDDER:** \_\_\_\_\_

**TITLE OF AUTHORIZED SIGNATORY OF BIDDER:** \_\_\_\_\_

**SIGNATURE OF AUTHORIZED SIGNATORY OF BIDDER \*\* :** \_\_\_\_\_

**DATE:** \_\_\_\_\_

**THE FOLLOWING ITEMS ARE TO BE INCLUDED WITH THE SUBMISSION OF THIS LOUISIANA UNIFORM PUBLIC WORK BIDFORM:**

\* The Unit Price Form shall be used if the contract includes unit prices. Otherwise it is not required and need not be included with the form. The number of unit prices that may be included is not limited and additional sheets may be included if needed.

\*\* **A CORPORATE RESOLUTION OR WRITTEN EVIDENCE** of the authority of the person signing the bid for the public work as prescribed by LA R.S. 38:2212(B)(5).

**BID SECURITY** in the form of a bid bond, certified check or cashier's check as prescribed by LA RS 38:2218.A is attached to and made a part of this bid.



**LOUISIANA UNIFORM PUBLIC WORKS BID FORM**  
**UNIT PRICE FORM**

**TO: Ascension Parish Government**  
**P.O. Box 2392**  
**Gonzales, Louisiana 70707**

**BID FOR: NEW RIVER TILTING WEIR**

**UNIT PRICES: This form shall be used for any and all work required by the Bidding Documents and described as unit prices. Amounts shall be stated in figures and only in figures.**

DESCRIPTION:	<input checked="" type="checkbox"/> Base Bid or <input type="checkbox"/> Alt.# SEEPAGE CUTOFF SHEET PILE WALL			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
1	1400	SQUARE FOOT		

DESCRIPTION:	<input checked="" type="checkbox"/> Base Bid or <input type="checkbox"/> Alt.# DRAINAGE EXCAVATION FOR WEIR			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
2	380	CUBIC YARDS		

DESCRIPTION:	<input checked="" type="checkbox"/> Base Bid or <input type="checkbox"/> Alt.# CLEARING AND GRUBBING			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
3	0.25	ACRE		

DESCRIPTION:	<input checked="" type="checkbox"/> Base Bid or <input type="checkbox"/> Alt.# REMOVE EXISTING WEIR			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
4	1	LUMP SUM		

DESCRIPTION:	<input checked="" type="checkbox"/> Base Bid or <input type="checkbox"/> Alt.# RIP RAP – 30 POUND CLASS			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
5	350	SQUARE YARD		

DESCRIPTION:	<input checked="" type="checkbox"/> Base Bid or <input type="checkbox"/> Alt.# DRIVEN PILES			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
6	600	LINEAR FOOT		

DESCRIPTION:	<input checked="" type="checkbox"/> Base Bid or <input type="checkbox"/> Alt.# CAST-IN PLACE STRUCTURAL CONCRETE - FOUNDATION			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
7	73	CUBIC YARD		

DESCRIPTION:	<input checked="" type="checkbox"/> Base Bid or <input type="checkbox"/> Alt.# DEFORMED REINFORCING STEEL - FOUNDATION			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
8	1600	POUNDS		

DESCRIPTION:	<input checked="" type="checkbox"/> Base Bid or <input type="checkbox"/> Alt.# CAST-IN PLACE STRUCTURAL CONCRETE – WALLS			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
9	30	CUBIC YARD		



DESCRIPTION:	☒ Base Bid or ☐ Alt.# DEFORMED REINFORCING STEEL - FOUNDATION			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
10	2375	POUNDS		

DESCRIPTION:	☒ Base Bid or ☐ Alt.# METAL GRATING			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
11	246	SQUARE FOOT		

DESCRIPTION:	☒ Base Bid or ☐ Alt.# STRUCTURAL STEEL FOR METAL GRATING SUPPORT			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
12	3500	POUNDS		

DESCRIPTION:	☒ Base Bid or ☐ Alt.# ALUMINUM HANDRAILS AND KICKPLATES			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
13	200	LINEAR FOOT		

DESCRIPTION:	☒ Base Bid or ☐ Alt.# CARBON STEEL WEIR GATE ASSEMBLIES			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
14	5	EACH		

DESCRIPTION:	☒ Base Bid or ☐ Alt.# GENERAL ELECTRICAL WORK			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
15	1	LUMP SUM		

DESCRIPTION:	☒ Base Bid or ☐ Alt.# CONSTRUCTION LAYOUT			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
	1	LUMP SUM		

DESCRIPTION:	☒ Base Bid or ☐ Alt.# MOBILIZATION / DEMOBILIZATION			
REF. NO.	QUANTITY:	UNIT OF MEASURE:	UNIT PRICE	UNIT PRICE EXTENSION ( <i>Quantity times Unit Price</i> )
	1	LUMP SUM		



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**LOUISIANA UNIFORM PUBLIC WORK BID FORM**

**TO:** Ascension Parish Government  
Department of Public Works  
42077 Churchpoint Road  
Gonzales, Louisiana 70737  
*(Owner to provide name and address)*

**BID FOR:** Tiltling Weir at New River and US61  
HDCA Project No. 2021-14  
\_\_\_\_\_  
\_\_\_\_\_  
*(Owner to provide name of project)*

The undersigned bidder hereby declares and represents that she/he; a) has carefully examined and understands the Bidding Documents, b) has not received, relied on, or based his bid on any verbal instructions contrary to the Bidding Documents or any addenda, c) has personally inspected and is familiar with the project site, and hereby proposes to provide all labor, materials, tools, appliances and facilities as required to perform, in a workmanlike manner, all work and services for the construction and completion of the referenced project, all in strict accordance with the Bidding Documents prepared by: \_\_\_\_\_  
H. Davis Cole & Associates, LLC and dated: March, 2022.  
*(Owner to provide name of entity preparing bidding documents.)*

Bidders must acknowledge all addenda. The Bidder acknowledges receipt of the following **ADDENDA:**(Enter the number the Designer has assigned to each of the addenda that the Bidder is acknowledging) \_\_\_\_\_

**TOTAL BASE BID:** For all work required by the Bidding Documents (including any and all unit prices designated "Base Bid"\* but not alternates) the sum of: \_\_\_\_\_ Dollars (\$ \_\_\_\_\_)

**ALTERNATES:** For any and all work required by the Bidding Documents for Alternates including any and all unit prices designated as alternates in the unit price description.

**Alternate No. 1** *(Construct additional aluminum safety rail on drainage pump station deck, Additive)* for the lump sum of:  
\_\_\_\_\_ N/A \_\_\_\_\_ Dollars (\$ \_\_\_\_\_ N/A \_\_\_\_\_)

**Alternate No. 2** *(Construct access platforms beneath drainage pump station deck, Additive)* for the lump sum of:  
\_\_\_\_\_ N/A \_\_\_\_\_ Dollars (\$ \_\_\_\_\_ N/A \_\_\_\_\_)

**Alternate No. 3** *(Install new protective coatings for safe house facility, Additive)* for the lump sum of:  
\_\_\_\_\_ N/A \_\_\_\_\_ Dollars (\$ \_\_\_\_\_ N/A \_\_\_\_\_)

**NAME OF BIDDER:** \_\_\_\_\_  
**ADDRESS OF BIDDER:** \_\_\_\_\_  
**LOUISIANA CONTRACTOR'S LICENSE NUMBER:** \_\_\_\_\_  
**NAME OF AUTHORIZED SIGNATORY OF BIDDER:** \_\_\_\_\_  
**TITLE OF AUTHORIZED SIGNATORY OF BIDDER:** \_\_\_\_\_  
**SIGNATURE OF AUTHORIZED SIGNATORY OF BIDDER\*\*:** \_\_\_\_\_  
**DATE:** \_\_\_\_\_

**THE FOLLOWING ITEMS ARE TO BE INCLUDED WITH THE SUBMISSION OF THIS LOUISIANA UNIFORM PUBLIC WORK BID FORM:**

\* The Unit Price Form shall be used if the contract includes unit prices. Otherwise it is not required and need not be included with the form. The number of unit prices that may be included is not limited and additional sheets may be included if needed.

\*\* **A CORPORATE RESOLUTION OR WRITTEN EVIDENCE** of the authority of the person signing the bid for the public work as prescribed by LA R.S. 38:2212(B)(5).

**BID SECURITY** in the form of a bid bond, certified check or cashier's check as prescribed by LA RS 38:2218.A is attached to and made a part of this bid.

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## SECTION 01010 – GENERAL REQUIREMENTS (REV 11/13/2017)

### PART 1 -- GENERAL

#### 1.1 ABBREVIATIONS OF INSTITUTIONS

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

B. Abbreviations:

AA	Aluminum Association
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABMA	American Bearing Manufacturer's Association – ABMA
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
AF&PA	American Forest and Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHAM	Association of Home Appliance Manufacturers
AI	The Asphalt Institute
AIA	American Institute of Architects
AIHA	American Industrial Hygiene Association
AIIM	Association for Information and Image Management
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Movement and Control Association International, Inc
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	The Engineered Wood Association
API	American Petroleum Institute
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
ASQ	American Society for Quality
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWCI	American Wire Cloth Institute
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association

AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CABO	Council of American Building Officials
CDA	Copper Development Association
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CMAA	A division/section of the Material Handling Industry of America
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drilling Manufacturer's Association
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EASA	Electrical Apparatus Service Association
EI	Energy Institute
EIA	Electronic Industries Alliance
EPA	Environmental Protection Agency
ETL	Electrical Test Laboratories
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
FEMA	Federal Emergency Management Association
FHWA	Federal Highway Administration
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute, Hydraulic Institute
HSWA	Federal Hazardous and Solid Waste Amendments
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
ICCEC	Electrical Code
ICC-ES	International Code Council Evaluation Service
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFC	International Fire Code
IFGC	International Fuel Gas Code
IMC	International Mechanical Code
IME	Institute of Makers of Explosives
IPC	International Plumbing Code, Association Connecting Electronic Industries
IRC	International Residential Code
ISA	Instrument Society of America
ISDI	Insulated Steel Door Institute
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
ITU-T	Telecommunications Standardization Sector of the International Telecommunications Union
LDOTD	Louisiana Department of Transportation and Development

LPI	Lightning Protection Institute
LRQA	Lloyd's Register Quality Assurance
MBMA	Metal Building Manufacturer's Association
MIL	Military Standards (DoD)
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
DASMA	Door and Access Systems Manufacturers Association International
NAPF	National Association of Pipe Fabricators
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NCCLS	National Committee for Clinical Laboratory Standards
NCMA	National Concrete Masonry Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association or National Fluid Power Association
NISO	National Information Standards Organization
NIST	National Institute of Standards and Technology
NLGI	National Lubricating Grease Institute
NRCA	National Roofing CONTRACTORs Association
NSF	National Sanitation Foundation
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PPI	Plastic Pipe Institute
RCRA	Resource Conservation and Recovery Act
RMA	Rubber Manufacturers Association
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SDI	Steel Door Institute, Steel Deck Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning CONTRACTORs National Association
SPFA	Steel Plate Fabricator's Association
SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coating
SSPWC	Standard Specifications for Public Works Construction
STLE	Society of Tribologists and Lubricating Engineers
TAPPI	Technical Association of the Worldwide Pulp, Paper, and Converting Industry
TFI	The Fertilizer Institute
TIA	Telecommunications Industries Association
TPI	Truss Plate Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WDMA	National Window and Door Manufacturers Association
WEF	Water Environment Federation
WI	Woodwork Institute
WRI	Wire Reinforcement Institute, Inc.

## 1.2 REFERENCE STANDARDS

- A. **Titles of Sections and Paragraphs:** Titles and subtitles accompanying specification sections and paragraphs are for convenience and reference only, and do not form a part of the Specifications.
- B. **Applicable Publications:** Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Contract is advertised for bids shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth in the Specifications or shown on the Drawings will be waived because of any provision of, or omission from, said standards or requirements.
- C. References herein to "Building Code" shall mean The International Building Code (IBC) latest edition. Similarly, references to "Mechanical Code", "Plumbing Code" and, "Fire Code" shall mean International Mechanical Code, International Plumbing Code and International Fire Code of the International Conference of the Building Officials (ICBO). "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA). The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the WORK is advertised for bids, as adopted by the agency having jurisdiction, shall apply to the WORK herein, including all addenda, modifications, amendments, or other lawful changes thereto.
- D. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing any materials or furnishing labor. The CONTRACTOR shall bid for the most stringent requirements.
- E. References herein to "OSHA Regulations for Construction" shall mean **Title 29, Part 1926, Construction Safety and Health Regulations**, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- F. References herein to "OSHA Standards" shall mean **Title 29, Part 1910, Occupational Safety and Health Standards**, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- G. The CONTRACTOR shall be responsible that all work included in the Contract Documents, regardless if shown or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of hazardous materials, including petroleum products. Where no specific regulations exist, chemical, hazardous, and petroleum product piping and storage in underground locations shall be installed with double containment piping and tanks, or in separate concrete trenches and vaults, or with an approved lining which cannot be penetrated by the chemicals, unless waived in writing by the OWNER.

### 1.3 APPLICATIONS FOR PAYMENT

- A. Applications for Payment shall contain both an application and continuation pages, along with all substantiating documentation detailed herein or as deemed necessary by the ENGINEER. The application and continuation sheets shall be typed in the format specified herein and created on 8-1/2" x 11" paper.
- B. The CONTRACTOR shall submit Applications for Payment typed on American Institute of Architects (AIA) Form G-702. Continuation sheets shall be submitted on American Institute of Architects (AIA) Form G-703.
- C. The CONTRACTOR shall populate the application form (AIA G-702) in accordance with the form instructions and as prescribed below:
  - 1) Include required information, including Change Orders executed prior to the date of the application;
  - 2) Include summary of dollar amounts to agree with totals depicted within continuation sheets;
  - 3) Execute certification by a Corporate Principal.
  - 4) The signed application form shall be notarized by a Notary Public Registered in the State of Louisiana.
- D. The CONTRACTOR shall submit Applications for Payment typed on American Institute of Architects (AIA) Form G-702. Continuation sheets shall be submitted on American Institute of Architects (AIA) Form G-703.
- E. The CONTRACTOR shall populate the application form (AIA G-702) in accordance with the form instructions and as prescribed below:
  - 1) If the project is to be conducted under a Lump Sum Contract, include list of all scheduled items of the WORK per the Schedule of Values with each as a single line item. Include list of all payment items included in Section 01025 – Measurement and Payment with each as a single line item.
  - 2) Fill in dollar amount in each column for each line item on the continuation page.
  - 3) List each Change Order executed prior to date of submission at the end of the continuation pages.
  - 4) Submit copies of paid invoices for stored materials, along with photos of stored materials in the amount and quality deemed acceptable by the ENGINEER.
- F. The CONTRACTOR shall submit applications for Payment to the ENGINEER at the times stipulated in the General Conditions.
- G. Prior to submittal of the completed Application for Payment, the CONTRACTOR shall submit to the ENGINEER an electronic copy of a "draft" Application for Payment, including all substantiating documentation for review. The draft application shall be

created in Adobe Acrobat Portable Document Format (.PDF). The CONTRACTOR shall undertake all revisions as required by the ENGINEER prior to submitting the completed application for payment.

- H. When the ENGINEER finds the application for payment correct, he will instruct the CONTRACTOR to submit the completed application for approval and transmittal to the OWNER. The CONTRACTOR shall submit the number of applications for payment as determined at the pre – construction conference.
- I. The ENGINEER will not collate or assemble Applications for Payment. Assembly of the Application for Payment shall be the sole responsibility of the CONTRACTOR.
- J. The CONTRACTOR shall submit construction progress photographs documenting progress of the WORK with applications for payment.
- K. The CONTRACTOR shall submit construction progress narratives documenting the progress of the WORK with applications for payment.

#### **1.4 CHANGE ORDER PROCEDURES**

- A. The CONTRACTOR shall implement and abide by the procedures for Change Orders as specified herein and the General Conditions.
- B. The CONTRACTOR shall:
  - 1) Provide full written data as required or requested for the evaluation of changes by the OWNER and ENGINEER;
  - 2) Maintain detailed records of work done on a time – and – material or force account basis;
  - 3) Provide full documentation to the ENGINEER upon request.
- C. The CONTRACTOR shall designate in writing the member of the CONTRACTOR's organization who is authorized to accept changes in the WORK and who is responsible of informing others in the CONTRACTOR's employ of the authorization for changes in the WORK.
- D. The OWNER will designate in writing the person who is authorized to execute change orders.
- E. The OWNER or ENGINEER may initiate changes to the WORK by submitting a Proposal Request to the CONTRACTOR. Such a request is to be for information only and shall not be construed as an authorization to execute the WORK. This request will include, but not necessarily be limited to, the following items:
  - 1) Detailed description of the proposed change, products, and location of the proposed change to the WORK;
  - 2) Supplementary or revised drawings and/or specifications;
  - 3) Projected time for making the change, and a specific statement as to whether or not overtime work is or is not authorized;



- 4) A specific period of time for which the requested price is to remain valid.
- F. The CONTRACTOR may initiate a request for changes to the WORK by submitting a written notice to the ENGINEER containing at a minimum the following items:
- 1) A description of the proposed changes;
  - 2) Statement of the reason for making the changes
  - 3) Statement of the effect on the Contract Price and Contract Time;
  - 4) Statement of the effect on the work of separate CONTRACTORS;
  - 5) Documentation supporting any change in the Contract Sum or Contract Time, as appropriate.
- G. The CONTRACTOR shall support each quotation for a lump-sum proposal, and for each unit price which has not previously been established, with sufficient substantiating data to allow Engineer to evaluate the quotation.
- H. On request of the ENGINEER or OWNER, the CONTRACTOR shall provide additional data to support time and cost computations, such as the following:
- 1) Labor Required;
  - 2) Equipment Required;
  - 3) Products required (recommended source of purchase and unit cost, quantities required);
  - 4) Taxes, insurance, and bonds;
  - 5) Credit for WORK deleted from the Contract;
  - 6) Overhead and Profit;
  - 7) Justification for any changes in the Contract Time.
- I. The CONTRACTOR shall support each claim for additional costs, and for work done on a time-and-material/force account basis, with documentation as required for a lump-sum proposal, plus additional information, such as the following:
- 1) Name of the OWNER's authorized agent who ordered the work, and date of the order;
  - 2) Dates and time work was performed, and by whom;
  - 3) Time record, summary of hours worked, and hourly rates paid;
  - 4) Receipts and invoices for equipment used listing dates and times of use;
  - 5) Receipts and invoices for products used, including quantities;

- 6) Receipts and invoices for subcontracts.
- J. The ENGINEER will prepare each Change Order.
- K. The form for Change Orders shall be the OWNER's standard form, which will be provided to the CONTRACTOR. A copy of the OWNER's standard form is included within this specification for the CONTRACTOR's information.
- L. The Change Order will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change.
- M. The Change Order will provide an accounting of adjustment in the Contract Sum and Contract Times.
- N. The content of Lump Sum/Fixed Price Change Orders will be based on, either:
- 1) ENGINEER's Proposal Request and CONTRACTOR's responsive proposal as mutually agreed upon between OWNER and CONTRACTOR;
  - 2) CONTRACTOR's Proposal for change to the WORK, as recommended by the ENGINEER.
- O. OWNER and ENGINEER will sign and date the Change Order as authorization for the CONTRACTOR to proceed with the changes.
- P. CONTRACTOR may sign and date the Change Order to indicate agreement with the terms therein.
- Q. The content of Unit Price Change Orders will be based on, either:
- 1) ENGINEER'S definition of scope of the required Changes in the WORK;
  - 2) CONTRACTOR's proposal for a Changes in the WORK, as recommended by the ENGINEER;
  - 3) Survey of completed work.
- R. The amounts of the unit prices shall be either:
- 1) Those stated in the Agreement;
  - 2) Those mutually agreed upon between OWNER and CONTRACTOR.
- S. When quantities of the items affected by the Change Order can be determined prior to the start of the work, the following procedure shall be employed:
- 1) OWNER and ENGINEER will sign and date the Change Order as authorization for the CONTRACTOR to proceed with the changes;
  - 2) CONTRACTOR may sign and date the Change Order to indicate agreement with the terms therein.

- T. When quantities of the items affected by the Change Order cannot be determined prior to the start of the work, the following procedure shall be employed:
- 1) The ENGINEER or OWNER will issue a construction change authorization directing CONTRACTOR to proceed with the change on the basis of unit prices, and will cite the applicable unit prices.
  - 2) At the completion of the change, the ENGINEER will determine the cost of such work based upon the unit prices and quantities of work performed. The CONTRACTOR shall submit documentation sufficient in the opinion of the ENGINEER to establish the change in Contract Sum and Contract Time.
  - 3) The ENGINEER will sign and date the Change Order to establish the change in Contract Sum and Contract Time.
  - 4) OWNER and CONTRACTOR will sign and date the Change Order to indicate their agreement with the terms included therein.
- U. The CONTRACTOR shall periodically revise Schedule of Values and application for payment forms to record each change as a separate item of WORK, and to reflect the adjusted Contract Price.
- V. The CONTRACTOR shall periodically revise the Construction Schedule to reflect Change Orders as specified herein.
- W. Upon completion of WORK under a Change Order, the CONTRACTOR shall enter pertinent changes into the Record Documents.

#### 1.5 CONTRACTOR SUBMITTALS

- A. Wherever submittals are required in the Contract Documents, submit them to the ENGINEER.
- B. **Shop Drawings:** Wherever called for in the Contract Documents or where required by the ENGINEER, the CONTRACTOR shall furnish to the ENGINEER for review, a number and type of each Shop Drawing submittal as established by the OWNER or ENGINEER. Shop Drawings may include detail design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items. Whenever the CONTRACTOR is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is located, unless otherwise indicated. Shop drawing submittals shall be accompanied by the CONTRACTOR's standard submittal transmittal form. Submittals shall be signed by the CONTRACTOR as an indication that they have been reviewed for completeness and organization.
- 1) **Organization:** A single submittal transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple sections will not be acceptable, unless the primary specification references other sections for components. Example: if a pump section references other sections for the motor, shop-applied protective coating,

anchor bolts, local control panel, and variable frequency drive, a single submittal would be acceptable. A single submittal covering vertical turbine pumps and horizontal split case pumps would not be acceptable.

- 2) Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match those used in the Contract Documents.
- 3) Each submittal shall be assigned a unique number. Submittals shall be numbered sequentially, and the submittal numbers shall be clearly noted on the transmittal. Original submittals shall be assigned a numeric submittal number followed by a letter of the alphabet to distinguish between the original submittal and each resubmittal. For example, if submittal 25-A requires a resubmittal, the first resubmittal will bear the designation "25-B" and the second resubmittal will bear the designation "25-C" and so on.
- 4) Disorganized submittals that do not meet the requirements of the Contract Documents will be returned without review.
- 5) Except as may otherwise be indicated, the ENGINEER will return a copy of each submittal to the CONTRACTOR with comments noted thereon, within 30 Days following receipt by the ENGINEER. It is considered reasonable that the CONTRACTOR will make a complete and acceptable submittal to the ENGINEER by the first resubmittal on an item. The OWNER reserves the right to withhold monies due to the CONTRACTOR to cover additional costs of the ENGINEER's review beyond the first resubmittal. The ENGINEER'S maximum review period for each submittal or resubmittal will be 30 Days. Thus, for a submittal that requires 2 resubmittals before it is complete, the maximum review period could be 90 Days.
- 6) If a submittal is returned to the CONTRACTOR marked "REVIEWED-NO EXCEPTIONS," formal revision and resubmission will not be required. If a submittal is returned marked "REVIEWED- EXCEPTIONS NOTED," CONTRACTOR shall make the corrections on the submittal, but formal revision and resubmission will not be required. If a submittal is returned marked "REVISE AND RESUBMIT," the CONTRACTOR shall revise it and shall resubmit the required number of copies to the ENGINEER for review. Resubmittal of portions of multi-page or multi-drawing submittals will not be allowed. For example, if a Shop Drawing submittal consisting of 10 drawings contains one drawing noted as "REVISE AND RESUBMIT," the submittal as a whole is deemed "REVISE AND RESUBMIT," and 10 drawings are required to be resubmitted. If a submittal is returned marked "REJECTED-RESUBMIT," it shall mean either that the proposed material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed, or is a substitution request not submitted in accordance with the requirements of the Contract Documents. In the first 2 cases, the CONTRACTOR shall prepare a new submittal and shall submit the required number of copies to the ENGINEER for review. In the latter case, the CONTRACTOR shall submit the substitution request according to the Contract Documents. Fabrication of an item may commence only

after the ENGINEER has reviewed the pertinent submittals and returned copies to the CONTRACTOR marked either "REVIEWED-EXECPTIONS NOTED" or "REVIEWED-NO EXCEPTIONS." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements. Re -submittal of rejected portions of a previous submittal will not be allowed. Every change from a submittal to a resubmittal or from a resubmittal to a subsequent resubmittal shall be identified and flagged on the resubmittal.

- 7) Submittals shall be carefully reviewed by an authorized representative of the CONTRACTOR prior to submission to the ENGINEER. Each submittal shall be dated and signed by the CONTRACTOR as being correct and in strict conformance with the Contract Documents. In the case of Shop Drawings, each sheet shall be so dated and signed. Any deviations from the Contract Documents shall be noted on the transmittal sheet. The ENGINEER will only review submittals that have been so verified by the CONTRACTOR. Non-verified submittals will be returned to the CONTRACTOR without action taken by the ENGINEER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.
- 8) Corrections or or comments made on the CONTRACTOR's Shop Drawings during review do not relieve the CONTRACTOR from compliance with Contract Drawings and Specifications. Review is for conformance to the design concept and general compliance with the Contract Documents only. The CONTRACTOR is responsible for confirming and correlating quantities and dimensions, fabrication processes and techniques, coordinating WORK with the trades, and satisfactory and safe performance of the WORK.

C. **Certificates:** Where certificates are required, submit them to the ENGINEER as specified herein. For materials, regardless of an approved certificate, the ENGINEER may still test the material if in his opinion it is questionable upon delivery. The abbreviations and definitions of certificates are as follows:

- 1) **Certificate of Analysis:** Certificate from the manufacturer or supplier of actual test results of the material properties. (This also includes "mill test reports.") A Certificate of Analysis shall be furnished with each lot of material delivered to the work.
- 2) **Certificate of Compliance:** Certificate from the manufacturer or supplier stating that the material complies with the required specifications. A Certificate of Compliance shall be furnished with each lot of material delivered to the work.

D. **Technical Manuals:** The CONTRACTOR shall submit technical operation and maintenance information for each item of mechanical, electrical, and instrumentation equipment in an organized manner in the Technical Manual. It shall be written so that it can be used and understood by the OWNER's operation and maintenance staff. The Technical Manual shall be subdivided first by specification section number; second, by equipment item; and last, by "Category." The following "Categories" shall be addressed (as applicable):

- 1) **Equipment Summary:** A table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.
- 2) **Operational Procedures:** Manufacturer – recommended procedures on the following shall be included: Installation, adjustment, startup, locations of controls, special tools, equipment required, or related instrumentation needed for operation, operation procedures, load changes, calibration, shutdown, troubleshooting, disassembly, reassembly, realignment, testing to determine performance efficiency, tabulation of proper settings and listing of all electrical relay settings.
- 3) **Preventative Maintenance Procedures:** Preventive maintenance procedures shall include manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by maintaining the equipment in place. Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.
- 4) **Parts List:** complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included. Cross-sectional or exploded view drawings shall accompany the parts list. Part numbers shall appear on the drawings with arrows to the corresponding part.
- 5) **Wiring Diagrams:** This shall include complete internal and connection wiring diagrams for electrical equipment items.
- 6) **Shop Drawings:** This category includes approved shop or fabrication drawings with ENGINEER comments and corrections incorporated, complete with dimensions.
- 7) **Safety:** This category describes the safety precautions to be taken when operating and maintaining the equipment or working near it.
- 8) **Documentation:** Equipment warranties, affidavits, certifications, calibrations, laboratory test results, etc. required by the Technical Specifications shall be placed in this category

E. **Record Drawings:** The CONTRACTOR shall maintain one set of Drawings at the Site for the preparation of record drawings. On these, it shall mark every project condition, location, configuration, and any other change or deviation which may differ from the Contract Drawings at the time of award, including buried or concealed construction and utility features that are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of buried utilities that differ from the locations indicated, or that were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or as CONTRACTOR is directed, to fully indicate the WORK as actually constructed. These record drawings are the CONTRACTOR's representation of as-built conditions, shall include revisions made by addenda and change orders, and shall be maintained up-to-date during the progress of the WORK. Red ink shall be used for alterations and notes. Notes shall identify relevant Change Orders by number and date. Disorganized or

incomplete record drawings will not be accepted. The CONTRACTOR shall revise them and resubmit within 10 Days. Record drawings shall be accessible to the ENGINEER during the construction period. Final payment will not be acted upon until the record drawings have been completed and delivered to the ENGINEER.

#### **1.6 CONSTRUCTION PHOTOGRAPHS**

- A. The CONTRACTOR shall furnish construction photographs showing the progress of the WORK. A competent photographer shall take photos via digital format of a resolution sufficient for documentation of the work and acceptable to the Engineer. CONTRACTOR shall provide a log with the date of photographing, the project title, short description of what is in the photograph, and the direction the camera is facing.
- B. Starting when the WORK begins and for as long as the WORK is in progress, not less than twelve (12) photographs at intervals no longer than two (2) weeks apart, consisting of different angles or views at different locations of progress on the site. Digital photographs shall be furnished to the ENGINEER within one (1) week. Digital photographs shall become property of the OWNER upon submittal by the CONTRACTOR.
- C. CONTRACTOR shall submit construction photographs with applications for payment.
- D. Upon completion of the WORK but before final payment, an additional twenty (20) photographs shall be made of the WORK as directed by the ENGINEER. For the purposes of documenting the completed work, digital photographs and logs shall be delivered to the ENGINEER for transmittal to the OWNER.

#### **1.7 SCHEDULE OF VALUES**

- A. The CONTRACTOR shall prepare and submit a detailed Schedule of Values, as indicated in the Special Provisions, to the ENGINEER prior to the CONTRACTOR's first application for payment. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate progress payment amounts, sufficient detailed breakdown shall be provided to meet this requirement. The ENGINEER shall be the sole judge of acceptable numbers, details and description of values established. If, in the opinion of the ENGINEER, a greater number of Schedule of Values items than proposed by the CONTRACTOR is necessary, the CONTRACTOR shall add the additional items so identified by the ENGINEER.

#### **1.8 CONSTRUCTION PROGRESS SCHEDULE**

- A. Prior to or at the preconstruction conference and before beginning work on the project, the CONTRACTOR shall submit to the project engineer a Construction Progress Schedule giving a satisfactory schedule of operations that provides for completion of the work within the contract time. This schedule shall be on the prescribed bar graph form. The CONTRACTOR shall have copies of the schedule available at the preconstruction conference.
- B. If the CONTRACTOR's operations are affected by changes in the plans or amount of work, or if the CONTRACTOR has failed to comply with the approved schedule, or if requested by the engineer, the CONTRACTOR shall submit a revised Construction Progress Schedule for approval. This revised schedule shall show how the CONTRACTOR proposes to prosecute the balance of the work. If a revised schedule

has been requested by the engineer, the CONTRACTOR shall submit the revised schedule within 14 calendar days after the date of request or progress payments may be withheld.

- C. The approved Construction Progress Schedule will be used as the basis of establishing the controlling item of work, charging contract time and as a check on the progress of the work. The Construction Progress Schedule shall show only one controlling item of work for each contract day. If the Construction Progress Schedule has not been approved prior to the issuance of the Notice to Proceed, the engineer will establish the controlling work item and charge contract time accordingly

#### 1.9 **SANITARY, HEALTH, AND SAFETY PROVISIONS**

- A. The CONTRACTOR shall not require any worker to work under conditions which are unsanitary, hazardous or dangerous to health or safety. The CONTRACTOR shall maintain the work in a sanitary, safe and nonhazardous condition.
- B. The CONTRACTOR shall provide and maintain in a neat, sanitary condition, restrooms and other such accommodations for use of employees and ENGINEER or OWNER personnel. Such facilities shall comply with requirements of the State and local governments.
- C. **Sanitary and Other Organic Wastes:** The CONTRACTOR shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of away from the Site in a manner satisfactory to the ENGINEER and in accordance with all laws and regulations pertaining thereto.
- D. **Toilet Facilities:** Fixed or portable chemical toilets shall be provided wherever needed for the use of CONTRACTOR's employees. Toilets at construction job sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction. Provide separate field office facilities in conformance with Section 01590.

#### 1.10 **NAVIGABLE WATERS AND WETLANDS**

- A. All work in, over, or adjacent to navigable waters or wetlands shall be conducted in accordance with rules and regulations of the U. S. Army Corps of Engineers and U. S. Coast Guard.
- B. Navigable clearances on waterways shall not be infringed upon, and existing navigable depths shall not be impaired except as allowed by permits issued by the responsible agency.
- C. The CONTRACTOR shall display lights on equipment operating, berthed or moored in navigable streams, and provide temporary navigational lighting on temporary and permanent construction in the navigable limits as required by the U. S. Coast Guard.
- D. Should the CONTRACTOR sink, lose or throw overboard any material, machinery or equipment which may be dangerous to navigation, it shall be immediately removed or recovered. The CONTRACTOR shall give immediate notice of such obstruction to proper authorities and, if required, shall mark or buoy such obstruction until it is removed.



- E. The CONTRACTOR shall not deposit excavated material into the water-way or wetland without a permit from the appropriate agency.
- F. All operations in connection with the work shall be in accordance with permits, rules and regulations of the U. S. Army Corps of Engineers and the U. S. Coast Guard. Deviations therefrom shall be only by special permission or special permit which shall be the responsibility of the CONTRACTOR. Failure of the CONTRACTOR to become familiar with the terms, conditions and provisions of the permits, rules and regulations applicable to the work shall not relieve the CONTRACTOR of responsibility under the contract.

#### 1.11 **BARRICADES AND WARNING SIGNS**

- A. The CONTRACTOR shall provide, erect and maintain necessary barricades, suitable lights, danger signals, signs and other traffic control devices, including flaggers, and shall take all necessary precautions for protection of the work and safety of the public. Highways closed to traffic shall be protected by effective barricades. Suitable warning signs shall be provided to direct traffic

#### 1.12 **USE OF EXPLOSIVES**

- A. Explosives shall not be used.

#### 1.13 **ARCHEOLOGICAL AND HISTORICAL FINDINGS**

- A. If the CONTRACTOR encounters cultural artifacts or archaeological or historical sites, operations shall be discontinued. The engineer will contact the proper authorities in order that an appropriate assessment may be made to determine the disposition thereof and necessary actions relative to the site. When directed, the CONTRACTOR shall excavate the site to preserve the artifacts encountered. Such excavation will be paid for as extra work, including an appropriate adjustment in contract time. Borrow and muck disposal areas furnished by the CONTRACTOR will be subject to such assessment prior to use.

#### 1.14 **TEMPORARY UTILITIES**

- A. The CONTRACTOR shall be responsible for the provision of all temporary utilities he deems necessary for the proper execution of the WORK in the most efficient manner practical. The cost of provision of these temporary utilities shall be borne by the CONTRACTOR and shall be included in the price of the WORK.
- B. THE CONTRACTOR shall provide either new or used materials and equipment, which are in substantially undamaged condition and without significant deterioration and which are recognized in the construction industry, by compliance with appropriate standards, as being suitable for intended use in each case. Where a portion of temporary utility is provided by utility company, the CONTRACTOR shall provide the remaining portion with matching and compatible materials and equipment and shall comply with recommendations of utility company.
- C. **Power:** The CONTRACTOR shall provide power required for its operations under the Contract, and shall provide and maintain all temporary power lines required to perform the WORK in a safe and satisfactory manner.

- D. **Temporary Power Distribution:** The CONTRACTOR shall provide a weatherproof, grounded, temporary power distribution system sufficient for performance of entire WORK of project, including temporary electrical heating where indicated, operation of test equipment and test operation of building equipment and systems which cannot be delayed until permanent power connections are operable, temporary operation of other temporary facilities, including permanent equipment and systems which must be placed in operation prior to use of permanent power connections (pumps, HVAC equipment, elevators, and similar equipment), and power for temporary operation of existing facilities (if any) at the Site during change-over to new permanent power system. Provide circuits of adequate size and proper power characteristics for each use; run circuit wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations and will result in minimal interference with performance of the WORK; provide rigid steel conduit or equivalent raceways for wiring which must be exposed on grade, floors, decks, or other exposures to damage or abuse. Wiring for temporary electric light and power shall be properly installed and maintained and shall be securely fastened in place. Electrical facilities shall conform to the requirements of Subpart K of the OSHA Safety and Health Standards for Construction.
- E. **Construction Lighting:** WORK conducted at night or under conditions of deficient daylight shall be suitably lighted to insure proper WORK and to afford adequate facilities for inspection and safe working conditions.
- F. **Temporary Lighting:** The CONTRACTOR shall provide a general, weatherproof, grounded temporary lighting system in every area of construction work, as soon as overhead floor/roof deck structure has been installed to provide sufficient illumination for safe work and traffic conditions. Run circuit wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations on grade, floors, decks, or other areas of possible damage or abuse.
- G. **Construction Water:** The CONTRACTOR shall provide an adequate supply of water of a quality suitable for all domestic and construction purposes. The CONTRACTOR shall not make connection to or draw water from any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use of said fire hydrant or pipeline and from the agency owning the affected water system. For each such connection made, the CONTRACTOR shall first attach to the fire hydrant or pipeline a valve and a meter, if required by the said authority, of a size and type acceptable to said authority and agency. The CONTRACTOR shall pay all permit and water charges.

#### 1.15 **SITE ACCESS AND STORAGE**

- A. The CONTRACTOR shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the WORK. It shall be the CONTRACTOR's responsibility to construct and maintain any haul roads required for its construction operations.
- B. Wherever necessary, to maintain vehicular crossings, the CONTRACTOR shall provide suitable temporary bridges or steel plates over unfilled excavations, except in such cases as the CONTRACTOR shall secure the written consent of the responsible individuals or authorities to omit such temporary bridges or steel plates, which written consent shall be delivered to the ENGINEER prior to excavation. All such bridges or steel plates shall be maintained in service until access is provided across the backfilled excavation.

- C. Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, alleyway, or parking area during the performance of the WORK hereunder, and it shall conduct its operations to not interfere unnecessarily with the authorized work of utility companies or other agencies in such streets, alleyways, or parking areas. No street shall be closed to the public without first obtaining permission of the ENGINEER and proper governmental authority.
- D. The OWNER may designate and arrange for the CONTRACTOR's use, a portion of the property for its exclusive use during the term of the Contract as a storage and shop area for its construction operations on the WORK. At completion of WORK, the CONTRACTOR shall return this area to its original condition, including grading and landscaping.
- E. The CONTRACTOR shall make its own arrangements for any necessary off-Site storage or shop areas necessary for the proper execution of the WORK.
- F. The CONTRACTOR shall construct and use a separate storage area for hazardous materials used in constructing the WORK.

#### **1.16 SITE CONDITIONS SURVEYS**

- A. The CONTRACTOR shall conduct thorough pre-construction and post-construction Site conditions surveys of the entire Project, as indicated in the Special Provisions. Site conditions surveys shall consist of photographs and videotape recordings.

#### **1.17 PROTECTION OF EXISTING UTILITIES**

- A. The CONTRACTOR shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation, all in accordance with the Contract Documents.
- B. When the CONTRACTOR's work involves excavating or underground demolition activity, the CONTRACTOR is required to reach Louisiana One Call, prior to starting any work, by calling (225) 275-3700 or toll-free 1-800-272- 3020, or by fax (225) 272-1967 in order to comply with the Louisiana Underground Utilities and Facilities Damage Prevention Law.
- C. In the event of interruption of utility services due to accidental breakage or being exposed or unsupported, the CONTRACTOR shall promptly notify the proper authority and shall cooperate with such authority in restoration of service. If utility service is interrupted, continuous cooperation will be required until service is restored. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority.

#### **1.18 QUALITY CONTROL**

- A. The CONTRACTOR shall establish and maintain an effective quality control process. The quality control process shall consist of plans, procedures, and organization necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the contract requirements. The process shall cover construction operations both onsite and offsite, and shall be keyed to the proposed construction sequence.

### 1.19 PROTECTION OF THE WORK

- A. The CONTRACTOR shall be responsible for the protection of the site, and all WORK, materials, equipment and existing facilities thereon, against theft, vandals, and other unauthorized persons.
- B. No claim shall be made against Owner by reason of any act of an employee or trespasser, and CONTRACTOR shall make good all damage to Owner's property resulting from his failure to provide security measures as specified.
- C. Security measures shall be at least equal to those usually provided to protect the existing facilities during normal operation, but shall also include such additional security fencing, barricades, lighting, watchman services and other measures as required to protect the site.
- D. The CONTRACTOR shall maintain the security of the limited access areas as required by the Owner.
- E. The WORK shall be under the charge and care of the CONTRACTOR until final acceptance. The CONTRACTOR shall take precautions against damages to the WORK by action of the elements or from other cause, and shall satisfactorily repair any damaged work at his expense. In case of suspension of work, the CONTRACTOR shall be responsible for all materials and shall properly store them if necessary, and shall erect temporary structures where necessary.
- F. If the CONTRACTOR fails to comply with the provisions of this section, the ENGINEER will notify the CONTRACTOR, in writing, of such noncompliance. If the CONTRACTOR fails to remedy unsatisfactory maintenance within 48 hours after receipt of such notices, the ENGINEER may immediately proceed to provide security for the project, and the cost of this security will be deducted from payments for the work.
- G. If unsatisfactory maintenance results in a condition that is hazardous to life, health or property, the ENGINEER will immediately effect necessary repairs and deduct the cost of such repairs from payments for the work.

### 1.20 CONTRACTOR USE OF SITE

- A. If unsatisfactory maintenance results in a condition that is hazardous to life, health or property, the ENGINEER will immediately effect necessary repairs and deduct the cost of such repairs from payments for the work.

### 1.21 PROJECT MEETINGS

#### A. Preconstruction Conference:

- 1. Prior to the commencement of WORK at the Site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by the CONTRACTOR'S Project Manager, its superintendent, and its subcontractors as the CONTRACTOR deems appropriate. Other attendees will be:
  - a. ENGINEER and the Resident Project Representative.
  - b. Representatives of OWNER.

- c. Governmental representatives as appropriate.
  - d. Others as requested by CONTRACTOR, OWNER, or ENGINEER.
2. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the CONTRACTOR prior to the meeting date. However, the CONTRACTOR should be prepared to discuss all of the items listed below.
  - a. Status of CONTRACTOR's insurance and bonds.
  - b. CONTRACTOR's tentative schedules.
  - c. Transmittal, review, and distribution of CONTRACTOR's submittals.
  - d. Processing applications for payment.
  - e. Maintaining record documents.
  - f. Critical work sequencing.
  - g. Field decisions and Change Orders.
  - h. Use of Site, office and storage areas, security, housekeeping, and OWNER's needs.
  - i. Major equipment deliveries and priorities.
3. The ENGINEER will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.
4. The CONTRACTOR and its subcontractors should plan on the conference taking no less than one half of one full working day.

**B. Progress Meetings:**

1. The ENGINEER will schedule and hold regular on-Site progress meetings as requested by CONTRACTOR or OWNER or as required by progress of the WORK. The CONTRACTOR, ENGINEER, and all subcontractors active on the Site shall attend each meeting. CONTRACTOR may at its discretion request attendance by representatives of its suppliers, manufacturers, and other subcontractors.
2. The ENGINEER will preside at the progress meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings is to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, the CONTRACTOR shall present any issues that may impact its progress with a view to resolve these issues expeditiously.

## 1.22 PROJECT CLOSEOUT

- A. The CONTRACTOR shall promptly remove from the vicinity of the completed WORK, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the WORK by the OWNER will be withheld until the CONTRACTOR has satisfactorily performed the final cleanup of the Site.
- B. The CONTRACTOR shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow the OWNER, the ENGINEER, and their authorized representatives sufficient time to schedule attendance at such activities.

**PART 2 -- PRODUCTS (NOT USED)**

**PART 3 -- EXECUTION (NOT USED)**

- END OF SECTION -

## SECTION 02200 – EARTHWORK (REVISED 10/17/2017)

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall perform earthwork indicated and required for construction of the WORK, complete and in place, in accordance with the Contract Documents.

#### 1.2 CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING

- A. Contractor Submittals shall be per Section 01010.
- B. **Submittal:** The CONTRACTOR shall submit an excavation plan, detailing methods of bracing, sheeting, and/or shoring of all excavations. This plan shall be prepared under the supervision of a licensed professional engineer registered in the State of Louisiana, and shall be sealed by such.
- C. **Submittal:** The CONTRACTOR shall submit a dewatering plan, detailing methods of dewatering all excavations.
- D. Materials proposed for and utilized in the WORK will be sampled as indicated herein. The frequency of testing may be altered at the discretion of the ENGINEER. The CONTRACTOR shall provide all materials required for testing at no additional cost to the OWNER.
- E. **Tests for Soil Properties:** Unless noted otherwise, soil will be classified in accordance with DOTD TR 423 from samples taken in the original location or from dedicated stockpiles. Unless noted otherwise, the following methods will be utilized in determination of soil properties:

Soil Property	Test Method
Plasticity Index (PI)	DOTD TR 428
Liquid Limit (LL)	DOTD TR 428
% Organic	DOTD TR 413
% Silt	DOTD TR 407
pH	DOTD TR 430

- F. **Tests for Aggregate Properties:** When required, aggregates such as granular material will be classified in accordance with DOTD TR 423. Unless noted otherwise, the following methods will be utilized in testing aggregates:

Aggregate Property	Test Method
Deleterious Materials	DOTD TR 119

Unit Weight	AASHTO T 19
Specific Gravity and Absorption of Fine Aggregate	AASHTO T 84
Specific Gravity and Absorption of Coarse Aggregate	AASHTO T 85
Polish Value	AASHTO T 278 and T 279
Amount of Material Finer than the No. 200 Sieve	DOTD TR 112
Sieve Analysis (Gradation)	DOTD TR 113
Plasticity Index (PI)	DOTD TR 428
Liquid Limit (LL)	DOTD TR 428

**G. Levee Embankment:**

1. **Source Approval:** Prior to the work, the CONTRACTOR shall submit a sample of select soil material from each source proposed to be utilized in the WORK to the ENGINEER or Testing Laboratory for source approval and classification. The sample will be tested for compliance with specification requirements. Moisture – density relationships of acceptable material will be tested and reported in accordance with DOTD TR 418. Sample size shall be two (1) full Louisiana Department of Transportation and Development standard sample sack, or as directed by the Testing Lab. Source approval testing shall be completed for each source of material utilized in the WORK.
2. **Acceptance:** During the work, the CONTRACTOR shall submit one sample per 1,000 cubic yards of select soil supplied. The sample will be classified and tested for compliance with specifications. Failed tests may be deemed as cause for rejection of the work by the ENGINEER. For embankments or backfill, Determination of In – Place Density and Determination of In – Place Moisture Content will be determined by DOTD TR 401 and DOTD TR 403, respectively. Frequency of In – Place Moisture Density and In – Place Density will be at the discretion of the ENGINEER.
3. **Contractor Testing:** The CONTRACTOR shall provide sufficient testing to ensure that specification requirements are met.

**H. Granular Material for Structures or Backfill**

1. **Source Approval:** Prior to the work, the CONTRACTOR shall submit a sample of material from each source of granular material proposed to be utilized in the WORK to the ENGINEER or Testing Laboratory for source approval and classification. The sample will be tested for compliance with specification requirements. Classification and Group Index will be determined in accordance with DOTD TR 423. Moisture – density relationships of acceptable material will be tested and reported in accordance with DOTD TR 418. Sample size shall be two (1) full Louisiana



Department of Transportation and Development standard sample sacks, or as directed by the Testing Lab. Source approval testing shall be completed for each source of material utilized in the WORK.

2. **Acceptance:** During the work, the CONTRACTOR shall submit one sample per 1,000 cubic yards of select soil supplied. The sample will be classified and tested for compliance with specifications. Failed tests may be deemed as cause for rejection of the work by the ENGINEER. For backfill, Determination of In – Place Density and Determination of In – Place Moisture Content will be determined by DOTD TR 401 and DOTD TR 403, respectively. Frequency of In – Place Moisture Density and In – Place Density will be at the discretion of the ENGINEER.
3. **Contractor Testing:** The CONTRACTOR shall provide sufficient testing to ensure that specification requirements are met.

I. **Bedding Material:**

1. **Source Approval:** Prior to the work, the CONTRACTOR shall submit a sample of bedding material proposed to be utilized in the WORK to the ENGINEER or Testing Laboratory for source approval. Material will be tested for deleterious materials and gradation. Relative Density Index of acceptable material will be developed in reported in accordance with ASTM D4253 and ASTM D4254. Sample size shall be two (1) full Louisiana Department of Transportation and Development standard sample sack, or as directed by the Testing Lab. Source approval testing shall be completed for each source of material utilized in the WORK.
2. **Acceptance:** During the work, the CONTRACTOR shall submit one sample per 1,000 cubic yards of select soil supplied. The sample will be tested for compliance with specifications. Failed tests may be deemed as cause for rejection of the work by the ENGINEER. For backfill, Determination of In – Place Density and Determination of In – Place Moisture Content will be determined by DOTD TR 401 and DOTD TR 403, respectively. Frequency of In – Place Moisture Density and In – Place Density will be at the discretion of the ENGINEER.
3. **Contractor Testing:** The CONTRACTOR shall provide sufficient testing to ensure that specification requirements are met.

J. **Topsoil**

1. **Source Approval:** Prior to the Work, the CONTRACTOR shall provide a report from an established testing laboratory for source approval.
2. **Acceptance:** Unless questionable, topsoil will not be sampled. If questionable, topsoil will be sampled and tested for compliance by the ENGINEER or Testing Laboratory. Sample size shall be two (1) full Louisiana Department of Transportation and Development standard sample sack, or as directed by the Testing Lab.
3. **Contractor Testing:** The CONTRACTOR shall provide sufficient testing to ensure that specification requirements are met.

K. **Aggregate Surface Course:**

1. **Source Approval:** Prior to the work, the CONTRACTOR shall submit a sample of aggregate surface course material proposed to be utilized in the WORK to the ENGINEER or Testing Laboratory for source approval. Material will be tested for compliance with the specifications. Sample size shall be two (1) full Louisiana Department of Transportation and Development standard sample sack, or as directed by the Testing Lab. Source approval testing shall be completed for each source of material utilized in the WORK.
2. **Acceptance:** During the work, the CONTRACTOR shall submit one sample per 1,000 cubic yards of non – plastic embankment supplied. The sample will be tested for compliance with specifications. Failed tests may be deemed as cause for rejection of the work by the ENGINEER.
3. **Contractor Testing:** The CONTRACTOR shall provide sufficient testing to ensure that specification requirements are met.

### 1.3 REFERENCE STANDARDS

#### A. American Association of State Highway and Transportation Officials (AASHTO)

AASHTO T 19	Standard Method of Test for Bulk Density (Unit Weight) and Voids in Aggregate
AASHTO T 84	Standard Method of Test for Specific Gravity and Absorption of Fine Aggregate
AASHTO T 85	Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate
AASHTO T 278	Standard Method of Test for Frictional Properties Using the British Pendulum Tester
AASHTO T 279	Standard Method of Test for Accelerated Polishing of Aggregates Using the British Wheel

#### B. ASTM International

ASTM D 1388	Standard Test Methods for Stiffness of Fabrics
ASTM D 4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D 4254	Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 6637	Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method
ASTM D 698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
ASTM D 2487	Standard Practice for Classification of Soils for Engineering Purposes

ASTM D 2974	Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils
ASTM D 1140	Standard Test Methods for Determining the Amount of Material Finer than 75- $\mu$ m
C. The Geo - Synthetic Institute (GSI)	
GG2	Test Method for Geogrid Junction Strength
D. Louisiana Department of Transportation and Development (DOTD)	
DOTD AML	Louisiana DOTD Approved Materials List
DOTD TR 112	Method of Test for Amount of Material Finer than the No. 200 Sieve in Aggregate by Wash
DOTD TR 113	Method of Test for Sieve Analysis of Fine and Coarse Aggregate
DOTD TR 119	Method of Test for Determination of Deleterious Materials
DOTD TR 401	Method of Test for the Determination of In – Place Density
DOTD TR 403	Method of Test for Determination of Moisture Content
DOTD TR 407	Method of Test for Mechanical Analysis of Soils
DOTD TR 413	Method of Test for Organic Material in Soil
DOTD TR 418	Method of Test for Moisture – Density Relationships
DOTD TR 423	Method of Test for Classification of Soils and Soil – Aggregate Mixtures
DOTD TR 428	Method of Test for Determining the Atterberg Limits of Soils
DOTD TR 430	Method of Test for Determination of pH Value of Water and Soil
DOTD QPL 2	Louisiana Department of Transportation and Development Approved Materials List – Aggregates

#### 1.4 **QUALITY CONTROL**

- A. The CONTRACTOR shall locate, select, and place material conforming to specification requirements and requirements shown on the drawings. The CONTRACTOR shall control his processes, including performing tests and making adjustments as necessary to result in a uniform product meeting all the requirements of the drawings and specifications.
- B. All sheeting, shoring, and bracing of excavations shall conform to requirements necessary to comply with local codes and authorities having jurisdiction. Impact pile driving and sheet pile installations will cause vibrations that may affect existing

residences or underground utilities in the vicinity of the proposed force main. Peak particle velocities due to pile driving should be monitored at critical locations with a seismograph during the installation of test piles, job piles and sheet piles. The record of peak particle velocities will provide information in assessing the need for changes in driving operations and the types of changes best suited for the project requirements. Monitoring will be performed by an independent testing lab retained by the OWNER.

## **PART 2 -- PRODUCTS**

### **2.1 FILL AND BACKFILL MATERIAL REQUIREMENTS**

- A. **Soil Usage:** Soils which do not meet Liquid Limit or Plasticity Index requirements shall not be blended to reduce Liquid Limit or Plasticity Index. Soils may be treated with Lime to reduce plasticity index only with the approval of the ENGINEER.

### **2.2 LEVEE EMBANKMENT**

- A. The embankment for levee, berms, ramps and road crossings shall be constructed of earth materials naturally occurring or CONTRACTOR blended. Materials that are classified in accordance with ASTM D 2487 or CL or CH with less than 35% sand content are suitable for use as embankment fill. Materials classified as ML are suitable if blended to produce a material that classifies as CH or CL according to ASTM D 2487. All fill materials shall be free from masses of organic matter, sticks, branches, roots, and other debris including hazardous and regulated solid wastes. As earth from the designated excavation areas may contain excessive amounts of wood, isolated pieces of wood will not be considered objectionable in the embankment provided their length does not exceed 1 foot, their cross-sectional area is less than 4 square inches, and they are distributed throughout the fill. Not more than 1 percent (by volume) of objectionable material shall be contained in the earth material placed in each cubic yard of the levee section. Pockets and/or zones of wood shall not be placed in the embankment. The CONTRACTOR shall notify the ENGINEER whenever the in-place Plasticity Index of the material is 15 or less. Materials placed in the section must be at above the Plasticity Index of 10. Materials placed in the section must be at or below organic content of 9 percent by weight, as determined by ASTM D 2974, Method C. Materials placed in the section must contain less than 35 percent sand content by weight, as determined by ASTM D 1140.

### **2.3 GRANULAR MATERIAL FOR STRUCTURES OR BACKFILL**

- A. Granular material shall be material shall be Mississippi River "pumped sand", DOTD Classification of A-4 or better having a maximum liquid limit of 25 and a maximum plasticity index of 6. All sands shall be free of trash, weeds, lumps, humus, pieces of wood or any other deleterious material. Granular material shall have a group index number not to exceed 6.

### **2.4 BEDDING MATERIAL FOR PIPE OR STRUCTURES**

- A. Bedding Material shall be crushed limestone for pipe bedding shall be #57 stone as indicated below. Bedding material shall be free of soil, roots, debris, deleterious materials, or other rubbish. The limestone shall be wrapped with geotextile fabric as indicated on the drawings or as specified. Crushed concrete or other alternate bedding materials will not be accepted. Stone shall be supplied from a source listed on the Louisiana Department of Transportation and Development Approved Materials List (QPL 2).

<b>#57 Stone Gradation</b>		
<b>US Sieve</b>	<b>Metric Sieve</b>	<b>Percent Passing</b>
1-½ Inch	37.5 mm	100
1 Inch	25.0 mm	95 - 100
No. 4	4.75 mm	0 – 10
No. 8	2.36 mm	0 – 5

## 2.5 TOPSOIL

- A. When available, topsoil shall be existing surface soil stripped and stockpiled. When additional topsoil is required beyond the available topsoil from the stripping operation, topsoil shall be delivered and amended as recommended by soil tests. Soil tests shall be provided prior to delivery of topsoil to the site. The tests shall determine the quantities and type of soil amendments required to meet local growing conditions for the seed species provided. Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested for particle size, pH, organic content, textural class, chemical composition and soluble salts. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over 1 ½ inches diameter. Topsoil shall be free from viable plants and plant parts. Topsoil shall also be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. Topsoil shall have a minimum PI of 4, a maximum PI of 12, a pH of 5.5-8.0, a minimum organic content of 2 percent, and shall be capable of supporting adequate vegetation.
- B. Soil amendments to be blended with the topsoil shall be delivered to the site either in the original, unopened containers bearing the manufacturer’s chemical analysis, or in bulk. A chemical analysis shall be provided for bulk deliveries.
- C. Existing topsoil meeting the above requirements within construction limits may be used. If agricultural lime or organic matter is added to a soil to bring topsoil into conformance with these specifications, it shall be at the expense of the CONTRACTOR.

## 2.6 AGGREGATE SURFACE COURSE

- A. **Stone:** Stone shall be supplied from a source listed on the Louisiana Department of Transportation and Development Approved Materials List (QPL 2). Stone shall consist of 100 percent stone and shall comply with the following gradation:

<b><u>U.S. Sieve</u></b>	<b><u>Metric Sieve</u></b>	<b><u>Percent Passing</u></b>
1 1/2 inch	37.5 mm	100
3/4 inch	19.0 mm	50-100
No. 4	4.75 mm	35-65
No. 40	425 µm	10-32

No. 200	75 µm	3-15
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B. **Reclaimed Asphaltic Pavement (RAP):** RAP shall comply with the following gradation:

<u>U.S. Sieve</u>	<u>Metric Sieve</u>	<u>Percent Passing</u>
2 – ½ Inch	63 mm	100
No. 4	4.75 mm	35-75

## 2.7 SHEETING, SHORING, AND BRACING

- A. Wood for shoring and sheeting shall be green, rough cut hardwood (i.e. oak or hickory). Planking for sheeting and foundation lumber shall have a minimum thickness of 2 inches. CONTRACTOR shall be responsible for the design and installation of all wood sheeting unless wood shoring is indicated on the plans.
- B. Steel sheet piling shall be a continuous interlock design. The sheet piling must be in good condition and shall provide a tight interlocking connection, which will retard the infiltration of ground water. Cofferdams shall be provided when constructing wet wells at pump station sites. The CONTRACTOR shall be responsible for the design and installation of all cofferdams.
- C. Trench boxes and shields shall be in good, sound condition and shall comply with all applicable OSHA requirements. Installation, use, and removal of trench shields or boxes shall be in accordance with the manufacturer's recommendations. CONTRACTOR shall be responsible for the design and installation of all trench boxes or shields and the use thereof shall be depicted within the CONTRACTOR's sheeting, shoring and bracing plan.

## PART 3 -- EXECUTION

### 3.1 GENERAL

- A. Except when specifically provided to the contrary, excavation shall include the removal of materials, including obstructions that would interfere with the proper execution and completion of the WORK. The removal of such materials shall conform to the lines and grades indicated or ordered. Unless otherwise indicated, the entire Site shall be stripped of vegetation and debris and shall be grubbed, and such material shall be removed from the Site prior to performing any excavation or placing any fill.

### 3.2 SHEETING, SHORING, AND BRACING

- A. The CONTRACTOR shall furnish, place, and maintain supports and shoring that may be required for the sides of excavations. The CONTRACTOR shall be solely responsible for the stability and safety of all excavations.
- B. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

- C. The use of horizontal strutting below the barrel of a pipe or structure or the use of a pipe as support for trench bracing will not be permitted.

### 3.3 EXCLUSION OF WATER

- A. The CONTRACTOR shall remove and exclude water, including storm water, groundwater, irrigation water, and wastewater, from excavations. Dewatering wells, well-points, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least 2 feet below the bottom of excavations before the excavation WORK begins at each location. Water shall be removed and excluded until backfilling is complete and field soils testing has been completed.

### 3.4 OVER-EXCAVATION

- A. **Indicated:** Where areas are indicated to be over-excavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade indicated.
- B. **Not Indicated:** When ordered to over-excavate areas deeper and/or wider than required by the Contract Documents, the CONTRACTOR shall over-excavate to the dimensions ordered and backfill to the indicated grade.
- C. **Neither Indicated nor Ordered:** Any over-excavation carried below the grade ordered or indicated shall be backfilled and compacted to the required grade with granular material or non – plastic embankment as part of the WORK.

### 3.5 DISPOSAL OF EXCESS EXCAVATED MATERIAL

- A. Unless otherwise indicated, excess excavated material shall be the property of the CONTRACTOR. The CONTRACTOR shall be responsible for the removal and disposal of excess excavated material. Material shall be disposed of at an approved on-Site disposal area or off-Site at a location arranged by the CONTRACTOR in accordance with laws and regulations regarding disposal of such material.

### 3.6 LEVEE EMBANKMENT

- A. The location and extent of the compacted fill is shown on the drawings. All embankment, berms, ramps and road crossings material shall be compacted fill. Compacted fill shall not be placed in water. The materials for compacted fill shall be placed or spread in layer, the first or bottom layer and the last two layers not more than 6 inches in thickness and all layers between the first and the last two layers not more than 12 inches in thickness prior to compaction. Layers shall be started in full out to the slope stakes and shall be carried substantially horizontal and parallel to the levee centerline with sufficient crown or slope to provide satisfactory drainage during construction. Areas on which geotextile is to be placed shall be dressed out and leveled to the grade indicated on the drawings. When placing fill on the geotextile, mechanical equipment shall not be allowed to come in contact with geotextile in any way. Requirements for benching into the slope of the existing embankment are required in order to place and compact the material in horizontal layers as described on the drawings. Benching shall not consist of excavating the existing levee embankment as shown on the drawings and described herein. The vertical face of the existing embankment resulting from the benching operation shall be a minimum of 1 foot in height but shall not exceed 2 feet in height as shown on the drawings. Material excavated from the benching operations shall be used as compacted fill. When the surface of any compacted layer is too smooth to bond properly with the

succeeding layer, it shall be adequately scarified before the next layer is placed thereon. The elevation of the levee embankment shall not exceed the elevation of the berm embankment(s) by more than 2 feet.

- B. The first and each successive layer of compacted fill material for embankments, berms, ramps, and road crossings shall be compacted to at least 90 percent of maximum dry density as determined by ASTM D 698 (Standard Proctor Compaction Test) at a moisture content within the limits of plus 5 to minus 3 percentage points of optimum moisture content determined from ASTM D 698. The first and each successive layer of the sand drainage blanket shall be compacted to at least 95 percent of maximum dry density as determined by ASTM D 698 at moisture content within the limits of plus to minus 3 percentage points of optimum moisture content determined from ASTM D 698. For the first layer above the geotextile, a tractor having a ground pressure no greater than 4.7 plus or minus 0.2 psi shall be used to spread and then compact the layer.
- C. The entire embankment, berms, ramps and road crossings shall be brought to not less than the prescribed design cross section, within allowable tolerance, at all points. Unreasonable roughness of the surface shall be dressed out to permit fertilizing, seeding and mulching operations.

### 3.7 **BEDDING MATERIAL**

- A. **Placement of Bedding:** Geotextile fabric shall be placed in accordance with plan details prior to placing bedding material. Care shall be taken to prevent damage to geotextile fabric during placement of bedding material. Materials shall be placed in lifts, shaped, and uniformly compacted to 75 percent of relative density.
- B. Adjacent rolls of fabric will be overlapped or sewn. When rolls are overlapped, the overlap shall be a minimum of 18 inches, including the ends of the rolls. The top layer of the fabric shall be parallel with adjacent rolls and in the direction of bedding materials placement. When rolls are sewn, the CONTRACTOR shall join adjacent rolls by sewing with polyester, or Kevlar thread. Field sewing shall employ the "J" seam or "Butterfly" seam with the two pieces of geotextile fabric mated together, turned in order to sew through 4 layers of fabric and sewn with 2 rows of Type 401, two-threaded locking chain stitch. Factory seams other than specified may be submitted to the ENGINEER for approval. When the ground is covered with water or supersaturated soil, sewing of the fabric will be required.
- C. Damaged fabric shall be either removed and replaced with new fabric or covered with a second layer of fabric extending 2 feet in each direction from the damaged area.
- D. Excavation below the established grade of the structure for placement of bedding material shall be used or disposed.

### 3.8 **GRANULAR MATERIAL FOR BACKFILL OR STRUCTURES**

- A. Materials shall be placed, properly shaped and uniformly compacted lifts not exceeding 6 inches by approved methods to a minimum of 95 percent of maximum dry density. Maximum dry density will be determined in accordance with DOTD TR 415 or TR 418 and in-place density will be determined in accordance with DOTD TR 401. Granular materials shall not be displaced during subsequent operations. Each lift shall be compacted and tested as specified herein, unless determined otherwise by the ENGINEER.



### 3.9 **AGGREGATE SURFACE COURSE**

- A. Equipment necessary to produce a finished project meeting specification requirements shall be furnished and maintained by the CONTRACTOR. Equipment will be approved prior to use.
- B. The material shall be placed directly on the prepared and approved subgrade from hauling vehicles or spreading equipment. No surface course shall be placed on damaged subgrade until repairs to the subgrade have been completed and approved.
- C. **Aggregate Surfacing:** Aggregate surfacing materials shall not be placed or spread on adjacent portland cement concrete or asphaltic concrete pavements. Aggregate surfacing operations shall be conducted so that pavement surfaces, edges, and joints are not damaged.
- D. The material shall be shaped by suitable means and compacted. Shaping and compacting shall continue until the surface conforms to the required sections and is free from ruts and waves.
- E. Stone aggregate surfacing shall be compacted to the satisfaction of the ENGINEER by approved methods. After initial compaction, the surface shall be wetted as necessary and rolled with a pneumatic-tire or steel-wheel roller to a tight, uniform surface.
- F. Reclaimed asphaltic material shall be placed to required thickness, shaped to the required section, and compacted with at least three passes by an approved pneumatic-tire roller to a tight, uniform surface.

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## SECTION 02201 - SITE PREPARATION (REVISED 07/2016)

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The WORK of this Section includes measures required during the CONTRACTOR's initial move onto the Site.

#### 1.2 REFERENCE STANDARDS

- A. Commercial Standards:

AAN                                      American Association of Nurserymen

#### 1.3 CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING

- A. Material used for backfill shall be sampled and tested in accordance with Section 02200 – Earthwork.

#### 1.4 QUALITY CONTROL

- A. NOT USED

#### 1.5 SITE INSPECTION

- A. Prior to moving onto the Site, the CONTRACTOR shall inspect the Site conditions and review maps of the existing plant site, existing utilities, and facilities or other items delineating the OWNER's property and right-of-way lines.

### PART 2 -- PRODUCTS

### PART 3 -- EXECUTION

#### 3.1 PRIMARY CONSTRUCTION SITE ACCESS

- A. The CONTRACTOR shall develop any necessary access to the Site, including access barriers to prohibit entry of unauthorized persons.
- B. **Utility Interference:** Where existing utilities interfere with the WORK, notify the utility owner and the ENGINEER before proceeding in accordance with the General Conditions.

- END OF SECTION -

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**SECTION 02202 – DEMOLITION AND REMOVAL OF STRUCTURES AND OBSTRUCTIONS  
(REV 08/16)**

**PART 1 -- GENERAL**

**1.1 THE REQUIREMENT**

- A. The CONTRACTOR shall demolish facilities as indicated, and shall remove and/or relocate structures and obstructions as indicated, all in accordance with the Contract Documents.
- B. The CONTRACTOR shall carefully coordinate the WORK in areas where existing facilities are interconnected with new facilities and where existing facilities remain operational. The WORK as indicated is not all inclusive, and the CONTRACTOR shall be responsible to perform the reconstruction indicated plus that which can be reasonably inferred from the Contract Documents as necessary to complete the Project. The Specifications and Drawings identify the major facilities that shall be demolished and reconstructed, but auxiliary utilities are not necessarily shown.
- C. While demolition and reconstruction are being performed, the CONTRACTOR shall provide adequate access for the continued operation and maintenance of equipment and other facilities to remain. The CONTRACTOR shall erect and maintain fences, warning signs, barricades, and other devices around the reconstruction as required for the protection of the CONTRACTOR's employees and the OWNER's personnel. The CONTRACTOR shall remove such protection when reconstruction activities are complete, or as work progresses, or when directed by the ENGINEER.

**1.2 REFERENCE STANDARDS**

- A. Code of Federal Regulations  
49 CFR, Parts 172-180                      Regulations for Hazardous Materials
- B. Louisiana Administrative Code (LAC)  
LAC Title 33, Part V, Chapter 38, Section 3813  
LAC Title 33, Part V, Chapter 38
- C. Louisiana Department of Transportation and Development (LDOTD)  
Water Well Rules, Regulations, and Standards, State of Louisiana
- D. Louisiana Department of Environmental Quality (LDEQ)  
UST Regulations                              Regulations for Underground Storage Tanks

**1.3 CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING**

- A. Contractor Submittals shall be per Section 01010.
  - 1. Submittal: Demolition and reconstruction activities and procedures, including operational sequence, shall be submitted to the ENGINEER for approval. The procedures shall provide for safe conduct of the WORK, careful removal and

disposition of materials and equipment, protection of existing facilities which are to remain undisturbed, coordination with existing facilities to remain in service, and timely disconnection and reconnection of utility services. The procedures shall include a detailed description and time schedule of the methods and equipment to be used for each operation and the sequence of operation. A storage plan for salvaged items shall be included.

2. Submittal: Certificates as required herein for shall be submitted to the ENGINEER.

## **PART 2 -- PRODUCTS - NOT USED**

## **PART 3 -- EXECUTION**

### **3.1 GENERAL**

- A. The CONTRACTOR shall coordinate demolition and reconstruction WORK with the OWNER and ENGINEER. Unless otherwise indicated, the CONTRACTOR shall be responsible for the sequence of activities. WORK shall be performed in accordance with applicable safety rules and regulations.
- B. The CONTRACTOR shall verify that any utilities connected to structures, equipment, and facilities to be removed, relocated, salvaged, replaced, or abandoned are rendered inoperable, replaced with new utilities, or adequately bypassed with temporary utilities before proceeding with demolition and reconstruction.
- C. The CONTRACTOR shall take precautions to avoid damage to adjacent facilities and to limit the WORK activities to the extent indicated. If reconstruction beyond the scope indicated is required, the CONTRACTOR shall obtain approval from the ENGINEER prior to commencing.
- D. The CONTRACTOR shall perform a functional test of existing equipment that is relocated and reinstalled to ensure the equipment functions in the manner documented during the initial inspection. The CONTRACTOR shall inform the ENGINEER in writing a minimum of 5 Days prior to the functional testing in order for the OWNER and ENGINEER to witness the test. If, in the opinion of the ENGINEER, the relocated equipment does not function in a satisfactory manner, the CONTRACTOR shall make repairs and modifications necessary to restore the equipment to its original operating condition at no additional cost to the OWNER.

### **3.2 PROTECTION OF EXISTING FACILITIES**

- A. Before beginning any reconstruction, the CONTRACTOR shall carefully survey the existing facilities and examine the Specifications and Drawings to determine the extent of reconstruction and coordination with the WORK. Existing facilities not subject to reconstruction shall be protected and maintained. Damaged existing facilities shall be repaired to the previous condition or replaced.
- B. Persons shall be afforded safe passages around areas of demolition.
- C. Structural elements shall not be overloaded. The CONTRACTOR shall be responsible for shoring, bracing, or adding new supports as may be required for adequate structural support as a result of WORK performed under this Section. The CONTRACTOR shall

remove temporary protection when the WORK is complete or when so authorized by the ENGINEER.

- D. The CONTRACTOR shall carefully consider bearing loads and capacities before placement of equipment and material on Site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, the CONTRACTOR shall consult with the ENGINEER prior to the placement of such equipment or material.

### 3.3 DEMOLITION AND REMOVAL OF STRUCTURES AND OBSTRUCTIONS

- A. **Equipment Supports:** Equipment supports, including concrete pads, baseplates, mounting bolts, and support hangers, shall be removed where indicated. Damage to the existing structure shall be repaired as indicated.
- B. **Exposed Piping:** Exposed piping including vents, drains, and valves shall be removed. Where exposed piping penetrates existing floors and walls, the piping, including wall thimbles, shall be removed to a minimum depth of 2-inches. Resultant openings in the structure shall be repaired as indicated.
- C. **Electrical Control Panels:** Electrical control panels, junction boxes, motor control centers, and local switches and pushbuttons shall be removed, as indicated on the Drawings.
- D. **Connections:** Connections to embedded electrical conduits shall be removed a minimum of 2-inches inside the finished surface of the existing structure. Wiring shall be removed and the resulting openings shall be repaired as indicated.
- E. **Structures:** Unsalvageable materials in a structure designated for removal shall become the property of the CONTRACTOR and shall be removed and disposed of by the CONTRACTOR. Appurtenances forming a part of a structure to be demolished, whether integral or not integral to the structure, shall be demolished and removed by the CONTRACTOR.
- F. **Pipe:** Pipe to be relaid shall be removed and stored so that there will be no loss or undue damage before relaying. The CONTRACTOR shall replace sections lost from storage or unduly damaged at no direct pay. When specified, pipe not to be relaid and considered usable shall be salvaged, cleaned of soils or other materials, stored and stacked.

### 3.4 REMOVING ENVIRONMENTALLY SENSITIVE MATERIALS

- A. When removal or remediation of any environmentally sensitive or contaminated sites is required during construction, the CONTRACTOR's operations shall be coordinated through the appropriate agency having jurisdiction. If the CONTRACTOR fails to follow the guidelines of the agency having jurisdiction, and subsequently causes or increases harm or damage to the environment, then all resulting fines and clean-up costs shall be the responsibility of the CONTRACTOR.
- B. **Non-Friable Asbestos:** When a structure contains non-friable asbestos, the CONTRACTOR shall carefully remove the asbestos without excessive breakage or crushing before removal, relocation or demolition of the structure. The non-friable asbestos material shall be disposed of at an approved industrial landfill.

- C. **Friable Asbestos:** When a structure contains friable asbestos, the CONTRACTOR shall immediately notify the Department of Environmental Quality (DEQ), Air Quality Division and request that DEQ provide a confirmation letter with an Asbestos Disposal Verification Form (ADVF). The CONTRACTOR shall complete the ADVF within 90 calendar days from the date of issue. When this information is available, the Department will indicate on the plans which structures contain friable asbestos. Only entities certified by DEQ as Asbestos Abatement Entities shall remove friable asbestos from structures. The asbestos removal shall be performed before removal, relocation or demolition of the structure. Friable asbestos removal, handling and disposal shall be performed in accordance with the latest requirements for asbestos abatement of the DEQ, Air Quality Division. The CONTRACTOR shall maintain, and furnish to the ENGINEER, within 21 calendar days, Chain of Custody verification records for the friable asbestos from the work site to the disposal site. These records will become part of the permanent project records.
- D. **Contaminated Soils:** Soil contaminated with Benzene, Toluene, Ethyl Benzene, Xylene (BTEX), Total Petroleum Hydrocarbons- Gasoline (TPH-G), Total Petroleum Hydrocarbons-Diesel (TPH- D), Total Petroleum Hydrocarbons-Oil (TPH-O), or other identified toxic materials, in areas of underground fuel tanks or other areas, at levels above the regulatory limits and is non-protective of groundwater shall be excavated by the CONTRACTOR as shown on the plans or as directed. Determination of groundwater protection shall be through the use of the Synthetic Precipitation Leachate Procedure (SPLP) or as directed. The CONTRACTOR shall remove the overburden above the contaminated soil to the dimensions shown on the plans or as directed. The CONTRACTOR shall also excavate the contaminated soil at the locations shown on the plans or as directed. The contaminated soil shall be loaded into approved hauling vehicles by the CONTRACTOR and be disposed of in a disposal site approved by the Department of Environmental Quality. The CONTRACTOR shall furnish the ENGINEER, within 21 calendar days, Chain of Custody verification records for the contaminated soil. The Materials and Testing Section will verify that all contaminated soil has been removed. While the excavation is open, the CONTRACTOR shall construct and maintain a soil berm around the excavation to prevent surface water runoff from entering the excavation. The removed overburden may be used to construct the berm and backfill the excavation. Removal and disposal of contaminated soils will be in accordance with all local, state and federal laws and regulations.
- E. **Paint Containing Lead or Other Hazardous Materials on Metal Surfaces:** Steel members of structures protected by paint containing lead or other hazardous materials as shown on the plans or as discovered in the field shall be removed and prepared for transport by methods approved by the ENGINEER. Such steel members shall be delivered to a licensed recycling center capable of processing steel members coated with paint identified by the Resource Conservation and Recovery Act (RCRA) as hazardous. Prior to removal, transport, treatment or disposal of any steel members, the CONTRACTOR shall submit the following to the ENGINEER.
- 1) Plan of removal of steel members.
  - 2) Plan for transport of steel members.
  - 3) Name and address of the licensed recycling center.

All steel members shall be transported in accordance with all federal, state and local laws. Certificates of Disposal, Chain of Custody forms, or other applicable documents shall be provided within 21 calendar days following each shipment.



- F. **Treated Timber:** Creosoted and other treated timber or lumber shown on the plans or discovered in the field shall be removed and prepared for transport by methods approved by the ENGINEER. All materials that are not designated to be salvaged by the OWNER or salvaged by the CONTRACTOR are to be disposed of in an appropriate landfill. Certificates of Disposal, Chain of Custody forms, or other applicable documents shall be provided within 21 calendar days following each shipment.
- G. **Universal Wastes:** Universal wastes are hazardous wastes defined in LAC Title 33, Part V, Chapter 38, Section 3813 to include batteries, pesticides, thermostats, lamps and antifreeze. Universal wastes shall be removed by the CONTRACTOR in accordance with the plans and shall be stored and prepared for transport as specified in LAC Title 33, Part V, Chapter 38 and herein. A lamp is the bulb or tube portion of an electric lighting device. Universal waste lamps include, but are not limited to, fluorescent, high intensity discharge, neon, mercury vapor, high pressure sodium, and metallic halide. Such lamps shall be removed and stored in containers or packages that are structurally sound, adequate to prevent breakage, and compatible with the contents of the lamps. Such containers shall remain closed and lack evidence of leakage, spillage or damage that could cause releases of mercury or other hazardous constituents to the environment under reasonably foreseeable conditions. The containers shall be clearly labeled or marked with the words "Universal Waste – Lamps" and with the earliest date that any lamp in the container was discarded as waste. If a container develops a leak, it shall be placed into an over-pack container. The CONTRACTOR shall immediately clean up any leakage and place in a container any lamp that shows evidence of breakage, leakage, or damage. Universal waste lamps will not be allowed to accumulate for a period longer than one year from the date the lamps were discarded. The waste lamps shall be delivered to a universal waste disposal site or destination facility by a Universal Waste Transporter in accordance with the applicable U.S. Department of Transportation Regulations, 49 CFR, Parts 172-180. The CONTRACTOR shall be responsible for informing all employees who handle universal wastes of the proper handling and emergency procedures appropriate to the type of waste.

- END OF SECTION –

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## SECTION 02204 - TEMPORARY ENVIRONMENTAL CONTROLS (REVISED 8/2016)

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall comply with federal, state, and local laws and regulations controlling pollution of the environment, including air, water, and noise. The CONTRACTOR shall take precautions to prevent pollution of waters and wetlands with fuels, oils, asphalts, chemicals, or other harmful materials.

#### 1.2 REFERENCE STANDARDS

- A. Louisiana Department of Environmental Quality (LDEQ)

LAR 100000                      Master General Permit for Discharges of Storm Water from Construction Activities – Five Acres or More

LAR 200000                      Storm Water General Permit for Small Construction Activities

- B. Occupational Safety Hazard Administration (OSHA)

Part 1926                      Safety and Health Regulations for Construction

- C. United States Environmental Protection Agency (US EPA)

Storm Water Management for Construction Activities

#### 1.3 CONTRACTOR SUBMITTALS

- A. Contractor Submittals shall be per Section 01010.

1. **Submittal:** Where a stormwater pollution prevention plan (SWPPP) is required, submit to the ENGINEER as specified herein. The CONTRACTOR shall submit all activity reports as required by permits as applicable. Where SWPPP is not required, the CONTRACTOR shall inform the ENGINEER in writing, documenting the reasons why a SWPPP is not required.
2. **Submittal:** Where certificates, inspection reports, or other items are required, submit to the ENGINEER as specified herein.

#### 1.4 DUST ABATEMENT

- A. The CONTRACTOR shall prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity of the Site. The CONTRACTOR shall be responsible for any damage resulting from dust originating from its operations. Dust abatement measures shall be continued until the CONTRACTOR is relieved of further responsibility by the ENGINEER.
- B. **Storage Piles:** The CONTRACTOR shall enclose, cover, water (as needed), or apply non-toxic soil binders according to manufacturer's specifications on material piles (i.e. gravel, sand, dirt) with a silt content of 5 percent or greater.

- C. **Active Areas of Site:** The CONTRACTOR shall water active construction areas and unpaved roads as needed and as directed by ENGINEER.
- D. **Inactive Areas of Site:** The CONTRACTOR shall apply non-toxic soil stabilizers according to manufacturer's specifications to inactive construction areas, or water as needed to maintain adequate dust control.
- E. **Vehicle Loads:** The CONTRACTOR shall cover or maintain at least 2-feet of freeboard vertical distance between the top of the load and the top of the trailer sides on trucks hauling dirt, sand, soil, or other loose materials off of the Site.
- F. **Roads:** When there is visible track-out onto a paved public road, the CONTRACTOR shall install wheel washers where the vehicles exit and enter onto the paved roads and wash the undercarriage of trucks and any equipment leaving the Site on each trip. The CONTRACTOR shall sweep the paved street at the end of each shift with a water spray pick-up broom-type street sweeper as necessary or as directed.
- G. **Vehicle Speeds:** If watering of unpaved roads is not sufficient to control dust. The CONTRACTOR shall reduce vehicle speeds as required for control of dust.

#### 1.5 **SEDIMENTATION ABATEMENT**

- A. For work disturbing one acre or less, no Storm Water Pollution Prevention Plan is required. CONTRACTOR shall be responsible for collecting, storing, hauling, and disposing of spoil, silt, and waste materials in compliance with applicable federal, state, and local rules and regulations and the Contract Documents.
- B. The CONTRACTOR shall install and maintain erosion and sediment control measures, such as swales, grade stabilization structures, berms, dikes, waterways, filter fabric fences, and sediment basins.
- C. The CONTRACTOR shall filter fabric barrier systems, if used, shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.
- D. The CONTRACTOR shall remove and dispose of sediment deposits at the designated spoil area. If a spoil area is not indicated, dispose of sediment off-Site at a legally permitted disposal facility. Sediment to be placed at the spoil area should be spread evenly, compacted, and stabilized. Sediment shall not be allowed to flush into a stream, drainage structure, or drainage way.
- E. The CONTRACTOR shall maintain erosion and sediment control measures until final acceptance or until directed by the ENGINEER to remove it.

#### 1.6 **STORMWATER POLLUTION PREVENTION PLAN**

- A. The CONTRACTOR shall prepare and maintain a Storm Water Pollution Prevention Plan (SWPPP), for work disturbing one acre or greater. The plan shall describe in specific details the CONTRACTOR's program to prevent contamination of the storm water collection system for this project. A suggested Template and Sample SWPPP Inspection Report, as well as other valuable information can be found at EPA's website: <http://cfpub.epa.gov/npdes/stormwater/swppp.cfm>

- B. The CONTRACTOR'S Storm Water Pollution Prevention Plan shall be comprised of all relevant components specified in the U.S. Environmental Protection Agency document entitled, "Storm Water Management for Construction Activities".
- C. The CONTRACTOR shall implement, maintain, and inspect all erosion and sediment controls identified in the SWPPP. The program shall address both common construction activities and extraordinary events. The CONTRACTOR shall remove all temporary SCMs, such as silt fences, catch basin filters, wash areas, etc. at the end of construction.
- D. The CONTRACTOR shall include Water Pollution Control Drawings (WPCD) in the SWPPP to illustrate the locations, applications, and deployment of the Storm Water Control Measures (SCMs) identified in the SWPPP. The WPCDs shall be included as an attachment to the SWPPP.
- E. **Storm Water Control Measures (SCMs):** The Storm Water Control Measures (SCMs) are techniques, processes, activities, or structures used to reduce the pollutant content of a storm water or non-storm water discharge. SCMS may include simple, non-structural methods such as good housekeeping, staff training, and preventative maintenance. Additionally, SCMs may include structural modifications such as the installation of berms, canopies, or treatment control.
- F. The CONTRACTOR shall comply with laws, rules, and regulations of the State of Louisiana and agencies of the United States Government prohibiting the pollution of lakes, wetlands, streams, or river waters from the dumping of contaminates, refuse, rubbish, or debris.
- G. The CONTRACTOR shall submit copies of the SWPPP a minimum of 10 working days prior to beginning construction, to the ENGINEER. The CONTRACTOR shall update the SWPPP as necessary during the work to prevent contamination of the storm water collection system.
- H. Before the start of work, the CONTRACTOR shall train all employees and Subcontractors on the approved SWPPP and related WPCD and provide the ENGINEER with written documentation of said training.
- I. For work disturbing one acre or less, Storm Water Control Measures (SCMs) must be in place. There shall be no Notice of Intent (NOI) required. The CONTRACTOR shall complete inspection reports and submit copies to OWNER. The CONTRACTOR and the INSPECTOR shall keep a copy of the report on file.
- J. For work disturbing one to five acres, Storm Water Control Measures (SCMs) must be in place. The CONTRACTOR must prepare SWPPP and post prominently on the job site. The CONTRACTOR must have the LAR 200000 General Permit posted on the job site. There shall be no Notice of Intent (NOI) required. The CONTRACTOR shall complete all required reports and submit them to OWNER.
- K. For work disturbing five acres or more, Storm Water Control Measures (SCMs) must be in place. The CONTRACTOR must have Notice of Intent (NOI) completed, sent to DEQ, and posted. The CONTRACTOR must prepare a SWPPP and post prominently on the site. The CONTRACTOR shall have the LAR 100000 General Permit posted on site with DEQ permit number for specific site. The CONTRACTOR must complete a Notice of Termination (NOT) and submit it to DEQ.

## 1.7 RUBBISH CONTROL

- A. During the progress of the WORK, the CONTRACTOR shall keep the Site and other areas for which it is responsible in a neat and clean condition and free from any accumulation of rubbish. The CONTRACTOR shall dispose of rubbish and waste materials of any nature and shall establish regular intervals of collection and disposal of such materials and waste. The CONTRACTOR shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of rubbish and surplus materials shall be off the Site in accordance with local codes and ordinances governing locations and methods of disposal and in conformance with applicable safety laws and the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

## 1.8 CHEMICALS

- A. Chemicals used on the WORK or furnished for facility operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant, or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

**PART 2 -- PRODUCTS (NOT USED)**

**PART 3 -- EXECUTION (NOT USED)**

- END OF SECTION -

## SECTION 02711 – RIPRAP (REVISED 04/16/2018)

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and place riprap in accordance with these specifications and in conformity to lines, grades and thickness shown on the plans or as directed.

#### 1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO)  
AASHTO T85            Specific Gravity and Absorption of Coarse Aggregate
- B. Louisiana Department of Transportation and Development (LDOTD)  
AML                    Approved Materials List

#### 1.3 CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01010.
- B. Materials proposed for and utilized in the WORK will be sampled as indicated in herein. The frequency of testing may be altered at the discretion of the ENGINEER. The CONTRACTOR shall provide all materials required for testing at no additional cost to the OWNER.
- C. **Submittal/Source Approval:** The CONTRACTOR shall submit the location and name of the proposed rip – rap supplier as well as evidence of listing of the source on the LDOTD AML (formerly QPL 2).
- D. **Submittal/Source Approval:** If geotextile fabric is specified, the CONTRACTOR shall provide submittals as detailed in Section 02200 – Earthwork.
- E. **Sampling/Acceptance:** At the option of the ENGINEER, the CONTRACTOR shall submit a sample of rip rap for gradation testing to confirm compliance with these specifications. The ENGINEER shall have the option of inspecting rip – rap at the source prior to delivery.

### PART 2 -- PRODUCTS

#### 2.1 MATERIALS

- A. Stone riprap shall be from an approved source listed in the LDOTD AML (formerly QPL 2). Stone riprap shall not disintegrate upon exposure to the elements or be easily broken from handling, shall be reasonably free from earth and other foreign materials. When tested in accordance with AASHTO T 85, the solid weight of stone shall be at least 155 pounds per cubic foot (based on bulk specific gravity). The least dimension of any individual stone shall be 1/3 its maximum dimension. Each shipment of stone shall be reasonably well graded within specified limits.

- B. Recycled concrete may be used as riprap unless otherwise indicated herein provided its solid weight is at least 155 pounds per cubic foot (based on bulk specific gravity) and it is free of protruding reinforcement.
- C. Stockpiles of recycled concrete shall be source approved prior to use and kept separate from other materials. Stockpiles shall be uniform and free of soil, debris, excessive amounts of asphaltic materials, and foreign matter. Once a stockpile has been approved as an acceptable source of material, no material shall be added without prior approval.
- D. Control of gradation will be by visual inspection at the source, project site or both.
- E. Any difference of opinion between the ENGINEER and CONTRACTOR will be resolved by checking the gradation of two random truckloads (or equivalent size samples). Equipment, labor and sorting site shall be furnished by the CONTRACTOR at no additional cost to the OWNER.
- F. **Riprap:** Riprap shall be reasonably well graded and shall comply with Table 02711-1.
- G. **Geotextile Fabric:** Geotextile Fabric shall comply with Section 02200 – Earthwork.

**Table 02711-1**

Riprap Class <sup>1</sup>	Stone Size lb	Spherical Diameter, ft <sup>2</sup>	Percent of Stone Smaller Than
55 lb (25 kg) <sup>3</sup>	275	1.50	100
	110	1.11	42-100
	55	0.88	15-50
	20	0.63	0-15

<sup>1</sup>The stone size used to define the Riprap Class is the minimum median stone size for the stone class. The minimum thickness of a riprap layer shall be no less than the spherical diameter of the maximum stone size in Riprap Class.

<sup>2</sup>Spherical diameters of riprap classes up to 30 lb are based on a solid weight of 140 lb/cu ft . Spherical diameters of riprap classes above 30 lb are based on a solid weight of 155 lb/cu ft.

<sup>3</sup>Recycled Portland cement concrete may not be used in these riprap classes.

## **PART 3 -- EXECUTION**

### **3.1 CONSTRUCTION REQUIREMENTS**

- A. **Riprap:** Areas on which riprap is to be placed shall be graded to the required section. Riprap shall be placed on the prepared slope or area in a manner which will produce a reasonably well-graded mass of stone with a minimum practicable percentage of voids. The entire mass of stone will be placed to be in conformance with the lines, grades, and thickness at one operation and to avoid displacing underlying material. Placing of riprap in layers, or dumping into chutes, or by similar methods likely to cause segregation, will not be permitted.
- B. When placement in water currents is required, the CONTRACTOR shall make drift checks and place riprap in such manner as to compensate for drift. The CONTRACTOR shall furnish necessary facilities and personnel for checking riprap depth and distribution.
- C. **Filter Stone:** When specified, filter stone shall be placed on the prepared slope or area before placement of riprap. When filter stone is placed under water, free dumping will not be permitted. Underwater placement shall be controlled by methods using bottom dump



buckets or wire rope baskets lowered through the water to the point of placement. If placement in strong water currents is required, placement of riprap will follow soon after placement of filter stone. Unless shown otherwise on the plans or directed, filter stone shall be Riprap (Class 10 lb) or less.

- D. **Geotextile Fabric:** When specified, geotextile fabric shall be placed on the prepared slope or area in accordance with Section 02200 - Earthwork before placement of riprap. Care shall be taken not to damage the geotextile fabric when placing riprap. Placing riprap by rolling riprap down slope, or dropping riprap from extreme heights, or by similar methods likely to damage geotextile fabric, will not be permitted. Damaged geotextile fabric shall be replaced in accordance with Section 02200 – Earthwork or as directed by the ENGINEER.

- END OF SECTION –

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## SECTION 02717 – SEEDING (REVISED 04/24/2017)

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall seed all areas affected by construction.
- B. Unless otherwise specified, seed shall be applied mechanically in a dry condition.
- C. The CONTRACTOR shall obtain the services of an established soil testing entity to coordinate soil sampling, perform testing and analyses, and prepare recommendations for materials and procedures to be used during the preplanting phase of new turf establishment. When practicable, soil testing shall be performed early enough to permit agricultural lime or other additives (if required) to be applied sufficiently in advance of planting so that the soil pH adjustment will occur before planting. Samples shall be tested and analyzed to determine pH and fertility conditions. The test results and recommendations shall be used to determine the quantities of agricultural lime and fertilizer required for preplanting applications. A copy of the test report with recommendations shall be furnished to the ENGINEER. Testing will be at no direct pay. Agricultural lime recommendations shall consider probable time of application.

#### 1.2 REFERENCE STANDARDS

- A. NOT USED

#### 1.3 CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01010.
- B. Materials proposed for and utilized in the WORK will be sampled as indicated in herein. The frequency of testing may be altered at the discretion of the ENGINEER. The CONTRACTOR shall provide all materials required for testing at no additional cost to the OWNER.
- C. **Source Approval/Submittal:** The CONTRACTOR shall submit product information on all seeding products to be utilized or incorporated into the WORK. The submittal for source approval shall include information on chemical properties, compliance with applicable standards, and any other information required sufficient for the ENGINEER to review the acceptability of the proposed products.

#### 1.4 QUALITY ASSURANCE

- A. NOT USED

#### 1.5 DELIVERY, STORAGE, AND HANDLING:

- A. NOT USED

### PART 2 -- PRODUCTS

#### 2.1 TOPSOIL

- A. Areas to be seeded shall be covered with 2" of top soil per Section 02200.

**2.2 FERTILIZER**

- A. Fertilizer shall be as specified in Section 02718 – Fertilizer and Agricultural Lime.

**2.3 AGRICULTURAL LIME**

- A. Agricultural Lime shall be as specified in Section 02718 – Fertilizer and Agricultural Lime.

**2.4 SEED**

- A. Seed shall comply with requirements of Louisiana law. minimum percentage of pure live seed and the maximum percentage of weed seed permitted shall be in accordance with the table below:

<b>Variety</b>	<b>Minimum Percent of Pure Live Seed (Purity Times Germination Including Hard Seed by Count)</b>	<b>Maximum Percent of Weed Seed by Count</b>
Hulled Bermuda	83	1
Pensacola Bahia	81	2
Crimson Clover	78	1
Kentucky 31 Fescue	80	1
Unhulled Bermuda	80	1
Ball Clover	80	1
Vetch	80	1
Lespedeza	80	1
Annual Rye	80	1
Browntop Mullet	80	1

- B. Each variety of seed shall be furnished and delivered in separate bags or other containers. Each bag or container shall bear an analysis tag which is a minimum No. 6 standard shipping tag having all information required by the Louisiana Seed Law.
- C. Seed furnished shall be the previous season's crop (the last crop year for the crop kind in question) and the date of analysis shown on each tag shall be within 5 months (excluding the month in which the test is completed) of the time of delivery to the project. Noxious weeds shall be interpreted to mean that list of weeds, except Bermuda, which has been adopted by the Louisiana Seed Commission as being noxious in Louisiana. Noxious weed seeds shall not exceed the limitations prescribed in the regulations and in no case shall they exceed 500 per pound. Analysis tags shall be removed from each bag or container only by the ENGINEER or an authorized representative.

**PART 3 -- EXECUTION**

**3.1 SOIL AREAS AND SEED SELECTION**

A. The CONTRACTOR's seed supplier shall recommend and select seed mixture on the basis of the five general areas described below and the time of planting. Seed mixtures, soil areas, and planting and establishment dates are detailed in the table below.

- 1) Area 1 – Alluvial Soils of Mississippi and Red River Bottoms
- 2) Area 2 – Mississippi Terraces and Loessial Soils
- 3) Area 3 – Coastal Plain Soils
- 4) Area 4 - Coastal Prairie Soils
- 5) Area 5 - Ouachita River Bottom

Type	Seed Mixture	Minimum Pounds per Acre (Respectively)	Soil Area	Planting Dates	Establishment Period
A	Hulled Bermuda	30	1,2,3,4,5	Mar – Sep	Mar – Dec
B	Hulled Bermuda, Crimson Clover	20, 25	1,2,3,5	Feb – Mar	Feb – Jun
C	Kentucky Fescue, Unhulled Bermuda	31 25,20	1,2,3,4,5	Sep – Feb	Sep – May
D	Unhulled Bermuda, Crimson Clover	20, 40	1,2,3,4,5	Sep – Feb	Sep – May
E	Pensacola Bahia	25	1,2,3,5	Mar – Sep	Mar – Dec
F	Ball Clover, Unhulled Bermuda	25, 20	1,2,3,4,5	Feb – Mar	Feb – Jun
G	Vetch, Unhulled Bermuda	40, 20	1,2,3,4,5	Sep – Oct	Sep – Jan
H	Annual Rye	30	1,2,3,4,5	Sep – Jan	Sep – Apr

### 3.2 PREPARATION OF SEED BED

- A. Seed beds shall be prepared by disking, harrowing or other approved methods. Soil on slopes of 3- horizontal-to-1-vertical and flatter shall be tilled to a minimum of 4 inches depth. On slopes between 3-horizontal-to-1-vertical and 1- horizontal-to-1 vertical, the soil shall be tilled to a minimum of 2 inches depth by scarifying with heavy rakes, or other methods. Rototillers may be used where soil conditions and length of slope permit. On slopes 1- horizontal-to-1-vertical and steeper, no tillage is required. Drainage patterns shall be maintained as indicated on the plans. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements. The pH adjuster, fertilizer, and soil conditioner may be applied during this procedure. The prepared surface shall be a maximum 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.
- B. **Lawn Area Debris:** Debris and stones over a maximum of 5/8- inch in any dimension shall be removed from surfaces designated on the plans as lawn areas or as directed by the ENGINEER.
- C. **Field Area Debris:** Debris and stones over a maximum of 3-inches in any dimension shall be removed from the surface
- D. **Protection:** Prepared surface areas shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

### 3.3 PERMANENT SEEDING

- A. Seed shall be planted within the dates specified above, unless otherwise directed or permitted by the ENGINEER.

### 3.4 WATERING

- A. When deemed necessary due to dry conditions, seeded areas shall be periodically watered until final acceptance at no direct pay.

### 3.5 SEED ESTABLISHMENT PERIOD

- A. Turf will be considered to be established and completed when the areas to be turfed have produced Bermuda grass stems or runners which overlap adjacent Bermuda grass growth over a minimum of 85 percent of the entire area as determined by the ENGINEER by random sampling on a square yard basis and when the areas to be turfed have no spots greater than 4 square feet that are void of Bermuda grass.
- B. Acceptance of the entire turfed area will be based on the ENGINEER's visual inspection and determination of the required coverage. Acceptance will be based on coverage by Bermuda grass only. Dying or dead turf and eroded areas will not be accepted. Partial areas will not be accepted unless determined by the ENGINEER to be in the best interest of the OWNER.

- END OF SECTION -

## **SECTION 02727 - MOBILIZATION**

### **PART 1 -- GENERAL**

#### **1.1 GENERAL**

- A. CONTRACTOR shall mobilize as required for the proper performance and completion of the WORK and in accordance with the Contract Documents.
- B. Mobilization shall include at least the following items:
  - 1. Moving onto the Site of CONTRACTOR's plant and equipment necessary for the first month of operations.
  - 2. Installing temporary construction power, wiring, and lighting facilities.
  - 3. Establishing fire protection system.
  - 4. Developing construction water supply.
  - 5. Providing on-Site sanitary facilities and potable water facilities.
  - 6. Arranging for and erection of CONTRACTOR's WORK and storage yards.
  - 7. Constructing and implementing security features and requirements as specified.
  - 8. Obtaining required permits.
  - 9. Having OSHA required notices and establishing safety programs.
  - 10. Having the CONTRACTOR's superintendent at the Site full time.
  - 11. Submitting initial submittals.

#### **1.2 PAYMENT FOR MOBILIZATION**

- A. The CONTRACTOR's attention is directed to the condition that no payment for mobilization, or any part thereof, will be recommended for payment under the Contract until mobilization items listed above have been completed.

### **PART 2 -- PRODUCTS (NOT USED)**

### **PART 3 -- EXECUTION (NOT USED)**

- END OF SECTION -

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## **SECTION 02740 – CONSTRUCTION LAYOUT**

### **PART 1 -- GENERAL**

#### **1.1 THE REQUIREMENT**

- A. The CONTRACTOR shall establish all lines and grades, take all cross sections, and stake out the construction work in accordance with these specifications, plan details, and as directed.

#### **1.2 REFERENCE STANDARDS**

- A. NOT USED

#### **1.3 CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING**

- A. NOT USED

### **PART 2 -- PRODUCTS (NOT USED)**

### **PART 3 -- EXECUTION**

#### **3.1 GENERAL**

- A. The CONTRACTOR shall establish all lines and grades and stake out all work, including sufficient vertical and horizontal points for all necessary operations.
- B. The ENGINEER will also provide one bench mark on or near the project for vertical control. The CONTRACTOR shall verify the values of any intermediate bench marks shown on the plans, by checking against the bench mark established by the ENGINEER for vertical control.
- C. The CONTRACTOR shall employ qualified engineering and surveying personnel experienced in layout of the type of work of this project to correctly establish and keep complete and comprehensive records of all lines and grades necessary from initial layout to final acceptance. The CONTRACTOR shall provide sufficient qualified staff, of at least one employee, on site during utility relocation periods. The CONTRACTOR shall provide any necessary survey work to ensure there are no utility conflicts with required construction. The CONTRACTOR shall provide daily documentation of utility relocation activities for incorporation into the project diaries.
- D. The CONTRACTOR shall be liable for the accuracy of the initial layout and all subsequent alignment and elevations and shall, at no additional cost to OWNER, rebuild, repair or make good any portion of the work found to be incorrectly positioned either horizontally or vertically at any time before final acceptance.

- END OF SECTION -

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## SECTION 02804 – DRIVEN PILES

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide driven piles, complete and in place, in accordance with the requirements of the Contract Documents.

#### 1.2 REFERENCE STANDARDS

A. **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M270                      Standard Specification for Structural Steel for Bridges

B. **ASTM International (ASTM)**

ASTM D 25                         Standard Specification for Round Timber Piles

ASTM D 173                        Standard Specification for Bitumen Saturated Cotton Fabrics Used in Roofing and Waterproofing

C. **American Wood Protection Association (AWPA)**

AWPA C1                            Preservative Treatment by Pressure Process

AWPA C3                            Piles – Preservative Treatment by Pressure Process

AWPA M4                            Standard for the Care of Preservative – Treated Wood Products

AWPA P1                            Standard for Creosote Preservative

AWPA P2                            Standard for Creosote Solutions

AWPA P3                            Standard for Creosote – Petroleum Oil Solution

AWPA P5                            Standard for Waterborne Preservatives

AWPA P8                            Standard for Oil – Borne Preservatives

AWPA P9                            Standard for Solvents and Formulations for Organic Preservative Systems

#### 1.3 SUBSURFACE CONDITIONS

- A. A geotechnical engineering study has been performed for the site. Copies of pertinent reports are included as an Appendix to the Contract Documents and Technical Specifications. The CONTRACTOR shall understand and conform to all recommendations and criteria associated with pile foundations given in this report.
- B. The CONTRACTOR shall visit the site and shall satisfy itself as to all existing surface and subsurface conditions affecting its WORK. The information provided in the geotechnical engineering report is available to the CONTRACTOR to assist it, at its own risk, in its assessment of subsurface conditions at the site. Prior to bidding, interested

parties may make their own subsurface investigations to satisfy themselves as to site and subsurface conditions, but such subsurface investigations shall be performed only under time schedules and arrangements approved in advance by the OWNER.

#### **1.4 SUBMITTALS, SAMPLING, AND TESTING**

A. The CONTRACTOR shall furnish submittals in accordance with Section 01010.

B. The CONTRACTOR shall submit the following:

1. Pile Driving Plan: The CONTRACTOR shall submit a description of the proposed pile driving system, which includes the pile driving equipment to be furnished by the CONTRACTOR and the method of pile installation in the form of a Pile Installation Plan for review by the ENGINEER. The pile driving equipment and the pile installation method shall be such that piles will obtain the required penetration without damage. In no case shall the pile driving equipment be transported to the project site until approval is received in writing. Any parts of the CONTRACTOR's submittal that are unacceptable will be rejected and the CONTRACTOR will resubmit changes agreed upon for reevaluation. The ENGINEER will notify the CONTRACTOR, within seven calendar days after receipt of proposed changes, of their acceptance or rejection. The time required for submission, review, and approval of a revised pile driving system shall not constitute the basis for a contract time extension by the CONTRACTOR. All approvals given by the ENGINEER shall be subject to trial and satisfactory performance in the field. The CONTRACTOR shall use the approved pile driving system during pile driving operations. The CONTRACTOR shall make any required changes, including supplying additional hammers, that may result from unsatisfactory field performance. Final acceptance will be given after necessary modifications are made. No changes in the driving system or installation method may be made after final approval without the written approval of the ENGINEER. The pile installation plan shall provide detailed information pertaining to the pile driving equipment and method of piling installation. The submittal shall include at a minimum the following information:

- a. A detailed list detailing the type and size of the proposed pile driving equipment, including hammer, leads, jetting equipment, compressors and drilling equipment for pre-boring. Include hammer manufacturer's operating manual and compressor data sheets. If a mandrel is used to install piles, a complete description shall be provided including size and weight of components.
- b. Proposed pile driving methods that may be required to facilitate pile driving installation such as pre-boring or jetting.
- c. Methods to determine hammer energy in the field for determination of the pile bearing capacity. When pressure measuring equipment will be used to determine hammer energy, the submittal shall include hose length, hose diameter, equivalent energy charts, and calibrations.
- d. Pile driving sequence for each unique pile layout configuration.

2. **Timber Pile Information:** The CONTRACTOR shall submit information regarding pile dimensions, source, treatment, and other information as required by the ENGINEER. The information shall contain a physical address for where piles to be utilized are located to facilitate inspection prior to shipment.

C. Materials proposed for and utilized in the WORK will be sampled or inspected as indicated in herein.

1. Prior of shipment of the piles to the site, the CONTRACTOR shall arrange for the inspection of the piles proposed for the WORK by the Testing Laboratory. The Testing Laboratory will inspect the piles at their location for dimensional compliance with specifications, for preservative retention, and will mark piles which are found to be acceptable for use.
2. Upon arrival at the site, the Testing Laboratory will inspect the piles delivered to the site to verify that they are the piles which were proposed and marked as acceptable for use.
3. The Testing Laboratory will take blow counts during the installation of the piles. This information will be provided to the CONTRACTOR and ENGINEER, but the Testing Laboratory will make no evaluation of the pile driving operation.

**PART 2 -- PRODUCTS**

**2.1 PILE LENGTHS**

A. The CONTRACTOR shall furnish piles in accordance with the plans, which show the number, size, length, and location of all permanent piles. The lengths shown on the plans will be based upon the lengths that are assumed to remain in the completed structure. At the CONTRACTOR's expense, the pile lengths shall be increased as required to provide for fresh heading and for such additional length as required to suit the CONTRACTOR's method of operation. When test piles or indicator piles are required, the pile lengths shown on the plans were for estimating purposes. The ENGINEER may revise pile lengths when driving conditions differ from those in design.

**2.2 TIMBER PILES**

A. Timber piles shall be Southern Yellow Pine or Douglas Fir and shall comply with ASTM D 25, except that the table below shall be used in lieu of Tables I and II in ASTM D 25.

Circumference and Diameters of Timber Piles (Measurements shall be taken with bark removed)						
Length, Feet	3 Feet from Butt, Inches				At Tip, Inches	
	Minimum		Maximum		Minimum	
	Circumference	Diameter (Approx)	Circumference	Diameter (Approx)	Circumference	Diameter (Approx)
Under 40	38	12	63	20	25	8
40 to 54 Inclusive	38	12	63	20	22	7
55 to 74 Inclusive	41	13	63	20	22	7

- B.** All timber piles shall be treated with timber preservative. The type preservatives to be used are as follows:
1. Creosote: Creosote for land, fresh, and coastal water use shall comply with AWPA P1/P3.
  2. Creosote Solutions: Creosote solutions for fresh and coastal water shall comply with AWPA P2.
  3. Pentachlorophenol – Petroleum Solution: Pentachlorophenol – Petroleum solution shall comply with AWPA P8 and P9.
  4. Chromated Copper Arsenate: Chromated Copper Arsenate shall comply with AWPA P5, Type B or C.
  5. Creosote for Field Repairs: Creosote for field repair shall comply with AWPA M4.
- C. Treatment of Timber Piles:** Piles shall be treated according to current AWPA Standard Specifications for Preservative Treatment by Pressure Process C1 and C3, modified as indicated herein. Kiln – dried timber shall be steamed prior to treatment for a minimum of two hours. The amount of preservative shall be as indicated in the Minimum Preservative Retention Table below. The amount of preservative shall be determined by assay. The assay zone shall be as specified in the AWPA standards. All penetration requirements of the AWPA standards shall be met. Treating reports shall be forwarded to the ENGINEER upon request and may be utilized for acceptance at the discretion of the ENGINEER. Material treated with CCA shall be conditioned by kiln – drying prior to treatment.

Minimum Preservative Retention Table for Timber Piles (Pounds per Cubic Foot of Wood)				
Material and Usage	Creosote	Creosote Solutions	Pentachlorophenol	Chromated Copper Arsenate
Foundation Piles (Piles which are Embedded in the Ground and Capped with Concrete)				
Land and Fresh Water, Southern Pine	12.0	12.0	0.60	0.80
Land and Fresh Water, Douglas Fir	17.0	17.0	0.85	N/A

## PART 3 -- EXECUTION

### 3.1 GENERAL

- A. Hammers:** Piles may be driven with either diesel hammers or external combustion hammers (ECH) such as hammers driven by steam, air, or hydraulic power. Non-impact hammers such as vibratory hammers shall not be used unless specified in the plans or permitted in writing by the ENGINEER. Hammers shall be rated based on the theoretical potential energy of the ram at impact. A variable energy hammer shall be used to drive precast concrete piles.

1. **Steam and Air Hammers:** Steam and air hammers that are used to drive precast concrete piles shall be capable of providing at least two ram stroke lengths. The short ram stroke length shall be approximately half of the full stroke. Reductions in steam or air pressures to produce reduced hammer strokes will not be permitted. In lieu of a variable energy hammer, the CONTRACTOR may propose in the Pile Installation Plan the use of multiple hammers of different rated energies to drive precast concrete piles. The plant and equipment furnished for steam and air hammers shall have sufficient capacity to maintain the hammer at the volume and pressure specified by the manufacturer. The plant and equipment shall be equipped with accurate pressure gauges that are easily accessible for viewing by the ENGINEER. The weight of the striking parts of air and steam hammers shall not be less than 1/3 the weight of drive head and pile being driven, and in no case shall the striking parts weight less than 2,750 pounds.
2. **Open-End Diesel Hammers:** Open-end diesel hammers used to drive precast concrete piles shall be capable of providing a selection of at least three fuel settings that will produce varying stroke lengths. The CONTRACTOR shall provide the ENGINEER a chart from the hammer manufacturer equating stroke in feet and blows per minute. The CONTRACTOR shall have available on-site an approved device to determine and display ram stroke in feet of an open-end diesel hammer. The device used to determine the hammer stroke shall be periodically verified as determined by the ENGINEER by comparing the computed hammer stroke with the observed stroke on rams that have rings on the ram or by placing a temporary scale extending above the ram cylinder.
3. **Closed-End Diesel Hammers:** Closed-end diesel hammers used to drive precast concrete piles shall be capable of providing a selection of at least three fuel settings that will produce varying stroke lengths. Closed – end (double acting) diesel hammers shall be equipped with a bounce chamber pressure gauge mounted to be easily accessible by the ENGINEER. The CONTRACTOR shall provide the ENGINEER a chart, calibrated to actual hammer performance, equating bounce chamber pressure to either equivalent energy or stroke for the closed-end diesel hammer to be used. The calibration between bounce chamber pressure and actual hammer performance should be performed within 30 calendar days prior to starting driving and at 90 calendar day intervals thereafter.
4. **Hydraulic Impact Hammers:** The power plant and equipment furnished for hydraulic hammers shall have sufficient capacity to maintain the hammer at the volume and pressure specified by the manufacturer. The power plant and equipment shall be equipped with accurate pressure gauges that are easily accessible to the ENGINEER. These hammers shall be equipped with sensors or other approved devices capable of monitoring and displaying hammer performance.
5. **Gravity Hammers:** Gravity hammers, if permitted in the contract, shall only be used to drive timber piles. When gravity hammers are permitted, the ram shall weight between 2,000 and 3,300 pounds and the height of drop shall not exceed 10 feet. In no case shall the weight of gravity hammers be less than the combined weight of helmet and pile. All gravity hammers shall be equipped with hammer guides to ensure concentric impact on the helmet.

**B. Drive System Components and Accessories:**

1. **Hammer Cushion:** All impact pile driving equipment designed to be used with a hammer cushion shall be equipped with a suitable thickness of hammer cushion material to prevent damage to the hammer or pile and to ensure uniform driving

behavior. Hammer cushions shall be made of durable, manufactured materials, provided in accordance with the hammer manufacturer's guidelines. Wood, wire rope, and asbestos hammer cushions shall not be used unless permitted by the ENGINEER. A striker plate as recommended by the hammer manufacturer shall be placed on the hammer cushion to ensure uniform compression of the cushion material. The hammer cushion shall be inspected in the presence of the ENGINEER when beginning pile driving at each structure and after every 100 hours of use during pile driving operations. The CONTRACTOR shall replace the cushion when the hammer cushion begins to deteriorate or when the reduction in thickness exceeds 25 percent of the original thickness.

2. **Helmet:** Piles driven with impact hammers require an adequate helmet or drive head to distribute the hammer blow to the pile head. The helmet shall be axially aligned with the hammer and the pile. The helmet shall be guided by the leads and not be free-swinging. The helmet shall fit around the pile head in such a manner as to prevent transfer of torsional forces during driving, while maintaining proper alignment of hammer and pile.
  3. **Pile Cushion:** A pile cushion shall protect the heads of precast concrete piles. The pile cushion shall be made of plywood, hardwood, or a composite plywood and hardwood material. The minimum pile cushion thickness placed on the pile head prior to driving shall not be less than 4 inches. The pile cushion dimensions shall match the cross sectional area of the pile top. A new pile shall be provided for each pile driven unless otherwise permitted by the ENGINEER. The pile cushion shall be replaced during pile driving when the cushion begins to deteriorate or burn. Pile bearing capacity shall not be determined using a new pile cushion until after the pile has been driven a minimum of 5 feet or 100 blows. When easy driving conditions exist throughout the entire depth of driving, the ENGINEER may allow the pile cushion to be reused on several piles after guidelines for pile cushion replacement are developed from successful field performance. The objective shall be to maintain consistent energy delivery at the end-of-driving for proper determination of the pile bearing capacity without pile damage.
  4. **Leads:** Piles shall be supported in line and position with leads while being driven. Pile driver leads shall be constructed in a manner that affords freedom of movement of the hammer while maintaining alignment of the hammer and the pile to ensure concentric impact for each blow. Leads may be either fixed, semi-fixed or swinging types. Swinging leads shall be used in combination with a rigid template providing pile support meeting the approval of the ENGINEER. The pile section being driven shall not extend above the leads. The leads shall be of sufficient length to make the use of followers unnecessary and shall be so designed as to permit proper alignment of batter piles.
  5. **Templates:** A rigid template shall be used swinging leads are used. When driving battered piles with swinging leads, the template shall be two tiered or equipped with cradles to hold the pile at the required batter, and the bottom of the leads shall be attached to the template. Template construction shall allow the pile to pass freely through the template without binding.
- C. Piles shall be accurately located and driven either vertically or to the prescribed batter as shown. No variation greater than 1/4-inch per foot will be permitted. Piles with greater variation and those seriously damaged in driving shall be removed or cut off, and replaced with new piles. Any pile heaved by the subsequent driving of adjacent piles shall be re-driven. Piles, after driving, shall not be out of position by more than 6 inches. All correction costs shall be paid by the CONTRACTOR.



### 3.2 PREPERATION FOR INSTALLATION OF DRIVEN PILES

- A. **Excavation:** Piles shall not be driven until after any required excavation is complete. Any material forced up between the piles shall be removed to the correct elevation before concrete for the foundation is placed.
- B. **Embankment Fill:** The full height of embankments shall be constructed prior to dricing piles. Piles to be driven through compacted embankment greater than 6 feet shall be driven through pre-bored holes limited to the depth of the embankment.
- C. **Cofferdams:** Prior to driving any piles the CONTRACTOR shall ensure the cofferdam is stable by monitoring the external stability of the ground outside of the cofferdam, wall inclination, and depth of excavation within the cofferdam. All excavation within the cofferdam shall be complete prior to driving piles. The depth of the excavation within the cofferdam shall be inspected for proper depth with a weighted line or other approved method.

### 3.3 PILING PREPARATION

- A. **Transportation of Precast Concrete Piling:** Precast concrete piling shall be supported adequately to prevent damage during transport.
- B. **Collars:** Collars, bands, or other approved devices to protect timber piles against splitting or brooming shall be provided when necessary, or as required by the ENGINEER.
- C. **Painting of Piling:** When required by the plans, the foundation piling will be painted. The area of steel piles or the exterior surface of the steel shell of cast-in-place concrete piles, as specified in the plans shall be cleaned and painted from the top of the pile to a point 10 feet below the ground or mudline. The paint system shall be a 2-coat coal tar epoxy in accordance with Section 09800 – Protective Coatings.
- D. **Supporting Holes for Piles:** When approved, piles may be set in supporting holes, but in no case shall the depth of the holes be more than 10 feet for piles up to 50 feet long, or more than 20 percent of the designated penetration of the piles for piles over 50 feet long. If additional support is required, templates or falsework above ground shall be furnished. After piles are driven, supporting holes shall be backfilled to finished ground or base of footing with granular-type material acceptable to the ENGINEER and saturated with water.
- E. **Splicing Piles:**
  - 1. **Precast Concrete Piles:** Precast concrete piles shall be furnished and driven in full lengths, unless otherwise specified in the plans or approved in writing by the ENGINEER. There will be no direct payment for splicing.
  - 2. **Steel Piles:** Steel piles shall be furnished and driven in full lengths unless splices are authorized. Splices shall be limited to two field splices per pile. Splicing of steel piles shall be made by welding with full penetration welds as specified below:
    - 1. **Structural Steel Shapes:** Welding of structural steel shapes shall comply with the latest edition of ANSI/AASHTO/AWS D1.5 Bridge Welding Code. All minimum preheat and interpass temperatures in this code that are less than 125 F shall be amended to be a minimum of 125 F.

2. **Tubular Members:** Welding of steel pipe and tubular members shall comply with the latest edition of ANSI/AWS D1.1 Structural Welding Code – Steel. All minimum preheat and interpass temperatures in this code that are less than 125 F shall be amended to be a minimum of 125 F.
3. **Timber Piles:** Timber piles shall be furnished and driven full length.
4. **Cast – in – Place Concrete Pile Shells:** Cast – in – place concrete shells may be field spliced, but sections that in the opinion of the ENGINEER are too short shall not be used. Field splices of shell sections shall be made in accordance with the manufacturer’s recommendations and to the satisfaction of the ENGINEER.
5. **Pickup Straps:** Pickup straps shall be cutoff and epoxy grouted prior to driving in coastal areas.

### 3.4 CONSTRUCTION REQUIREMENTS

- A. **Pre-boring:** Pre-boring by augering, wet-rotary drilling, or other methods used to facilitate pile driving will not be permitted unless specified in the plans or specifications or required by the ENGINEER. When the soil investigation or field trials indicate impenetrable material above the minimum pile tip elevation, pre-boring may be required to facilitate pile driving. The use of spuds to punch through impenetrable soil layers shall not be permitted without approval. The depth of the prebored hole shall be developed so as to minimize the pile skin friction disturbance and still be sufficient to permit pile installation to the required pile tip elevation. Preboring procedures shall be carried out in a manner that will not impair the capacity of the piles already in place or the safety of existing structures. The CONTRACTOR shall develop the preboring depth limits based on the soil information obtained from soil boring logs and submit the limits to the ENGINEER for approval. The maximum prebored depth shall be 3 feet above pile tip elevation, unless otherwise directed. Prebored holes shall have a maximum diameter of 80 to percent of the pile diameter unless written approval to do otherwise is received from the ENGINEER. The prebored hole diameter for tapered piles shall be determined by the ENGINEER. Upon completion of the preboring, any voids around the pile shall be filled with granular-type material acceptable to the ENGINEER and saturated with water. The CONTRACTOR is responsible for any and all effects due to preboring.
- B. **Jetting:** Jetting will not be permitted unless allowed in the plans or required by the ENGINEER. Jetting will not be allowed in footings, header banks, or where stability of embankments or other structures would be endangered unless approved in writing by the ENGINEER. When the soil investigation or field trials indicate impenetrable material above the minimum pile tip elevation, jetting may be required to facilitate pile driving. The jet pipe penetration limit shall be developed to minimize the pile skin friction disturbance and still be sufficient to permit pile installation to the required pile tip elevation. The CONTRACTOR shall develop the jet pipe penetration limits based on soil information obtained from soil boring logs and shall submit the limits to the ENGINEER for approval. The maximum jet penetration limit shall be 5 feet above the required pile tip elevation. Extending the maximum jet penetration limit will require written approval by the ENGINEER.
- C. When water jets are permitted, the jetting procedures shall be carried out in a manner which will not impair the capacity of the piles already in place or the safety of existing structures or create a crater around the pile causing it to drift. The CONTRACTOR shall be responsible for all damage to the site caused by unapproved or improper jetting operations. The number and size of jets and the volume and pressure of water at jet nozzles shall be sufficient to erode material adjacent to the pile but not disturb the soil

bearing material within 5 feet of the required pile tip penetration. The jetting plant shall have sufficient capacity to deliver at all times a pressure equivalent to at least 100 psi at two 0.75 inch jet nozzles. One jet pipe will be allowed only when the CONTRACTOR is pre-jetting a hole prior to placing and driving the pile or when driving is interrupted and the jet is placed inside a steel pipe pile or a voided concrete pile. A minimum of two jets will be required when piles are jetted and driven concurrently using external jets. When jetting and driving is required, the jets shall be above the advancing pile tip approximately 3 feet, or as approved by the ENGINEER. Jetting operations shall cease when the jet penetration limit is reached, and the pile shall then be driven with the approved impact hammer to the final pile tip penetration. The pile bearing capacity shall be determined only from the results of driving after the jets have been withdrawn. The CONTRACTOR shall control, treat if necessary, and dispose of all jet water in a manner satisfactory to the ENGINEER. Upon completion of jetting a pile, any voids around the pile shall be filled with granular-type material acceptable to the ENGINEER and saturated with water.

- D. Followers and Underwater Hammers:** Followers or underwater hammers shall only be used when approved in writing by the ENGINEER. When a follower or underwater hammer is permitted, the first pile in each pile group and every tenth pile driven thereafter shall be sufficiently long to permit being driven without a follower or underwater hammer, to verify that adequate pile capacity is being attained to develop the desired end-of-driving pile capacity for the pile group. The determination of the pile bearing capacity shall be made as specified herein using the driving results of the extended piles. No direct payment will be made for cut-off of these extended piles. The follower or underwater hammer and pile shall be held and maintained in equal and proper alignment during driving. The follower shall be of such material and dimensions to permit the piles to be driven to the length determined necessary from the driving of the extended piles. The follower shall be provided with a socket or hood carefully fitted to the pile head to minimize energy losses and prevent pile damage.
- E. Location and Alignment Tolerances:** Piles shall be driven at locations shown on the plans or as ordered in writing. In pile bents, the centroid of a pile at cut-off elevation shall not vary from plan location by more than 3 inches measured perpendicular to the bent, nor more than 6 inches measured along the centerline of the bent. For footing piles, the centroid of load of any pile at cut-off elevation shall be within a 6 inch radius of a circle having the plan location as its center. No pile shall be nearer than 3 inches from any edge of the cap. Any increases in size of cap to meet these edge distance requirements shall be at the CONTRACTOR'S expense. The final pile head at cut-off elevation shall be plus or minus 2 inches of the final grade shown in the plans. Piles shall be installed so that the axial alignment is within 2 percent of the specified alignment shown in the plans. For piles that cannot be inspected internally after installation, an alignment check shall be made before installing the last 5 feet of pile, or after installation is completed provided the exposed portion of the pile is not less than 5 feet in length. The ENGINEER may require that driving be stopped in order to check the pile alignment. Pulling laterally on piles to correct misalignment, or splicing a properly aligned section on a misaligned section shall not be permitted. If the location and/or alignment tolerances specified herein are exceeded, the CONTRACTOR shall provide the ENGINEER with a sketch showing the actual versus theoretical positions of the piles. If corrective measures are necessary, the CONTRACTOR shall bear all costs, including delays, associated with the corrective action.
- F. Installation Sequence:** The CONTRACTOR'S approved pile driving sequence to drive individual piles in a footing shall be used unless otherwise directed by the ENGINEER.

The pile driving sequence for individual piles in a footing shall be in accordance with one of the following options:

1. From the center of the pile group outward.
2. By rows from the center of the pile group to the side.
3. By rows from one side of the pile group to the other side.

**G. Pile Driving Stresses:** The piles shall be driven in a manner as not to exceed the maximum allowable driving stresses. For steel piles, the maximum compressive driving stresses shall not exceed 90 percent of the yield point of the pile material. For timber piles, the compressive driving stress shall not exceed 3600 psi. For precast prestressed concrete piles, the tensile and compressive driving stress in units of psi from the Maximum Allowable Driving Stresses Table below shall not be exceeded.

**Maximum Allowable Driving Stresses Table**

<b>Tensile Driving Stress (Normal Environments):</b>	
U.S. Units	Metric Units:
$3 \sqrt{f'_c + f_{pe}}$	$0.25 \sqrt{f'_c + f_{pe}}$
<b>Tensile Driving Stress (Corrosive Environments):</b>	
U.S. Units	Metric Units
$f_{pe}$	$f_{pe}$
<b>Compressive Driving Stress (All Environments):</b>	
U.S. Units	Metric Units:
$0.85 f'_c - f_{pe}$	$0.85 f'_c - f_{pe}$
$f'_c$ = Concrete Compressive Strength, psi (MPa) $f_{pe}$ = Effective Prestress, psi (MPa)	

**H. Extent of Driving:** Driving shall be continued until the ENGINEER determines satisfactory penetration and pile bearing capacity have been obtained. Approval from the ENGINEER shall be required to terminate pile driving above the plan tip elevation. Piles shall be driven to the plan tip elevation in accordance with these specifications, unless a minimum pile tip is specified in the plans. If the pile penetration requirements and pile bearing capacity are achieved within 5 feet of the plan pile tip elevation, the ENGINEER may consider the penetration and capacity requirements to be satisfied. The following requirements shall be used to evaluate satisfactory pile penetration and pile bearing capacity.

1. **Pile Driving Penetration Requirements:** Practical refusal blow count depends on the site soil profile, the pile type, and hammer manufacturer limitations to prevent hammer damage. Practical refusal is broadly defined as a rate of 20 blows per inch at maximum stroke, for 3 consecutive inches. However, depending on site conditions, this criterion may not always be applicable. If practical refusal is encountered above the required plan pile tip elevation, the CONTRACTOR may be required to obtain a larger hammer capable of achieving the required penetration, or

to use pile installation techniques to facilitate pile driving such as preboring or jetting. Refusal conditions shall require that the approved hammer is operating at the maximum stroke or fuel setting required to achieve the hammer manufacturer's maximum rated energy. The hammer shall be in proper working order. If the hammer performance needs to be evaluated, the ENGINEER may require dynamic monitoring of the pile driving operations. If the hammer performance indicates that the pile driving system's effective efficiency is not satisfactory, the CONTRACTOR shall be required to adjust the pile driving system until satisfactory performance is observed. The cost of dynamic monitoring and/or delays due to unsatisfactory hammer performance shall be at the CONTRACTOR'S expense. Dynamic monitoring of hammers performing satisfactorily shall be paid for by the OWNER.

- 2. Pile Bearing Capacity Requirements:** The pile bearing capacity shall be determined as specified herein. If pile bearing capacity is less than the required end-of-driving pile capacity at cut-off elevation, the ENGINEER has the option of either loading a permanent pile to determine its ultimate pile capacity, continuing to drive the pile until satisfactory resistance is obtained, or perform a pile restrike to check for increase in pile bearing capacity due to soil set-up. The loading procedure of permanent piles shall be in accordance with the requirements of this section. The additional length of pile due to the additional driving shall be furnished in accordance with the construction methods specified herein for pile extensions. Pile restrikes shall be performed as specified herein. If the potential exists for obtaining false pile bearing capacity results due to excess pore water pressure or if this condition was observed during field testing of test piles, indicator piles, or monitor piles, the pile bearing capacity shall be determined from pile restrikes as directed by the ENGINEER.
- 3. Pile Restrikes:** Pile restrikes are to be conducted as required for test piles, indicator piles, and production piles or as directed by the ENGINEER. Pile restrikes shall be conducted at no direct pay. The piles to be restruck shall be driven initially to 1 foot above the required pile tip elevation, or as directed by the ENGINEER. All pile restrikes shall be performed with a warm hammer that has applied a minimum of 20 blows to another pile or dummy block immediately before being used to restrike the selected pile. For precast concrete piles, the original pile cushion used during initial driving shall be used. If the original pile cushion used to drive precast concrete piles is no longer in an acceptable condition, another similar used cushion shall be used. The maximum amount of pile penetration required for each pile restrike shall be 6 inches or a maximum of 50 hammer blows. If the required end-of-driving pile capacity is obtained during the restrike of permanent piles, the pile shall be driven to grade. Restrike blow counts shall be measured as the number of hammer blows per increment of 1 inch
- 4. Heaved Piles:** Elevations to check on pile heave after driving shall be made at the start of pile driving operations and shall continue until the ENGINEER determines that such checking is no longer required. Elevations shall be taken immediately after the pile has been driven and again after piles within a radius of 15 feet have been driven. If pile heave is observed, level readings referenced to a fixed datum shall be taken on all piles immediately after installation and periodically thereafter as adjacent piles are driven to determine the pile heave range. All end bearing piles that have been heaved more than 1/4 inch shall be redriven to the required resistance or penetration at no direct pay. Concrete shall not be placed in pile casings until all piles in a footing have been driven, or as directed by the ENGINEER.

## I. Pile Cut-Offs:

1. **Timber Piles:** The tops of timber piling which support concrete footings or caps shall be sawed off perpendicular to their axes at the required elevation. When piles support timber caps they shall be sawed to a horizontal plane or to the slope specified, in such manner as to fit the cap. Shimming on tops of piles will not be permitted. Treatment of pile heads shall be as follows:
  1. After cutting, pile heads shall be treated to prevent decay. Pile heads to be encased in concrete will not require treatment.
  2. Immediately after making final cut-off on treated timber foundation piles, the cut area shall be given two liberal applications of preservative followed by a heavy application of hot roofing pitch or other approved sealer. Heads of treated timber piles in bents or where the cut-off is exposed shall be protected by one of the following methods, as specified. If not specified, galvanized metal coverings shall be used.
  3. **Galvanized Metal Coverings:** The sawed surface shall be thoroughly brush coated with two applications of creosote oil, after which there shall be placed two layers of heavy canvas size 20 by 20 inches saturated with hot roofing pitch, followed by a 24 by 24 inches, 28 gage galvanized metal cover. The cover shall be bent down over the pile approximately 45 degrees.
  4. **Fabric Covering:** Heads of treated piles shall be covered with alternate layers of hot pitch and loosely woven fabric complying with ASTM D 173, using four applications of pitch and three layers of fabric. The cover shall measure at least 6 inches more in dimension than the diameter of the pile and shall be neatly folded down over the pile and secured by large headed galvanized nails or by binding with at least seven complete turns of galvanized wire securely held in place by large-headed galvanized nails and staples. Edges of fabric projecting below the wire wrapping shall be trimmed to present a workmanlike appearance.

### 3.5 UNSATISFACTORY PILES

- A. The procedure used in driving piles shall not subject them to excessive abuse which produces cracking, crushing or spalling of concrete, splitting, splintering and brooming of timber, or deformation of steel. Manipulation of precast concrete piles to force them into proper position will not be permitted. Any pile found to be unacceptable due to internal defects, by improper driving, driven out of proper location, or driven below required elevation shall be corrected at no direct pay by one of the following methods approved by the ENGINEER:
  1. The pile shall be withdrawn and replaced by a new and, if necessary, a longer pile. Additional pile length and/or load testing may be required with no additional compensation due to disturbance of the soil from jetting or other methods used during removal of the pile.
  2. A second pile shall be driven adjacent to the defective pile. This may require driving the replacement pile with a batter in order to place the pile head at the plan location.
  3. The pile shall be spliced or built up as otherwise provided herein or a sufficient portion of the footing extended to embed the pile.

4. The cap or footing shall be redesigned at no direct pay and shall be approved by the ENGINEER. The CONTRACTOR will not be allowed additional compensation for increased quantities in a bent or footing due to driving additional piles to correct unsatisfactory piles.

### 3.6 DETERMINATION OF PILE BEARING CAPACITY

A. The pile bearing capacity is the pile capacity obtained during the end-of-driving or pile restrike. The pile bearing capacity determination shall be made by use of the Dynamic Formula, the Wave Equation, or the Test Pile Loading Results as specified in the plans. If the method of pile capacity is not shown on the plans the Dynamic Formula shall be used.

1. **Dynamic Formula:** The pile bearing capacity shall be determined by the ENGINEER, based on the dynamic formula. Piles shall be driven with the approved pile driving equipment to the ordered length or other lengths necessary to obtain the required end-of-driving pile capacity. If the end of driving capacity is not shown on the plans the required pile bearing capacity shall be 3.5 times the pile design load.

**English Dynamic Formula:**

$$R = \frac{(1.75\sqrt{E_r} \log(10N_b)) - 100}{2}$$

*R = Pile Bearing Capacity (Tons)*

*E<sub>r</sub> = Manufacturer's Rated Energy at the field  
observed ram stroke (foot – pounds)*

*N<sub>b</sub> = Number of Hammer Blows/Inch*

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## SECTION 03315 – GROUT (REVISED 09/20/2016)

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents
- B. The following types of grout are specified in this Section:
  - 1. Cement Grout
  - 2. Non-Shrink Grout - Class I (cement based)
  - 3. Non-Shrink Grout - Class II (cement based)
  - 4. Non-Shrink Epoxy Grout
  - 5. Topping Grout and Concrete/Grout Fill

#### 1.2 MODIFICATION BY SPECIAL PROVISIONS

- 1. The WORK of this section may be affected by requirements contained within the Special Provisions. The CONTRACTOR shall review, understand, and incorporate the requirements contained within the Special Provisions into the WORK of this Section.

#### 1.3 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO)
  - AASHTO M171                      Standard Specification for Sheet Materials for Curing Concrete
  - AASHTO M182                     Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
- B. ASTM International (ASTM)
  - ASTM C307                         Standard Test Method for Tensile Strength of Chemical – Resistant Mortar, Grouts, and Monolithic Surfaces
  - ASTM C496                         Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
  - ASTM C579                         Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts, Monolithic Surfaces, and Polymer Concretes
  - ASTM C580                         Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical – Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes

- |            |   |
|------------|---|
| ASTM C827  | Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures |
| ASTM C882  | Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear           |
| ASTM C939  | Standard Test Method for Flow of Grout for Pre-placed Aggregate Concrete (Flow Cone Method)               |
| ASTM C1090 | Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic – Cement Grout |
| ASTM C1107 | Standard Specification for Packaged Dry Hydraulic Cement Grout (Nonshrink)                                |
- C. International Concrete Repair Institute
- Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
- D. Louisiana Department of Transportation and Development Testing Procedures (LDOTD)
- |                     |  |
|---------------------|--|
| TR 226<br>Specimens | Making, Field Curing, and Transporting Concrete  |
| TR 230              | Curing, Capping, and Determining the Compressive Strength of Molded Concrete Cylinders |

#### 1.4 **CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING**

A. The CONTRACTOR shall furnish submittals in accordance with Section 01010.

B. **Grout (All Types):**

1. **Submittal/Source Approval:** The CONTRACTOR shall submit Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the WORK, and location of use. The submittal shall contain a certification that grouts used on the project contain no chlorides or other chemicals that cause corrosion. A certification that non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion shall be included for non – shrink grouts.
2. **Acceptance:** The CONTRACTOR shall submit a certificate of compliance for all shipments of grout to the WORK.
3. **Verification:** If required by the ENGINEER, compression test specimens will be taken. If required, specimens will be taken at intervals thereafter selected by the ENGINEER. The specimens will be made by the ENGINEER or its representative. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C 1107 - Packaged Dry, Hydraulic-Cement Grout (Nonshrink), at intervals during construction

selected by the ENGINEER. A set of 3 specimens will be made for testing at 7 Days, 28 Days, and each additional time period as appropriate. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C 579 - Test Methods for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing and Polymer Concretes, Method B, at intervals during construction selected by the ENGINEER. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate. Compression tests for fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with LDOTD TR 226. The cost of laboratory tests on grout will be paid by the OWNER except where test results show the grout to be defective. In such case, the CONTRACTOR shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the WORK. The CONTRACTOR shall assist the ENGINEER in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.

## PART 2 -- PRODUCTS

### 2.1 APPLICATION

- A. Unless indicated otherwise, grouts shall be provided as listed below whether indicated on the Drawings or not.

<b>Application</b>	<b>Type of Grout</b>
Anchor bolts and reinforcing steel required to be set in grout that is not in high temperature or high fire risk areas.	Epoxy Adhesive per Section 05500
Beam and column (1 or 2 story) base plates less than 16-inches in the least dimension.	Non-Shrink - Class I
Column base plates (greater than 2 story or larger than 16-inches in the least dimension)	Non-Shrink - Class II
Storage tanks and other non-motorized equipment and machinery under 30 horsepower	Non-Shrink - Class I
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink - Class I (Class II where placement time exceeds 20 min.)
Under precast concrete elements	Non-Shrink - Class II
Toppings and concrete/grout fill less than 3-inches thick	Topping Grout
Toppings and concrete/grout fill greater than 3-inches thick	Minor Concrete, Class R or Class M per Section 03901 – Portland Cement Concrete
Surface repairs	Cement Grout

Repair of holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material	Non-Shrink - Class I
Repair of holes and defects in concrete members which are water bearing or in contact with soil or other fill materials	Non-Shrink - Class II
Any application not listed above, where grout is called for on the Drawings	Non-Shrink Class I, unless noted otherwise

## 2.2 CEMENT GROUT

- A. Cement grout shall be composed of one part cement, 3 parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 Days shall be 4000 psi.
- B. Cement grout materials shall be as indicated in Section 03901 – Portland Cement Concrete.

## 2.3 NON-SHRINK GROUTS (cement based)

### A. General:

1. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas-liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.
2. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout indicated herein shall be that recommended by the manufacturer for the particular application.
3. Grout shall not contain chlorides or additives that may contribute to corrosion.
4. Grout shall be formulated to be used at any consistency from fluid to plastic.
5. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:
  - a. Minimum tensile splitting strength of 500 psi per ASTM C 496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
  - b. Minimum flexural strength of 1000 psi per ASTM C 580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
  - c. Minimum bond strength (concrete to grout) of 1900 psi per modified ASTM C 882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

- d. Grout to be used in a marine environment shall be certified for use in a marine environment.
- e. Grout shall be certified for use in freeze/thaw environments.

**B. Class I Non-Shrink Grout:**

1. Class I non-shrink grout shall have a minimum 28 Day compressive strength of 5000 psi when mixed at a fluid consistency.
2. Class I non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.
3. Grout shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C 827 – Test Method for Early Volume Change of Cementitious Mixtures. The grout when tested shall not bleed or segregate at maximum allowed water.
4. Grout shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C 1090 - Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout.
5. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.
6. Class I Non-Shrink Grout shall be **Masterflow 713 Plus** by **MBT-Chemrex**; **Five Star Grout** by **Five Star Products**; **Sikagrout 212** by **Sika Corporation**; **Premier** by **L&M Construction Chemicals**; **High-Flow Grout** by **Euclid Chemical Company**; **CG 200 PC** by **Hilti**, or equal.

**C. Class II Non-Shrink Grout:**

1. Class II non-shrink grout shall be a high precision, fluid, extended working time, grout. The minimum 28-Day compressive strength shall be 7500 psi, when mixed at a fluid consistency.
2. Grout shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C 827.
3. Grout shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C 1090.
4. Class II non-shrink grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C 827 at temperature extremes of 45 to 90 degrees F in accordance with ASTM C 1107.
5. Class II non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C 939.
6. The grout when tested shall not bleed or segregate at maximum allowed water content.

7. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.
8. Class II non-shrink grout shall be **Masterflow 928** by **MBT-Chemrex**; **Five Star Fluid Grout 100** by **Five Star Products**; **Crystex** by **L&M Construction Chemicals**; or equal.

**2.4 TOPPING GROUT AND CONCRETE/GROUT FILL**

- A. Where fill is thicker than 3-inches, Minor Concrete, Class M or R, as indicated in Section 03901 – Portland Cement Concrete shall be used.
- B. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and be mixed as indicated. Materials and procedures indicated for normal concrete in Section 03901 – Portland Cement Concrete, shall apply unless indicated otherwise.
- C. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45.
- D. Coarse aggregate shall be graded as follows:

<b>U.S. STANDARD SIEVE SIZE</b>	<b>PERCENT BY WEIGHT PASSING</b>
1/2 in	100
3/8 in	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

**2.5 CURING MATERIALS**

- A. Curing materials shall be burlap cloth complying with AASHTO M182, Class 3, or combined burlap and white polyethylene sheeting shall complying with AASHTO M 171. For prepackaged grouts, curing materials shall be as recommended by the manufacturer of prepackaged grouts.

**2.6 CONSISTENCY**

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

- B. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

## 2.7 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurements shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

## PART 3 -- EXECUTION

### 3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Grout shall be stored in accordance with manufacturer's recommendations.

### 3.2 GENERAL

- A. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the ENGINEER.
- B. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.
- C. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.
- D. Shade the WORK from sunlight for at least 24 hours before and 48 hours after grouting.
- E. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

### 3.3 GROUTING PROCEDURES

- A. **General:** Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.
  1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout, or a thickness as indicated.
  2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as

recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the ENGINEER, alternate grouting methods shall be submitted for acceptance by the ENGINEER.

### **C. Topping Grout and Concrete/Grout Fill**

1. Mechanical, electrical, and finish WORK shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively where accepted by the ENGINEER, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.
2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.
3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) -- Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.
6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the ENGINEER, the tank shall be filled with sufficient water to cover the entire floor for 14 days.



**3.4 CONSOLIDATION**

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

**3.5 CURING**

- A. Cement based grouts shall be cured with wet burlap or combined wet burlap and white polyethylene sheeting and per the manufacturer's recommendations.

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## SECTION 03805 – STRUCTURAL CONCRETE (REVISED 09/19/2016)

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide Structural Concrete, complete and in place, in accordance with the contract documents.
- B. Structural excavation and backfill shall conform to Section 02200 - Earthwork.
- C. Unless otherwise noted, structural concrete shall be cast in place. Substitutions may be allowed if in the opinion of the ENGINEER a pre – cast structure will be equivalent in performance to cast – in – place structure. The ENGINEER will require that pre – cast substitutions be designed by the CONTRACTOR. If allowed, substitutions of precast structures for cast – in – place structures shall be at no additional cost to the OWNER.
- D. Standard pre – cast structures shall include items governed by ASTM C478 or other specific design standard referenced in the drawings or specified elsewhere. Custom designed structures shall be taken to be as all other precast structures or pre – cast substitutions for cast – in – place concrete.

#### 1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO)
  - AASHTO M148 Standard Specification for Liquid – Forming Compounds for Curing Concrete
  - AASHTO M153 Standard Specification for Preformed Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
  - AASHTO M171 Standard Specification for Sheet Materials for Curing Concrete
  - AASHTO M182 Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
  - AASHTO M213 Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
  - AASHTO M315 Standard Specifications for Joints for Circular Concrete Sewer and Culvert Pipe using Rubber Gaskets
- B. American Concrete Institute (ACI)

ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 517	Required Practice for Atmospheric Pressure Steam Curing
ACI 543	Guide to Design, Manufacture, and Installation of Concrete Piles
C. ASTM International (ASTM)	
ASTM A416	Standard Specification for Low – Relaxation, Seven – Wire Steel Strand for Pre-stressed Concrete
ASTM A653	Standard Specification for Steel Sheet, Zinc – Coated (Galvanized) or Zinc – Iron Alloy Coated (Galvaannealed) by the Hot – Dip Process
ASTM B370	Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
ASTM C1064	Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic Cement Grout (Non – Shrink)
ASTM D994	Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D7174	Standard Specification for Preformed Closed – Cell Polyolefin Expansion Joint Fillers for Concrete Paving and Structural Construction
D. American Welding Society	
AWS D1.1	Structural Welding Code
E. Louisiana Department of Transportation and Development (LDOTD)	
AML	Approved Materials List
	Application of Quality Assurance Specifications for Portland Cement Concrete Pavement and Structures
	Application of Quality Assurance Specifications for Precast – Pre-stressed Concrete Plants
TR 201	Weight per Cubic Foot, Yield, and Air Content of Concrete
TR 202	Air Content of Freshly Mixed Concrete

TR 207	Slump of Portland Cement Concrete
TR 226	Making, Field Curing, and Transporting Concrete Test Specimens
TR 230	Curing, Capping, and Determining the Compressive Strength of Molded Concrete Cylinders

F. Pre-stressed Concrete Institute

MNL-116	Manual for Quality Control for Structural Precast Concrete Concrete Products
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G. United States Army Corps of Engineers (USACE)

CRD-C-513	Corps of Engineers Specifications for Rubber Waterstop
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CRD-C-572	Corps of Engineers Specification for Polyvinyl Chloride Waterstop
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1.3 **CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING**

A. Furnish submittals and certificates in accordance with Section 01300 – CONTRACTOR Submittals.

B. Materials proposed for and utilized in the WORK will be sampled as indicated in herein. The frequency of testing may be altered at the discretion of the ENGINEER. The CONTRACTOR shall provide all materials required for testing at no additional cost to the OWNER.

C. **Portland Cement Concrete:** Requirements for submittals, sampling, and testing of Portland cement concrete shall be as specified in Section 03901 – Portland Cement Concrete.

D. **Joint Fillers:**

- 1) **Submittal/Source Approval:** The CONTRACTOR shall submit to the ENGINEER evidence of listing of the proposed product on the LDOTD AML.
- 2) **Acceptance:** Prior to acceptance of the WORK, the CONTRACTOR shall submit a signed certificate certifying compliance with the requirements of this specification section with each shipment of joint filler to the WORK.

E. **Joint Sealant:**

- 1) **Submittal/Source Approval:** The CONTRACTOR shall submit to the ENGINEER evidence of listing of the proposed product on the LDOTD AML.
- 2) **Acceptance:** Prior to acceptance of the WORK the CONTRACTOR shall submit a signed certificate certifying compliance with the requirements of this specification section with each shipment of joint sealant to the WORK.
- 3)

- F. **Reinforcing Steel:** Requirements for submittals, sampling, and testing of reinforcing steel shall be as specified in Section 03906 – Reinforcing.
- G. **Curing Material:** Burlap cloth, white polyethylene sheeting, combination burlap cloth and white polyethylene sheeting, and waterproof paper will be sampled if quality of the material is questionable in the opinion of the ENGINEER. Liquid membrane forming compounds will be sampled for compliance if the material is questionable in the opinion of the ENGINEER.
  - 1) **Submittal/Source Approval:** The CONTRACTOR shall submit to the ENGINEER evidence of listing of the proposed product on the LDOTD AML.
  - 2) **Acceptance:** Prior to acceptance of the WORK, the CONTRACTOR shall submit a signed certificate certifying compliance with the requirements of this specification section with each shipment of liquid membrane forming compound to the WORK.

**1.4 SAMPLING AND TESTING SCHEDULE**

- A. Materials proposed for and utilized in the WORK will be sampled as indicated in herein. The frequency of testing may be altered at the discretion of the ENGINEER. The CONTRACTOR shall provide all materials required for testing at no additional cost to the OWNER.

**1.5 CLASSES AND USES OF CONCRETE**

- A. Unless noted otherwise on the drawings, classes of concrete furnished shall be as indicated in the table below:

**Classes and Uses of Concrete**

Concrete Class	Use
A or A(M)	Concrete exposed to sea water, and all other concrete except as listed herein.
AA or AA(M)	Cast-in-place bridge superstructure
D	Pier footings
F	Dams and flood control structures
P or P(M)	Precast Concrete
P(X)	Pre-stressed Concrete
R	Non-reinforced sections
S	Underwater sections

**PART 2 -- PRODUCTS**

**2.1 MORTAR**

- A. Mortar shall consist of one part Portland cement, two parts mortar sand, and water as required for proper consistency. Mortar shall be used 30 minutes after mixing.
- B. Portland cement for mortar shall conform to Section 03901 – Portland Cement Concrete.
- C. Mortar sand for mortar shall conform to Section 03901 – Portland Cement Concrete.

## 2.2 PORTLAND CEMENT CONCRETE

- A. Portland cement concrete shall conform to Section 03901 – Portland Cement Concrete.

## 2.3 JOINT FILLERS

- A. Joint fillers shall be pre-formed joint fillers complying with any of the following:

1. **Preformed Resilient Bituminous Types:** Fillers shall consist of preformed strips which have been formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly saturated with a suitable bituminous binder, or strips which have been formed from clean, granulated cork particles securely bound together by a suitable bituminous binder and encased between two layers of felt. The type shall be as specified and shall conform to AASHTO M 213.
2. **Wood Fillers:** Bottom boards shall be clear heart redwood. Top boards shall be any type of wood which is free from defects and meets dimensional requirements. Occasional medium surface checks will be permitted provided the board is free of defects that will impair its usefulness. The load required to compress the material in an oven-dry condition to 50 percent of its original thickness shall not exceed 1750 psi. Boards shall not vary from specified dimensions in excess of the following tolerances:
  - a. Thickness: -0, +1/16 inch
  - b. Depth: +/- 1/8 inch
  - c. Length: +/- 1/4 inch
3. **Preformed Bituminous Type:** Bituminous preformed expansion joint filler shall consist of bituminous (asphalt or tar) mastic composition, formed and encased between two layers of bituminous impregnated felt. The preformed filler shall conform to ASTM D 994.
4. **Preformed Asphalt Ribbon:** This material shall be resistant to cracking, tearing or permanent deformation under normal handling and installation procedures. It shall be sufficiently rigid to enable it to form a straight joint. This filler shall consist of preformed strips of bitumen and inert filler material conforming to the following requirements:
  - a. Thickness, mm: 3-5
  - b. Depth Tolerance, mm: +/- 3
  - c. Weight, kg/100 sq meters, min: 245
  - d. Tensile Strength, kg/100 mm width, min: 90
  - e. Bitumen, % by weight:
5. **Preformed Closed Cell Polyethylene Joint Filler:** The joint filler shall comply with ASTM D 7174, Type I. This material shall be used with an adhesive-lubricant. Joint fillers and adhesive-lubricants shall be approved products listed on the LDOTD Approved Material List (formerly QPL 18).

6. **Preformed Rubber:** This filler shall consist of polyurethane bonded recycled rubber in accordance with AASHTO M 153.

## 2.4 REINFORCING STEEL

- A. Reinforcing steel shall conform to Section 03806 – Reinforcement unless otherwise noted.

## 2.5 CURING MATERIAL

- A. **Liquid Membrane – Forming Compounds:** Liquid membrane – forming compounds shall comply with AASHTO M 148 and shall be an approved product listed on the LDOTD AML (formerly QPL 65). The types shall be Type 2 white pigmented or Type 1-D, clear or translucent with fugitive dye.
- B. **Burlap:** Burlap cloth made from Jute or Kenaf shall comply with AASHTO M 182, Class 3.
- C. **Waterproof Paper:** Waterproof paper shall comply with AASHTO M 171.
- D. **White Polyethylene Sheeting:** White polyethylene sheeting shall comply with AASHTO M 171.
- E. **Combined Burlap and White Polyethylene Sheeting:** Combined burlap and white polyethylene sheeting shall comply with AASHTO M 171.

## 2.6 FORM MATERIALS

- A. Forms shall be of wood, metal or other approved material, built mortar-tight and of sufficient rigidity to prevent distortion due to pressure of concrete and other loads incident to construction operations.
- B. Forms shall be constructed and maintained to prevent warping and opening of joints due to shrinkage of lumber. Forms shall be substantial and unyielding and so designed that finished concrete will conform to proper dimensions and contours. Design of forms shall take into account the effect of vibration of concrete as it is placed.
- C. **Re-Used Forms:** Shape, strength, rigidity, mortar-tightness and surface smoothness of re-used forms shall be maintained. Warped or bulged lumber shall be resized before being reused. Unsatisfactory forms shall not be re-used.

## 2.7 FORM RELEASE AGENTS

- A. Form release agents for concrete shall be an approved product listed on the LDOTD AML (formerly QPL 29).

# PART 3 -- EXECUTION

## 3.1 HANDLING AND PLACING CONCRETE

- A. General: In preparation for placing concrete, all sawdust, chips and other debris shall be removed from the interior of forms. Struts, stays and braces serving to hold forms in correct shape and alignment shall be removed from the forms when concrete placing has reached an elevation rendering their use unnecessary.



- B. Concrete shall be placed to avoid segregation of materials and displacement of reinforcement. The use of long troughs, chutes and pipes for conveying concrete from mixer to forms will be permitted only with written authorization. If these devices cause segregation, impede workability, or produce detrimental effects, their use shall be discontinued.
- C. Open troughs and chutes shall be metal or metal-lined. Where steep slopes are required, chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement of concrete. Chutes, troughs and pipes shall be kept free from coatings of hardened concrete by thoroughly flushing with water after each pour. Water for flushing shall not be discharged within the structure.
- D. When placing operations involve dropping concrete more than 5 feet, it shall be deposited through a sheet metal or other approved tremie. After initial set of the concrete, forms and any reinforcing bar projection shall not be disturbed.
- E. Concrete, during and immediately after depositing, shall be thoroughly consolidated. Consolidation shall be done by mechanical vibration subject to the following provisions.
  - 1) Vibration shall be internal unless authorization for other methods is obtained or as provided herein.
  - 2) Vibrators shall be of an approved type and design, capable for transmitting vibration to concrete at frequencies of at least 4,500 impulses per minute.
  - 3) Intensity of vibration shall be such as to visibly affect concrete over a radius of at least 18 inches.
  - 4) The CONTRACTOR shall provide a sufficient number of vibrators to properly consolidate each concrete batch immediately after it is placed.
  - 5) Vibrators shall be manipulated so as to thoroughly WORK concrete around reinforcement and imbedded fixtures and into corners and angles of forms.
  - 6) Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. Vibrators shall be inserted and slowly withdrawn vertically from the concrete. Vibration shall be of sufficient duration and intensity to thoroughly compact concrete, but shall not cause segregation. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.
  - 7) Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which vibration is visibly effective.
  - 8) Vibration shall not be applied directly to or through reinforcement to sections or layers of concrete which have hardened to the degree that concrete ceases to be plastic under vibration. It shall not be used to make concrete flow over distances so great as to cause segregation. Vibrators shall not be used to drag concrete in forms.
  - 9) Vibration shall be supplemented by such spading as necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations inaccessible to vibrators.

- 10) These provisions for vibration shall apply to filler concrete for steel grid floor except that the vibrator shall be applied to the steel.
  - 11) These provisions for vibration shall also apply to precast concrete except that, if approved, the manufacturer's methods of vibration may be used.
- F. Concrete shall be placed in horizontal layers not more than 15 inches thick unless otherwise permitted. When less than a complete layer is placed in one operation, it shall be terminated at a vertical bulkhead. Each layer shall be placed and consolidated before the preceding batch has taken initial set to prevent damage to green concrete and avoid surfaces of separation between batches. The top surface of concrete adjacent to forms shall be finished to a suitable grade strip.
  - G. When concrete placement is temporarily discontinued, the concrete, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete after becoming firm enough to retain its form.
  - H. Where a featheredge might be produced at a construction joint, as in the sloped top surface of a wingwall, an inset form shall be used to produce a blocked out portion in the preceding layer which shall produce an edge thickness of not less than 6 inches in the succeeding layer. Placement of concrete shall not be discontinued within 18 inches of the top of any face, unless provision has been made for a coping less than 18 inches thick, in which case, the construction joint may be made at the underside of the coping.
  - I. Following concrete placement, accumulations of mortar splashed on reinforcement steel and forms shall be removed. Dried mortar chips and dust shall not be mixed in fresh concrete.

### **3.2 GIRDERS, SLABS, WALLS AND COLUMNS**

- A. Concrete in girders shall be deposited uniformly for the full length of girder and brought up evenly in horizontal layers.
- B. Concrete in slabs and slab spans shall be placed in one continuous operation for each slab and/or slab span.
- C. Concrete columns and walls shall be placed in a continuous operation. Concrete shall be allowed to set at least 24 hours before caps are placed. When friction collars are used to support cap forms, concrete columns shall have been poured at least 7 days or shall have at least 3,000 psi compressive strength before caps are placed. Compressive strength cylinder shall be made in accordance with DOTD TR 226 and tested in accordance with DOTD TR 230.
- D. No concrete shall be placed in the superstructure until column forms have been stripped sufficiently to determine the quality of concrete in the columns. The superstructure loads shall not be allowed on the bents until the concrete has attained at least 3,000 psi compressive strength but not less than 7 curing days. Compressive strength cylinders shall be made in accordance with DOTD TR 226 and tested in accordance with DOTD TR 230.

### **3.3 PUMPING**

- A. Pumping equipment shall be so arranged that no vibrations result which might damage freshly placed concrete. Pipes carrying concrete to placing area shall be laid out with a minimum of bends and no unauthorized change in size. Where concrete is conveyed

and placed by mechanically applied pressure, suitable equipment of adequate capacity shall be used.

- B. A grout mortar, or concrete without coarse aggregate, shall be pumped through the equipment ahead of the regular concrete to provide lubrication to start pumping operations. This material shall not be used in placement. The lubrication process need not be repeated as long as pumping operations are continuous.
- C. Operation of the pump shall be such as to provide a continuous stream of concrete without air pockets. When pumping is completed, concrete remaining in the pipes, if it is to be used, shall be ejected in such manner that there will be no contamination of concrete or separation of ingredients.

### 3.4 DEPOSITING CONCRETE UNDERWATER

- A. Concrete shall not be deposited in water except on approval. The method of placing shall be approved by the ENGINEER and conform to the following:
- B. To prevent segregation, concrete shall be placed in its final position by means of a tremie and shall not be disturbed after being deposited. Concrete shall be placed in caissons, cofferdams or watertight forms.
- C. For underwater parts of structures, concrete seals shall be placed in one continuous operation. The surface of the concrete shall be kept as nearly horizontal as possible; still water shall be maintained at the point of deposit.
- D. A tremie shall consist of a tube at least 10 inches (250 mm) in diameter; if constructed in sections, the couplings shall be watertight. Tremies shall be supported so as to permit positioning anywhere over the top surface of the WORK and for rapid lowering when necessary to retard or stop the flow of concrete.
- E. When concrete is dumped into the hopper, flow may have to be induced by slightly raising the discharge end of the tremie, but always keeping it in deposited concrete. Flow shall be continual until the WORK is completed. Aluminum tremies will not be permitted.
- F. Dewatering may proceed when the concrete is sufficiently hard, but not for at least 72 hours after concrete placement is completed. Prior to constructing succeeding portions of the structure, laitance or other unsatisfactory material shall be removed from the surface by scraping, chipping or other means which will not damage the concrete.

### 3.5 CONSTRUCTION JOINTS

- A. **General:** Construction joints shall be made only where located on the plans or shown on the pouring schedule, unless otherwise approved. When not detailed on the plans, construction joints shall be placed as directed. Raised shear keys or reinforcing steel shall be used where necessary to transmit shear or bond sections together.
- B. **Bonding:** Forms shall be retightened before placing new concrete on or against hardened concrete.
  - 1) **Neat Cement Slurry Joints:** The surface of hardened concrete shall be roughened as required in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface. It shall then be thoroughly cleaned of foreign matter and laitance, and saturated with

water. All surfaces shall be thoroughly coated with a neat slurry to ensure that adequate mortar is placed at the juncture of the hardened and newly deposited concrete. New concrete shall be placed before the grout has attained its initial set. Placing of concrete shall be carried continuously from joint to joint. Edges of joints which are exposed to view shall be finished true to line and elevation.

- 2) **Epoxy Resin Joints:** Vertical surfaces of bridge deck construction joints and other construction joints shall be coated prior to each succeeding pour with an approved Type II, Grade B or Grade C epoxy resin applied according to the manufacturer's recommendations. Surfaces of hardened concrete to which new concrete is to be bonded shall be cleaned of foreign material, loose or unsound concrete by sandblasting, hammers or wire brushes. Grease or oil shall be removed with a detergent wash such as trisodium phosphate, and the entire area washed with fresh water and brushed with a stiff brush. If a detergent is not required, dust and small particles not removed by other cleaning methods shall be removed by washing.
- 3) Unless a joint type (1) or (2) above is specified in the plans or specifications, the surface of the hardened concrete shall be thoroughly cleaned of foreign matter and laitance, and saturated with water prior to pouring fresh concrete.

### 3.6 FORM EXECUTION

- A. **Form Surface:** Forms for exposed surfaces shall not adhere to nor discolor concrete. Forms shall be made of either metal or dressed lumber of uniform thickness with or without approved form liner and shall be mortar-tight. Forms for reentrant angles shall be chamfered and forms shall be filleted at sharp corners. Forms for projections, such as girders or copings, shall be given a bevel or draft to ensure easy removal.
- B. When possible, forms shall be day-lighted at intervals not greater than 10 feet vertically, the openings being sufficient to permit free access for inspecting, working and spading the concrete.
- C. **Form ties:** Metal ties or anchorages within forms shall be constructed to permit their removal to a depth of at least 1/2 inch from the face without damage to concrete. If wire ties are permitted, upon removal of the forms, wire shall be cut back at least 1/4 inch inside from the face of the concrete with chisels or nippers. Fittings for metal ties shall be of such design that, upon their removal, cavities left will be of the smallest possible size. Cavities shall be filled with cement mortar and the surface left sound, smooth, even and uniform in color.
- D. Fiberglass ties may be used and shall be ground flush with the concrete surface.
- E. **Setting and Maintaining:** Forms shall be set and maintained reasonably true to required line and grade until concrete is sufficiently hardened. When forms are deemed to be unsatisfactory, either before or during placing of concrete, the WORK shall be stopped until defects have been corrected. Forms shall be so designed that portions where finishing is required may be removed without disturbing portions of forms to be removed later and, as far as practical, so that form marks will conform to general lines of the structure. For narrow walls and columns, where the bottom of the form is inaccessible, lower form boards shall be left loose so that they may be removed for cleaning out immediately before placing concrete.

### 3.7 CURING

- A. Concrete for structures (except for minor structures) shall be cured with wet burlap or combined wet burlap and white polyethylene sheeting, except where provided for herein.
- B. A Type 1-D curing compound may be used for curing concrete when surfaces do not require a Class 2A finish. When membrane curing is used, exposed reinforcing steel and construction joint surfaces shall be covered or shielded to prevent coating with curing compound. Construction joint surfaces shall be wet cured by approved methods as soon as possible after concrete placement. Concrete surfaces in contact with forms shall be sealed immediately after completion of form removal and surface finishing. Membrane curing shall be applied as soon as surface moisture has evaporated. Method and application rate of curing compound shall be in accordance with the manufacturer's recommendations, but in no case shall the application rate be less than one gallon per 100 square feet surface area. The compound shall be applied in one or two applications. If the compound is applied in two increments, the second application shall follow the first application within 30 minutes. Satisfactory equipment shall be provided, with means to properly control and direct application of curing compound on concrete surfaces to result in uniform coverage.
- C. If rain falls on newly coated concrete before the film has dried sufficiently to resist damage, or if the film is damaged, a new coat of compound shall be applied to affected portions.
- D. When curing with burlap, the exposed concrete immediately after finishing shall be covered with two thicknesses of wet burlap. Burlap shall be fixed so that it is in contact with the concrete at all times and shall be kept continuously wet for at least 5 curing days after concrete is placed, with curing days as defined as specified herein.

### 3.8 REMOVAL OF FALSEWORK AND FORMS

- A. Except as otherwise specified herein, face form for barrier curbs or rails and side forms for caps requiring a Class 2A finish shall be removed not less than 1/2 nor more than 2 curing days after concrete is placed to permit finishing.
- B. Forms for surfaces not requiring a Class 2A finish, and supporting forms and falsework for structure members such as bent caps, beams and slabs, shall be removed in accordance with one of the following methods. For concrete containing fly ash or ground granulated blast-furnace slag, only Method 1 shall be used.
  - 1) **Method 1:** Forms and falsework may be removed as soon as concrete has attained a compressive strength, as determined by cylinder tests, indicated in the table below. Test specimens will be made in accordance with DOTD TR 226 from the same concrete and cured under the same conditions as the portion of the structure involved. Specimens will be tested in accordance with DOTD TR 230.

**Removal of Forms and Falsework**

Concrete Class	Compressive Strength, Psi (MPa)
A	3,000 (20.7)
A (M)	4,000 (27.6)
AA	3,500 (24.1)
AA (M)	4,000 (24.1)
D	2,500 (17.2)
F	3,200 (22.1)

P (nonpre-stressed)	3,000 (20.7)
P(M) (nonpresetressed)	3,600 (24.9)
R	1,600 (11.0)

- 2) **Method 2:** Forms and falsework may be removed when concrete has aged for the minimum number of curing days in the table below:

#### Forms and Falsework Removal Schedule

Forms	Curing Days
Under slabs, beams or pile caps with span lengths less than 10 feet (3.0 m)	7 days
Under slabs, beams or pile caps with span lengths of 10 to 17 feet (3.0 to 5.0 m)	7 days plus 1 day for each foot (300 mm) of span over 10 feet (3 m)
Under slabs, beams or pile caps with span lengths over 17 feet (5.0 m)	7 days plus 1 day for each foot (300 mm) of span over 10 feet (3 m)
Under portion of slabs that cantilever more than 1 foot (300 mm)	7 days
Walls, columns, side forms for beams, pile caps and slabs that cantilever less than 1 foot (300 mm)	1 day
Caissons	1 day
Precast and/or Pre-stressed Concrete	Per Manufacturer and as provided for herein

- 3) The term "curing day" will be interpreted as a calendar day on which the temperature is above 50°F (10°C) or 55°F (13°C) if ground granulated blast furnace slag is used in concrete for at least 19 hours. Colder days may be counted if approved methods are used to maintain air temperature adjacent to concrete above 50°F (10°C) throughout the day.
- 4) During continued cold weather, when artificial heat is not provided, the ENGINEER may permit removal of forms and falsework at the end of a period of calendar days equal to two times the number of curing days stated above.
- 5) The foregoing provisions for form and falsework removal shall apply only to forms or parts of forms so constructed as to permit removal without disturbing forms or falsework which are required to be left in place for a longer period on other portions of the structure.
- 6) Methods of form removal likely to cause overstressing of concrete shall not be used. Forms and their supports shall not be removed without

approval. Supports shall be removed in such manner as to permit concrete to uniformly and gradually take stresses due to its own weight.

### 3.9 EXPANSION AND FIXED JOINTS, AND BEARINGS

- A. **Open Joints:** Open joints shall be constructed by insertion and subsequent removal of a wood strip, metal plate or other approved material. Insertion and removal of the template shall be accomplished without chipping or breaking corners of concrete. Reinforcement shall not extend across an open joint.
- B. **Filled Joints:** Joints to be sealed with poured seals shall be formed and constructed similar to open joints. For joints with preformed filler, the filler shall be in correct position when concrete is placed.

### 3.10 CONCRETE SURFACE FINISHES

- A. Surface finishes shall be classified in accordance with the table below.

#### Concrete Surface Finishes

Class 1	Ordinary Surface Finish
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- B. All concrete shall be given Class 1, Ordinary Surface Finish, in addition to any other type of finish specified.
- C. **Class 1, Ordinary Surface Finish:** Immediately following the removal of forms, fins and irregular projections shall be removed from all surfaces except from those which will not be exposed to view after construction or are not to be waterproofed. Cavities produced by form ties and other holes, honeycombed spots, broken corners or edges and other defects shall be cleaned and, after having been kept saturated with water, shall be pointed and trued with a mortar of cement and fine aggregate mixed in the proportions used in the concrete being finished.
  - 1) Mortar used in pointing shall be not more than 1 hour old. Water shall be added to a workable consistency. Concrete shall then be cured as specified under Subsection 805.10. Construction and expansion joints shall be free of mortar and concrete. Joint filler shall be left exposed for its full length with clean and true edges.
  - 2) Surfaces shall be true and uniform. Surfaces which cannot be satisfactorily repaired shall be coated as specified for Class 2A, Special Surface Finish
  - 3) Exposed surfaces not protected by forms shall be struck off with a straightedge and finished with a wood float to a true, even surface. Use of additional mortar to provide a grout finish will not be permitted.

- END OF SECTION -

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## SECTION 03806 - REINFORCEMENT

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide reinforcing steel for Portland cement concrete, complete and in place, in accordance with the contract documents.

#### 1.2 CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING

- A. Furnish submittals in accordance with Section 01010.
- B. Reinforcing:
  - 1) **Submittal:** Before placing reinforcing steel, a list of all reinforcing steel showing location, mark number, size and type bend shall be furnished to the ENGINEER. The CONTRACTOR shall be responsible for the accuracy of the lists and for furnishing and placing reinforcing steel in accordance with the details shown on the plans and as specified.
  - 2) **Submittal:** Before CONTRACTOR shall also furnish the ENGINEER placing plans for all structures where reinforcing steel is involved, unless the plans contain sufficient detail for proper placement of reinforcing steel. Placing plans shall show the location, type and spacing of supports.
  - 3) **Source Approval:** Prior to fabrication of reinforcing, the CONTRACTOR shall submit to the ENGINEER the name and address of each mill providing reinforcing steel. For each type of reinforcement to be used, the CONTRACTOR shall submit a statement that the material meets the requirements of this section. The CONTRACTOR shall submit the name, address, and current status of mills listed on the LDOTD AML to provide steel for the project.
  - 4) **Acceptance:** For each shipment of each type of reinforcement utilized, the CONTRACTOR shall submit a certified mill report or certificate analysis signed by an authorized representative of the mill providing the material.
  - 5) **Verification:** At his discretion, the ENGINEER may sample any type of reinforcement for verification of compliance with the requirements of this section.

#### 1.3 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO)  
AASHTO M 284                      Standard Specification for Epoxy Coated Reinforcing Bars
- B. American Welding Society (AWS)  
AWS D1.4                              Structural Welding Code – Reinforcing Steel
- C. ASTM International (ASTM)

ASTM A615	Standard Specification for Deformed and Plain Carbon – Steel Bars for Concrete Reinforcement
ASTM A996	Standard Specification for Rail – Steel and Axle – Steel Deformed Bars for Concrete Reinforcement
ASTM A1064	Standard Specification for Carbon – Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

D. Concrete Reinforcement Steel Institute

Manual of Standard Practice

E. Louisiana Department of Transportation and Development (LDOTD)

AML Approved Materials List

## PART 2 -- PRODUCTS

### 2.1 REINFORCING STEEL

- A. Reinforcing steel for concrete shall comply with the following unless otherwise specified. Reinforcing steel used in structures shall be Grade 60. Grade 40 steel may be used in Portland cement concrete pavement. Bars smaller than No. 3 need not be deformed. All deformed bars shall comply with items 1, 2, or 3 below. Size W 5 wire complying with item 4 below may be used in lieu of bars smaller than No. 3.
- 1) Billet-Steel Deformed and Plain Bars shall comply with ASTM 615 and shall be produced at a mill listed on the LDOTD AML (formerly QPL 71).
  - 2) Rail-Steel and Axle-Steel Deformed and Plain Bars shall comply with ASTM A 996.
  - 3) Cold-drawn Steel Wire shall comply with ASTM A 1064 with the following amendment: For material testing over 110,000 psi tensile strength in high strength applications such as spirals and ties, the 25 percent minimum reduction in area shall be reduced 5 percent for each 10,000 psi increment of tensile strength exceeding 110,000 psi.
  - 4) Welded Steel Wire Fabric shall conform to ASTM A 1064.
  - 5) Epoxy Coated Reinforcing Steel and patching materials shall comply with AASHTO M 284 and shall be listed on the LDOTD AML (formerly QPL 51).

## PART 3 -- EXECUTION

### 3.1 FABRICATION

- A. **Fabrication:** Unless otherwise authorized, bent bar reinforcement shall be cold bent to the shapes shown on the plans in accordance with the following requirements:

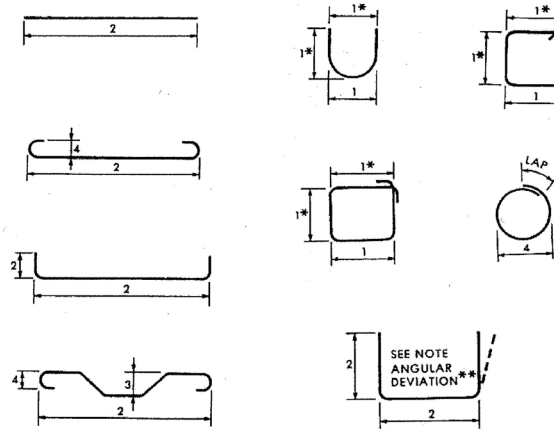
- 1) **Bending:** Stirrups and ties shall be bent around a pin having a diameter of at least four bar diameters for No. 5 or smaller bars, and at least five bar diameters for larger bars. All other bars, except as otherwise specified herein, shall be bent around a pin having a diameter as specified in the table below:

**Pins for Bar Bends**

Bar Size	Minimum Pin Diameter
Nos. 3 through 8 (Nos. 10 M through 25 M)	6 bar diameters
Nos. 9, 10 and 11 (Nos. 29, 32 and 36 M)	8 bar diameters
Nos. 14 and 18 (Nos. 43 M and 57 M)	10 bar diameters

No rebending of bars will be allowed. Special fabrication will be required for bending Nos. 14 and 18 bars more than 90 degrees.

- 2) **Tolerances:** Bars shall be fabricated in accordance with the tolerances specified in the figure below. All dimensions given in the figure below are out-to-out of bars.



Symbol	Tolerance, Inches (mm)
1	$\pm 1/2$ ( $\pm 13$ )
2	$\pm 1$ ( $\pm 25$ )
3	$+0, -1/2$ ( $+0, -13$ )
4	$\pm 1/2$ ( $\pm 13$ )

\*Not to differ for opposite parallel dimension by more than 1/2 inch (13 mm).

\*\*Angular Deviation-Maximum  $\pm 2$  1/2° or  $\pm 1/2$  inch/ft. (40 mm/m), but not less than 1/2 inch (13 mm).

- 3) **Shipping:** Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the Manual of Standard Practice of the Concrete Reinforcement Steel Institute (CRSI). The tags shall be made of durable material and marked in a legible manner with waterproof markings. There shall be at least one tag per bundle attached by wire. The tags shall show size of reinforcing, number of pieces, and mark or length of bars.
- 4) **Handling and Coating Repairs:** Epoxy coated reinforcing steel shall be handled in a manner to avoid damage to the coating. Bundling bands shall be padded. Bundles shall be lifted with multiple supports or strongbacks to prevent abrasion to the coating due to sag. Patching material used by the applicator and the CONTRACTOR shall be the same

as the prequalified patching material. Repairs shall be made in accordance with the patching material manufacturer's recommendations. Repairs to the coating will be required on all damaged areas larger than 1/4 inch square. The total bar surface area covered by patching material shall not exceed 2 percent. Ends of coated bars cut during field fabrication shall also be coated with the patching material before rusting appears; however, the coated ends are not to be included in the 2 percent maximum coverage of patching material. Hairline cracks without bond loss or other minor damage on fabrication bends need not be repaired.

### **3.2 PROTECTION OF MATERIAL**

- A. Reinforcing steel shall be stored above ground on platforms, skids or other supports and shall be protected from damage.
- B. The various sizes, grades and lengths shall be plainly marked and tagged to facilitate inspection.
- C. Epoxy coated steel bars shall be unloaded and stored on the project site in a manner to avoid damage or contamination. Bars shall be stored off the ground and covered such that formation of condensation and exposure to ultraviolet light is avoided.

### **3.3 PLACING AND FASTENING**

- A. Steel reinforcement shall be placed in the position shown on the plans and firmly held during placing and setting of concrete. When placed in the work, it shall be free from dirt, loose rust, loose scale, paint, oil, grease, form release agent, or other foreign material. Thin powdery rust and light rust need not be removed. Bars shall be tied with No.14 or 16 gage wire at all intersections, except where spacing is less than 1 foot in each direction, alternate intersections shall be tied.
- B. Distance of reinforcement from forms shall be maintained by metal chairs, ties, hangers or other approved supports. Precast mortar or concrete blocks may be used when approved by the ENGINEER in applications where concrete is to be cast against soil. Metal chairs in contact with exterior surfaces of concrete shall be hot-dipped galvanized, electroplated with zinc (GS Grade), plastic-coated or stainless steel. Layers of bars shall be separated by approved devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks will not be permitted. Vertical stirrups shall pass around main tension members and shall be securely attached thereto. The minimum covering, measured from the surface of concrete to face of reinforcing bars, shall not be less than 2 inches except as follows: bottom of slab, 1 inch; stirrups and ties in T-Beams, 1 1/2 inches. Additional coverage as shown on the plans shall be provided for reinforcement in bottom of footings or where marine environments, corrosive, abrasive or other severe exposure conditions exist. Reinforcement shall be inspected and will be subject to approval before placing concrete.
- C. During and after installation of epoxy coated bars, the CONTRACTOR shall repair all significant cuts, nicks and abraded places in the coating on the bars with the epoxy repair material supplied by the epoxy resin manufacturer. Any damaged metallic accessories shall also be repaired with a suitable material. No more than 0.25 percent of the bar surface area may be left bare.
- D. Damaged areas of the reinforcing steel and accessories shall be repaired before rusting occurs. Coated bars when incorporated into the work shall be free from dirt, paint, oil, grease, form release agent, or other foreign substances. Placing of concrete shall be

performed in a timely manner with methods and equipment which will not damage the coated materials.

- E. Since the epoxy coating is flammable, the coated bars shall not be exposed to fire or flame. Cutting coated bars by burning will not be permitted. Reinforcing steel to be partially embedded in concrete shall not be field bent unless specified on the plans or permitted by the ENGINEER.

### 3.4 SPLICING

- A. Reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without written approval. Splices shall be staggered as far as possible. Unless otherwise specified, bars shall be lapped in accordance with the requirements of the table below. Construction joints shall not be made within the limits of lapped bars. In lapped splices, bars shall be placed in contact and wired together in such manner as to maintain the minimum clear distance to other bars and to the surface of concrete. Welding of reinforcement steel shall be done only if detailed on the plans or if authorized in writing. Welding shall comply with the latest edition of AWS D1.4.

**Lap Splice Length for Grade 60 Steel**

<b>Bar No.</b>	<b>Lap Splice Length, Inches</b>
No. 3	18
No. 4	24
No. 5	30
No. 6	39
No. 7	53
No. 8	69
No. 9	88
No. 10	111
No. 11	137

- B. When permitted in the plans or specifications, reinforcing steel splices may be made by an approved mechanical butt splicing device listed on the LDOTD AML (formerly QPL 44) and used in accordance with the manufacturer's recommendations. The splice shall develop at least 125 percent of the specified yield strength of the reinforcing steel bars in tension.

### 3.5 SUBSTITUTIONS

- A. Substitutions of different size bars will be permitted with authorization of the ENGINEER. Substituted steel shall have cross-sectional and surface areas equivalent to the design areas or larger. Allowed substitutions will be made at no additional pay.

- END OF SECTION -

## SECTION 03901 – PORTLAND CEMENT CONCRETE (REVISED 09/19/2016)

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide Portland Cement Concrete, complete and in place, in accordance with the contract documents.
- B. Structural Concrete is designated by class and pavement concrete is designated by type.
- C. Portland cement concrete shall require an approved mix design and shall be produced by a Louisiana Department of Transportation and Development certified plant and shall be transported by Louisiana Department of Transportation and Development certified trucks.
- D. The design, control, and transportation of concrete mixtures in accordance with these specifications shall be the responsibility of the CONTRACTOR.

#### 1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO)
  - AASHTO M 85 Standard Specification for Portland Cement
  - AASHTO M240 Standard Specification for Portland – Limestone Cement
  - AASHTO M 295 Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use in Concrete
  - AASHTO M 302 Standard Specification for Slag Cement for Use in Concrete and Mortars
  - AASHTO M 307 Standard Specification for Silica Fume Used in Cementitious Mixtures
  - AASHTO T 19 Standard Method of Test for Bulk Density (Unit Weight) and Voids in Aggregate
  - AASHTO T 84 Standard Method of Test for Specific Gravity and Absorption of Fine Aggregate
  - AASHTO T 85 Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate
  - AASHTO T 278 Standard Method of Test for Frictional Properties Using the British Pendulum Tester
  - AASHTO T 279 Standard Method of Test for Accelerated Polishing of Aggregates Using the British Wheel
- B. ASTM International (ASTM)
  - ASTM C91 Standard Specification for Masonry Cement

## C. Louisiana Department of Transportation and Development (LDOTD)

Application of Quality Assurance Specifications for Portland  
Cement Concrete Pavement and Structures

Application of Quality Assurance Specifications for Precast –  
Prestressed Concrete Plants

AML	Approved Materials List
TR 106	Determining Total Moisture and Free Moisture in Aggregate
TR 109	Determining the Amount of Foreign Material in Clam Shell, Reef Shell, and Mixtures of Clam and Reef Shell
TR 112	Amount of Material Finer than No. 200 Sieve in Aggregate
TR 113	Sieve Analysis of Fine and Course Aggregates
TR 119	Determination of Deleterious Materials
TR 202	Air Content of Freshly Mixed Concrete
TR 207	Slump of Portland Cement Concrete
TR 226	Making, Field Curing, and Transporting Concrete Test Specimens
TR 230	Curing, Capping, and Determining the Compressive Strength of Molded Concrete Cylinders
TR 643	Determining Chloride Content in Admixtures for Portland Cement Concrete

1.3 **QUALITY ASSURANCE**

- A. The CONTRACTOR's obligations for quality assurance and design procedures shall be equivalent to the obligations of the CONTRACTOR that are specified in the latest edition of the LDOTD's publication entitled "Application of Quality Assurance Specifications for Portland Cement Concrete Pavement and Structures" and "Application of Quality Assurance Specifications for Precast-Prestressed Concrete Plants"

1.4 **CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING**

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01010.
- B. The CONTRACTOR shall submit a proposed concrete mix designs on a form acceptable to the ENGINEER giving the intended sources of materials and the mix design for concrete to be furnished. No work shall be started until the Portland cement concrete mix design has been reviewed and accepted. Review and acceptance of this mix design



does not release the CONTRACTOR from the responsibility of producing concrete that meets the minimum requirements of the specifications.

- C. Materials proposed for and utilized in the WORK will be sampled as indicated in herein. The frequency of testing may be altered at the discretion of the ENGINEER. The CONTRACTOR shall provide all materials required for testing at no additional cost to the OWNER.
- D. **Tests for Aggregate Properties:** When required, aggregates such as granular material will be classified in accordance with DOTD TR 423. Unless noted otherwise, the following methods will be utilized in testing aggregates:

Aggregate Property	Test Method
Deleterious Materials	DOTD TR 119
Unit Weight	AASHTO T 19
Specific Gravity and Absorption of Fine Aggregate	AASHTO T 84
Specific Gravity and Absorption of Coarse Aggregate	AASHTO T 85
Polish Value	AASHTO T 278 and T 279
Amount of Material Finer than the No. 200 Sieve	DOTD TR 112
Sieve Analysis (Gradation)	DOTD TR 113
Plasticity Index (PI)	DOTD TR 428
Liquid Limit (LL)	DOTD TR 428

E. **Portland Cement**

1. **Submittal/Source Approval:** The CONTRACTOR shall submit product information on all Portland cement products to be utilized for all Portland cement concrete mixes to be incorporated into the WORK. This information shall evidence of the listing of the proposed product on the LDOTD AML for the type of mix or mixes to be utilized on the project. The submittal for source approval shall include information on chemical properties, compliance with AASHTO M 85, alkali content, and any other information required sufficient for the ENGINEER to review the acceptability of the proposed product.
2. **Acceptance:** The CONTRACTOR shall submit a signed certificate of compliance and a certificate of analysis (mill certificate) verifying characteristics for each shipment of Portland cement incorporated into Portland cement concrete mixes incorporated into the WORK.

3. **Verification:** If, in the opinion of the ENGINEER any Portland cement materials are questionable, the ENGINEER will sample the material to test for compliance with these specifications.

**F. Aggregates for Concrete:**

1. **Submittal/Source Approval:** The CONTRACTOR shall submit product information on all coarse and fine aggregates to be utilized for all mixes to be incorporated in the WORK. This information shall evidence of the listing of the proposed aggregate products on the LDOTD AML for the type of mix or mixes to be utilized on the project. The submittal for source approval shall include information on deleterious materials, gradation, friction rating, unit weight, and any other information required sufficient for the ENGINEER to review the acceptability of the proposed product.
2. **Acceptance:** Fine and course aggregate will be sampled for testing for compliance by the ENGINEER from stockpiles or sources utilized by the CONTRACTOR. Fine and course aggregates will be sampled per lot of pavement, structural, or minor concrete, or per 1,000 cubic yards of pavement, structural, or minor concrete placed at the discretion of the ENGINEER. Small quantities of 50 cubic yards of concrete or less may not be sampled unless the ENGINEER determines the material is questionable.

**G. Admixtures for Concrete:**

1. **Submittal/Source Approval:** The CONTRACTOR shall submit product information on all concrete admixtures to be utilized for all mixes to be incorporated in the WORK. This information shall evidence of the listing of the proposed admixture products on the LDOTD AML for the type of mix or mixes to be utilized on the project. The submittal for source approval shall include information on chemical properties, and any other information required sufficient for the ENGINEER to review the acceptability of the proposed product.
2. **Acceptance:** The CONTRACTOR shall submit a signed certificate of compliance and a certificate of analysis (mill certificate) verifying characteristics for each shipment of admixtures incorporated into the WORK.
3. **Verification:** If, in the opinion of the ENGINEER any admixture materials are questionable, the ENGINEER will sample the material to test for compliance with these specifications.

**H. Water**

1. **Submittal/Source Approval:** Source of water shall be indicated in mix designs for all Portland cement concrete mixes to be incorporated into the WORK.
2. **Acceptance:** NOT USED
3. **Verification:** If, in the opinion of the ENGINEER any mixing water is questionable, the ENGINEER will sample the water to test for compliance with these specifications.

## I. Fly Ash

1. **Submittal/Source Approval:** The CONTRACTOR shall submit product information on all fly ash products to be utilized for all Portland cement concrete mixes to be incorporated into the WORK. This information shall evidence of the listing of the proposed products on the LDOTD AML for the type of mix or mixes to be utilized on the project. The submittal for source approval shall include information on chemical properties, compliance with AASHTO M 295, and any other information required sufficient for the ENGINEER to review the acceptability of the proposed product.
2. **Acceptance:** The CONTRACTOR shall submit a signed certificate of compliance and a certificate of analysis (mill certificate) verifying characteristics for each shipment of fly ash incorporated into Portland cement concrete mixes incorporated into the WORK.
3. **Verification:** If, in the opinion of the ENGINEER any fly ash materials are questionable, the ENGINEER will sample the material to test for compliance with these specifications.

## J. Structural Concrete (Classes AA(M), AA, A(M), A, D, F, P(X), P(M), S

1. **Submittal/Source Approval:** The CONTRACTOR shall submit a proposed concrete mix designs on a form acceptable to the ENGINEER giving the intended sources of materials and the mix design for concrete to be furnished. No work shall be started until the Portland cement concrete mix design has been reviewed and accepted. Review and acceptance of this mix design does not release the CONTRACTOR from the responsibility of producing concrete that meets the minimum requirements of the specifications.
2. **Acceptance:** The ENGINEER will conduct the following acceptance tests of a per – lot basis. Unless noted otherwise, a lot is defined as an identifiable placement of concrete not to exceed 200 cubic yards.
  - a. **Entrained Air:** Plastic concrete will be tested for air content at least once per lot or as otherwise determined by the ENGINEER. The air content will be determined in accordance with LDOTD TR 202.
  - b. **Slump:** Plastic concrete will be tested for slump at least once per lot or as otherwise determined by the ENGINEER. The slump of plastic concrete will be determined in accordance with LDOTD TR 207.
  - c. **Compressive Strength:** Compressive strength for acceptance of structural concrete will be determined by DOTD TR 226. Two (2) batches of three (3) 6 – inch by 12 – inch cylinders will be made and tested in accordance with DOTD TR 226 for each lot of structural concrete placed.

d. **Batch Tickets:** The CONTRACTOR shall provide batch tickets for each batch of concrete as indicated in Part 3 – Execution.

K. **Minor Structural Concrete (Classes M, R, Y)**

1. **Submittal/Source Approval:** The CONTRACTOR shall submit a proposed concrete mix designs on a form acceptable to the ENGINEER giving the intended sources of materials and the mix design for concrete to be furnished. No work shall be started until the Portland cement concrete mix design has been reviewed and accepted. Review and acceptance of this mix design does not release the CONTRACTOR from the responsibility of producing concrete that meets the minimum requirements of the specifications.
2. **Acceptance:** The ENGINEER will conduct the following acceptance tests of a per – lot basis. Unless noted otherwise, a lot for minor concrete shall be 50 cubic yards, regardless of day placed.
  - a. **Entrained Air:** Plastic concrete will be tested for air content at least once per lot or as otherwise determined by the ENGINEER. The air content will be determined in accordance with LDOTD TR 202.
  - b. **Slump:** Plastic concrete will be tested for slump at least once per lot or as otherwise determined by the ENGINEER. The slump of plastic concrete will be determined in accordance with LDOTD TR 207.
  - c. **Compressive Strength:** Compressive strength for acceptance of structural concrete will be determined by DOTD TR 226. One (1) batches of (3) 6 – inch by 12 – inch cylinders will be made and tested in accordance with DOTD TR 226 for each lot of structural concrete placed.
  - d. **Batch Tickets:** The CONTRACTOR shall provide batch tickets for each batch of concrete as indicated in Part 3 – Execution.

1.5 **MASTER PROPORTION TABLE FOR PORTLAND CEMENT CONCRETE**

- A. Portland cement concrete shall conform to the requirements of the table below. It shall be a mixture of portland cement, portland – pozzolan cement, or portland blast – furnace slag cement, fine aggregate, coarse aggregate, water, and when specified or allowed, approved admixtures. Fly ash or ground granulated blast furnace slag will be permitted as a partial replacement for portland cement in accordance with this specification.

## Master Proportion Table for Portland Cement Concrete

						Slump Range <sup>10</sup> , inches		
	Average Compressive Strength, psi at 28 days	Grade of Coarse Aggregate	Min. Cement lb/yd <sup>3</sup> of Concrete <sup>9,14</sup>	Maximum Water /Cement ratio, lb/lb <sup>1,9</sup>	Total Air Content (Percent by Volume) <sup>4</sup>	Non-Vibrated	Vibrated	Slip Form Paving <sup>2</sup>
<b>Structural Class<sup>11</sup></b>								
AA(M)	4400	A, P	560	0.44	5±1	2-5	2-4	N.A.
AA	4200	A, P	560	0.44	5±1	2-5	2-4	N.A.
A(M)	4400	A, P	510	0.53	5±2	2-5	2-4	N.A.
A	3800	A, F <sup>8</sup> , P	510	0.53	5±2	2-5	2-4	1-2.5
D	3300	A, B, D, P	420	0.58	5±2	2-5	1-3	N.A.
F	3400 <sup>5</sup>	A, P	460	0.44	5±1	2-5	2-4	N.A.
P(X)	7500 <sup>5</sup>	A, F <sup>8</sup> , P	700	0.40	5±2	N.A.	2-10	N.A.
P(M)	6000 <sup>5</sup>	A, F <sup>8</sup> , P	600	0.44	5±2	N.A.	2-6 <sup>7</sup>	N.A.
P	5000 <sup>5</sup>	A, F <sup>8</sup> , P	560	0.44	5±2	N.A.	2-6 <sup>7</sup>	N.A.
S	3800	A, P	650	0.53	5±2	6-8	N.A.	N.A.
<b>Minor Structure Class<sup>11</sup></b>								
M	3000	A, B, P	470	0.56	5±2	2-5	2-4	1-2.5
R	1800	A, B, D, P	370	0.70	5±2	2-5	2-4	N.A.
Y	3000	Y	560	— <sup>3</sup>	6-9	N.A.	1-3	N.A.
<b>Pavement Type<sup>11</sup></b>								

N.A. – Not Applicable

<sup>1</sup> Except for Class AA, AA (M), or F concrete, the maximum volume of water; gal. shall be reduced 5 percent when a water-reducing admixture is used, and 10 percent when an air-entraining admixture, or air-entraining and water-reducing admixtures, is used. When the coarse aggregate portion of the mix is 100 percent crushed aggregate, the water may be increased by 5 percent provided the maximum water listed in the Master Proportion Table for Portland Cement Concrete is not exceeded.

<sup>2</sup> Also slump range for other concrete placed by extrusion methods.

<sup>3</sup> Because of the absorptive nature of lightweight aggregate and the inability to obtain a true saturated surface dry condition for determining free moisture, a maximum amount of water cannot be specified for Class Y concrete. The slump requirement of the Master Mixture Proportion Table for Portland Cement Concrete or as specified will be the governing factor in determining maximum allowable water.

<sup>4</sup> Total air content ranges when air-entrainment is allowed or specified. Air content shall be designed at midrange.

<sup>5</sup> Values shown represent the minimum compressive strengths allowed.

<sup>6</sup> Average compressive strengths for Pavement Type concrete shall be 3600 psi when air-entrainment is used.

<sup>7</sup> NOT USED

<sup>8</sup> Grade F coarse aggregate shall be used only when specified or permitted. The minimum cement content shall be increased when this aggregate is used.

<sup>9</sup> For mixes including partial replacement of cement with fly ash or ground granulated blast furnace slag, the minimum cement and maximum water contents shown apply to the total cement and fly ash or ground granulated blast furnace slag content of the mix. Additional cement may be required to achieve minimum compressive strength.

<sup>10</sup> When a slump range is specified in other sections, that range shall govern.

<sup>11</sup> Allowable Cement Types shall be as specified herein.

<sup>12</sup> NOT USED.

<sup>13</sup> Aggregate grading shall comply with the requirements specified herein.

<sup>14</sup> The minimum cement factors may be waived in writing by the Engineer

1.6 **COMPOSITION OF CONCRETE**

A. Allowable types of cement are as follows:

<u>Use</u>	<u>Allowable Cement Types</u>
General Construction (Structural Class Concrete and Minor Structure Class Concrete)	Type I/II portland cement;

B. For concrete placements having a least dimension of 48 inches or greater or if designated on the plans or the project specifications as being mass concrete, the allowable cement type shall be Type II Portland cement, Type IP Portland-pozzolan cement, or Type IS Portland blast-furnace slag cement. The cement, or combination of cement and fly ash or ground granulated blast furnace slag, shall be certified to generate a heat of hydration of not more than 70 calories/gram at 7 days.

C. Due to the gradation of aggregate or other conditions, additional cement may be required to achieve minimum compressive strength.

D. When using only Types I or II Portland cement in concrete mixes, fly ash conforming or ground granulated blast-furnace slag as specified herein may be partially substituted for Portland cement on a pound for pound basis. The CONTRACTOR may use up to 20 percent fly ash by weight of cement for other minor structures and concrete pavement and up to 15 percent fly ash by weight of cement for structural concrete. In lieu of fly ash, the CONTRACTOR may use grade 100 or grade 120 ground granulated blast-furnace slag up to 50 percent by weight of cement. The combination of slag and fly ash will not be allowed as a partial substitution for cement.

E. **Chemical Admixtures:** An air-entraining admixture will be required in paving concrete when placed by slip-form methods or when a central mixing plant or non-agitating haul trucks are used. Air -entraining and water-reducing admixtures will be required in Class AA, F, AA(M) concrete. When an air-entraining admixture is used, the total air content of the concrete mix shall be tested in accordance with DOTD TR 202, and shall be as specified in the Master Proportion Table for Portland Cement Concrete. A water – reducing admixture is required for mass concrete. When the ambient air temperature is 70° F or below, the water-reducing admixture shall be the normal-set type. When the ambient air temperature is above 70°F and below 85°F, the water-reducing admixture may be either the normal-set type or the set-retarding type, except for concrete containing fly ash or ground granulated blast furnace slag where this choice is optional. Set-retarding admixtures shall be used in an amount sufficient to produce the necessary retardation. The CONTRACTOR shall consider the influence of different materials and job conditions, including local weather on setting characteristics. With approval of the mix design, the CONTRACTOR may use approved admixtures other than as stated above in order to control setting characteristics. Water contents for super-plasticized concrete mixes shall not be reduced to levels that will restrict cement hydration. The amount of water in the superplasticizer shall be included as a part of required mixing water. The dosage of superplasticizer may be adjusted depending on the consistency of the mix. Final slump of super-plasticized concrete shall be appropriate for its application. It shall not exhibit excessive bleeding or segregation of aggregates as determined by the ENGINEER. The method of adding and mixing the superplasticizer to the mix shall be as recommended by

the manufacturer. The use of admixtures in other classes or types of concrete will be optional with the CONTRACTOR with written approval.

- F. **Water:** The total amount of water in the mixture, including admixtures and free water, shall not exceed the maximum water-cement ratio specified in the Master Proportion Table for Portland Cement Concrete. Free water shall include all water entering the mix with the aggregates, except water absorbed by the aggregate. Because of the absorptive nature of lightweight aggregate and the inability to obtain a true saturated surface dry condition for determining free moisture, a maximum amount of water cannot be specified for Class Y concrete. The slump requirement of the Master Proportion Table for Portland Cement Concrete or as specified will be the governing factor in determining maximum allowable water.
- G. **Aggregates:** All aggregates for use in Portland cement concrete shall meet the requirements below and as specified herein:
  - 1. **Coarse Aggregate:** Coarse aggregate, shall be the grade specified in the Master Proportion Table for Portland Cement Concrete and shall comply with the requirements specified herein in Part 2.
  - 2. **Fine Aggregate:** Fine aggregate, shall meet the requirements specified herein in Part 2.

## PART 2 -- PRODUCTS

### 2.1 GENERAL

- A. Cement, and fly ash, shall be certified by the supplier in accordance with current procedures of the Louisiana Department of Transportation and Development (LDOTD).

### 2.2 PORTLAND CEMENT

- A. Portland cement shall be from an approved source listed in the LDOTD AML (formerly QPL 7) and shall comply with AASHTO M 85.
- B. **Chemical Requirements:** The chemical requirements shall be as specified in AASHTO M85. Alkali content calculated as sodium oxide equivalent shall not exceed 0.60 percent by weight for all types of cement.
- C. **Process Additions:** Process additions may be used in amounts not to exceed 3 percent by weight of portland cement clinker provided it meets the requirements for the cement portion of ASTM C 465 and the test results are submitted to the ENGINEER for review and approval.

### 2.3 AGGREGATES

- A. General: Aggregates shall meet the requirements of the Master Proportion Table for Portland Cement Concrete and shall be listed on the LDOTD AML (QPL 2). Aggregates shall meet the requirements specified herein.
- B. **Fine Aggregate:** Sand shall be a natural silica sand from a source listed on the LDOTD AML (QPL 2). The percentages of deleterious materials shall not exceed the following values:

<b>Property</b>	<b>Percent, Max</b>
Coal and Lignite	0.25
Clay Lumps	0.05
Clay Lumps and Friable Particles	3.00

Fine aggregate for all portland cement concrete except Types B and D pavements shall conform to the following gradations:

<b>Concrete Sand</b>	
<b>U.S. Sieve</b>	<b>Percent Passing</b>
3/8 inch	100
No. 4	95-100
No. 16	45-90
No. 50	7-30
No. 100	0-7
No. 200	0-3
<b>Mortar Sand</b>	
<b>U. S. Sieve</b>	<b>Percent Passing</b>
No. 4	100
No. 8	95-100
No. 100	0-25
No. 200	0-10

- C. Coarse Aggregate: Coarse aggregate used in Portland cement concrete for bridge decks shall have a Friction Rating of I, II, or III as defined in the Table below and as indicated on the LDOTD AML (QPL 2).

<b><u>Friction Rating</u></b>	<b><u>Description</u></b>
I	Aggregates that have a Polish Value of greater than 37 or demonstrate the ability to retain acceptable friction numbers for the life of the pavement.
II	Aggregates that have a Polish Value of 35 to 37 or demonstrate the ability to retain acceptable friction numbers for the life of the pavement.
III	Aggregates that have a Polish Value of 30 to 34 or demonstrate the ability to retain acceptable friction numbers for the life of the pavement
IV	Aggregates with a Polish Value of 20 to 29.

The maximum amount of deleterious materials shall not exceed the following:

<b><u>Property</u></b>	<b><u>Percent, Max</u></b>
Clay Lumps	0.05



Total Clay Lumps and Friable Particles	3.0
Iron Ore	2.0
Glassy Particles in Slag	10.0
Flat and Elongated Particles (5:1) (ASTM D4791)	10.0
Coal and Lignite	1.0
Wood (Wet)	0.05
Total Clay Lumps and Friable Particles, Iron Ore, Coal and Lignite, Wood	5.0

- D. **Uncrushed Coarse Aggregate:** Uncrushed coarse aggregate for all portland cement concrete shall comply with the table below.

**Portland Cement Concrete Aggregates**

U.S Sieve	Grade A (Size 57)	Grade B (Size 467)	Grade D (Size 357)	Grade F ---	Grade P (Size 67)
2 1/2 inch	---	---	100	---	---
2 inch	---	100	90-100	---	---
1 1/2 inch	100	85-100	---	---	---
1 inch	90-100	---	35-70	---	100
3/4 inch	---	35-70	---	100	80-100
1/2 inch	25-60	---	10-30	90-100	---
3/8 inch	---	10-30	---	---	20-55
No. 4	0-10	0-5	0-5	15-60	0-10
No. 8	0-5	---	---	0-15	0-5
No. 16	---	---	---	0-5	---
No. 200	0-1	0-1	0-1	0-1	0-1

- E. **Crushed Coarse Aggregate:** Crushed coarse aggregate for all portland cement concrete shall comply with the uncrushed coarse aggregate gradations except that when the material finer than the No. 200 (75 µm) sieve consists of the dust fraction from crushing, essentially free of clay, this percentage shall be 0-2 percent. When the total material passing from NO. 200 (75 µm) sieve from the coarse and fine aggregates does not exceed 5 percent, the percent passing the No. 200 sieve from the crushed coarse aggregate may be increased to 3 percent.

Each type of aggregate to be used in the proposed mixture shall be sampled and tested individually. The percent of total combined aggregates retained shall be determined mathematically based on the proportions of the combined aggregate blend. All gradation calculations shall be based on percent of dry weight (mass). The maximum amount of deleterious materials shall not exceed the following:

<u>Property</u>	<u>Percent, Max</u>
Clay Lumps	0.05

Total Clay Lumps and Friable Particles	3.0
Iron Ore	2.0
Glassy Particles in Slag	10.0
Flat and Elongated Particles (5:1) (ASTM D4791)	10.0
Coal and Lignite	1.0
Wood (Wet)	0.05
Total Clay Lumps and Friable Particles, Iron Ore, Coal and Lignite, Wood	5.0

## 2.4 ADMIXTURES

- A. **Physical Requirements:** Concrete admixtures shall be an approved product listed on the LDOTD AML (formerly QPL 58).
- B. **Chemical Requirements:** Unless a chloride type admixture is specified, the contribution of chloride ion resulting from the addition of admixtures to the concrete shall not exceed 0.02 pound per cubic yard of concrete, when tested in accordance with DOTD TR 643.

## 2.5 WATER

- A. Water suitable for human consumption shall be used.

## 2.6 FLY ASH

- A. Fly Ash shall be from an approved source listed on the LDOTD AML (formerly QPL 50) and shall comply with AASHTO M 295 for Class C and Class F only.

## PART 3 -- EXECUTION

### 3.1 GENERAL

- A. No concrete shall be mixed, placed, or finished when natural light is insufficient, unless an approved artificial lighting system is provided. No concrete shall be placed on a frozen subgrade nor shall frozen aggregates be used in concrete.

### 3.2 EQUIPMENT

- A. **General:** Sufficient plant capacity and transporting equipment to ensure delivery at the required rate shall be provided. Rate of concrete delivery during concreting operations shall provide for proper handling, placing and finishing of concrete and maintain a workable surface. Methods of delivering and handling concrete shall facilitate placing with a minimum of re-handling and without damage to the structure or concrete.
- B. **Plant Equipment:** Batch plants shall include approved storage, weigh hoppers, and measuring devices. Equipment shall be properly sealed and vented to minimize dusting and loss of material.

1. Materials shall be incorporated into the mix by methods that will ensure uniform distribution. The amount of each material used in the mix shall be recorded and certified by the contractor's authorized representative.
2. The plant shall be equipped with adequate water storage and a device for automatically controlling the amount of water used in each batch.
3. For plants using direct-fill elevating weigh hoppers, computer controlled indicator lights may be used as an indication of aggregate weights but shall not be the sole means of control for aggregate proportioning. Means of control shall be provided so that, as the quantity desired in the weigh hopper is approached, material may be added slowly and shut off with precision. Weight hoppers shall be constructed as to eliminate accumulation of materials and to discharge completely. Suitable provisions shall be made for removal of overload from the hopper by the operator. The plant shall demonstrate satisfactory performance by producing consistent concrete with adequate compressive strengths.
4. **Storage Bins and Silos:** For plants with overhead storage bins, which feed directly into the weight hopper, or storage bins with belt feed to the weight hopper, the bins shall have adequate separate compartments for fine aggregate and each size of coarse aggregate. Each compartment shall be designed to discharge efficiently and freely into the weigh hopper. Means of control shall be provided so that, as the quantity desired in the weigh hopper is approached, material shall be added slowly and shut off with precision.
5. Silos shall be weatherproof, sealed, free of holes, and shall prevent contamination. Silos shall be designed to freely discharge and shall be equipped with vibrators to maintain flow of material and prevent accumulation. Silos shall be designed with sufficient capacity for the operation. Silos shall be provided with a positive means of shut off without leaking into the weigh hopper. A separate silo shall be used for each dry bulk material, added to the mix. If a silo is divided into compartments for cement, fly ash, ground granulated blast furnace slag and microsilica, a positive means of separation shall be provided.
6. **Measuring Devices:** Materials shall be measured by weighing except where other methods are authorized.
7. Batch plants may be equipped to proportion materials by approved automatic weighing devices. Moisture probes can be used to determine the moisture content of aggregates for batch adjustment provided the accuracy is confirmed by the ENGINEER to be within 0.5 percent of the results obtained by the Certified Concrete Technician in accordance with DOTD TR 106.
8. Fine aggregates and each size of coarse aggregate from separate bins shall be weighed either separately or cumulatively on scales in the weigh hopper. The allowable quantities of bulk fly ash, bulk ground granulated blast furnace slag, or bulk microsilica may be weighed cumulatively in the same hopper with the cement, provided the cement is weighed first and the scale system is separate from that used for the aggregates.

9. Weight hoppers shall be constructed to eliminate accumulation of materials and to discharge completely. Suitable provisions shall be made for removal of an overload from the hopper by the operator.
10. Scales shall be accurate to 0.5 percent throughout the range of use. Maximum graduation on scales shall be 0.1 percent of the rated scale capacity. When beam type scales are used poises shall be designed to be locked in any position to prevent accidental change of position, and the weigh beam and a telltale device shall be in view of the operator. Plant and laboratory measuring devices shall be subject to approval and shall be tested, inspected, and certified by a qualified independent scale service or the Weights and Measures Division of the Louisiana Department of Agriculture and Forestry at no cost to the OWNER every 90 calendar days, and more often when the ENGINEER deems it necessary to assure their accuracy.
11. Individual aggregates shall be batched within 2 percent, and the total weight of aggregate shall be within 1 percent of the required weight.
12. Cement, fly ash, ground granulated blast furnace slag, and microsilica shall be within 1 percent of the required weight (mass). Cement in standard bags need not be weighted; however, when used, they shall be used in full bag increments and the quantities of other materials shall be adjusted accordingly. Bagged fly ash and bagged ground granulated blast furnace slag will not be allowed.
13. Mixing water shall be measured by volume or weight. Water measuring devices shall be accurate to 1 percent at ½ the maximum allowable water per batch and the maximum graduation shall be gallon.
14. **Ticket Printer System:** Certified concrete plants may be equipped with an approved automatic ticket printer system for recording required batching information. When an automatic ticket printer system is not used, quantities and batching information shall be determined by visual observation, recorded, and certified correct by the CONTRACTOR's authorized representative. The approved ticket printer system shall be tamper-proof and shall print time of batching, amount of water, batch weights, moisture content of aggregates, and quantities of admixtures. The Certified Concrete Technician may add moisture content of aggregates or quantities of admixtures to the printed ticket when the automatic system does not have these capabilities. During a breakdown, quantities shall be determined by visual observation and certified as stated above. All records of batches shall show batch number, day, month, year, and time of day to the nearest minute for each batch. The maximum quantity of water that can be added at the jobsite shall be shown on the batch ticket. The ENGINEER shall be provided with a legible copy of all batch records identified with lot number and mix design number

C. **Hauling Equipment:** Hauling equipment shall be watertight and shall be capable of discharging concrete at a satisfactorily controlled rate without segregation.

1. **Truck Mixer:** Truck mixers shall be the revolving drum type, equipped with pressurized, calibrated tanks for carrying a portion of the mixing water. Only the prescribed and verifiable amount of water is permitted in

the tank unless the tank is equipped with a device by which the quantity of water added can be readily verified. Truck mixers shall be equipped with electrically or mechanically actuated revolution counters, which display the number of revolutions. Counters shall be located to provide safe and convenient inspection. Each truck mixer shall have attached thereto in a prominent place a metal plate on which is plainly marked the uses for which the equipment is designed, the maximum rated capacity of the drum in terms of concrete volume and rotation speed for both agitation and mixing speeds. Truck mixers shall be equipped with means for accurately measuring the amount of water used in each batch.

2. **Agitator Hauling Equipment:** Agitators shall be supplied with adequate mixing blades or paddles to agitate the mix and prevent segregation. Covers shall be provided when directed. Each agitator shall have attached thereto in a prominent place a metal plate on which is plainly marked the uses for which the equipment is designed, the maximum rated capacity in terms of concrete volume, and agitation speed
3. **Non-Agitator Hauling Equipment:** The bodies of non-agitating hauling equipment shall be smooth, metal, and mortar tight containers. Covers shall be provided when directed.
4. **Portable Mixers:** Portable mixers shall have a minimum capacity of one cubic yard (cu m) and shall be capable of uniformly mixing and discharging concrete without segregation.

### 3.3 TRANSPORTATION AND STORAGE OF CEMENTITIOUS MATERIALS

- A. Cement, fly ash, ground granulated blast furnace slag, and microsilica shall be transported in watertight conveyances and stored in separate approved facilities so that cement, fly ash, ground granulated blast furnace slag, and microsilica will be protected from dampness or water intrusion. Material that is contaminated, is partially set, or contains lumps of caked material will be rejected. When the use of bagged cement, fly ash, ground granulated blast furnace slag or microsilica is permitted, the handling and storage will be as directed.
- B. Different brands or types or the same brand or type from different mills, shall not be mixed or used alternately unless authorized by the ENGINEER. This requirement may be waived in case of plant breakdown during production to allow concrete conforming to the requirements of this section to be furnished from another plant to finish the placement in progress.

### 3.4 HANDLING AND STORAGE OF AGGREGATES

- A. Equipment and methods for stockpiling aggregates shall be such that no detrimental degradation or segregation of aggregate will result; no appreciable amount of foreign material will be incorporated into aggregate; and there will be no intermingling of stockpiled materials. Stockpiles of aggregates shall be well drained and shall have uniform moisture content. Material shall not be added to working faces of the stockpiles during continuous operations.
- B. When specified, coarse aggregate shall be separated into two or more sizes to ensure greater uniformity of the concrete mixture. Different grades and types of aggregates shall be stored in separate stockpiles separated by bulkheads or sufficiently separated from each other to prevent material of edges of piles from intermingling. When segregation

occurs in the processing and handling of Grade D coarse aggregate, the aggregate shall be separated at the 1-inch sieve into two stockpiles. The stockpiled material shall be reportioned to meet the gradation requirements of Grade D. Activity that results in contamination or intermingling of aggregates, including overhead handling for the loading of bins or building of stockpiles, will not be permitted.

- C. Aggregates shall be handled from stockpiles or other sources to the batch plant so as to secure uniform grading of material. Aggregates that have become segregated or contaminated shall not be used. Aggregates processed or handled by hydraulic methods, and washed aggregates, shall be stockpiled or placed in bins for adequate drainage. Transport containers will be accepted as an adequate bin when adequate drainage is provided. Drainage of aggregates shall meet the approval of the ENGINEER prior to batching. The ENGINEER may require water sprinkling of coarse aggregates in stockpiles that have dried to the extent that the aggregates absorb mixing water. Such sprinkling shall continue until aggregates are saturated.

### 3.5 **QUALITY CONTROL OF CONCRETE**

- A. The CONTRACTOR shall be responsible for quality control of materials during handling, proportioning, mixing, and placement operations; for initial determination and necessary subsequent adjustments in proportioning of materials used to produce the specified concrete; and for providing suitable equipment for determination of aggregate gradation, moisture, air content, slump, unit weight, temperature, and trial mixes as necessary. Testing and analysis of the mix for quality control purposes, the setting of dials, gages, scales or meters, adjusting batch weights, and accurate batching shall be the responsibility of the CONTRACTOR.
- B. The CONTRACTOR shall have a Certified Concrete Technician present at the plant or job site to make adjustments in batch weights for moisture content, perform necessary adjustments in proportioning materials to produce the specified concrete, and perform tests necessary for control of the concrete mix within specifications requirements. Daily plant operations shall not begin unless the Certified Concrete Technician is at the plant to determine that gradations, moisture contents, and adjusted batch weights are within specifications limits. If a Certified Concrete Technician is not available at the job site, an Authorized Concrete Technician is not available at the job site, an Authorized Concrete Field Tester is allowed to perform the job site control tests for slump, air content, and mix temperature and report the results to the Certified Concrete Technician. The use of an Authorized Concrete Field Tester at the job site will not relieve the Certified Concrete Technician from performing the remaining duties as outlined in these specifications.
- C. The CONTRACTOR'S Certified Concrete Technician and Authorized Concrete Field Tester shall be certified or authorized upon satisfactory completion of the Louisiana Department and Transportation and Development requirements for such personnel.
- D. Mixtures shall produce concrete of suitable workability. Slumps shall be within the ranges show in the Master Proportion Table for Portland Cement Concrete or as specified when tested in accordance with DOTD TR 207. The ENGINEER may authorize an increase in maximum slump, by use of water reducers, for concrete used in the construction of walls and diaphragms less than 8 inches thick, and where the ENGINEER considers necessary provided the water-cement ratio is not exceeded and conventional forms are used.
  - 1. Concrete mixes shall be formulated to produce concrete which, when molded and cured in accordance with DOTD TR 226 and tested in accordance with DOTD TR 230, shall show an average compressive strength not less than as shown in the Master Proportion Table for

Portland Cement Concrete. Class P, Class P (M) and Class P (X) concrete cylinders for compressive strength tests shall be cured by the same methods used in curing the members they represent.

2. Proportioning for volume of coarse aggregates in concrete mixes, excluding concrete pipe, Types B and D pavement, and minor structure concrete shall be in accordance with the table below. An example of proportioning of coarse aggregate is shown in the LDOTD publication entitled "Application of Quality Assurance Specifications for Portland Cement Concrete Pavement and Structures".

**Volume of Coarse Aggregate Per Unit of Volume of Concrete**

Maximum Size of Aggregate, Inches (mm)	Volume of Dry-Rodded Coarse Aggregate Per Unit Volume of Concrete for Different Fineness Moduli of Fine Aggregate <sup>1</sup>				
	2.20	2.40	2.60	2.80	3.00
3/8 (9.50)	0.52	0.50	0.48	0.46	0.44
1/2 (12.5)	0.61	0.59	0.57	0.55	0.53
3/4 (19.0)	0.68	0.66	0.64	0.62	0.60
1 (25.0)	0.73	0.71	0.69	0.67	0.65
1 1/2 (37.5)	0.77	0.75	0.73	0.71	0.69
2 (50.0)	0.80	0.78	0.76	0.74	0.72
3 (75.0)	0.84	0.82	0.80	0.78	0.76

<sup>1</sup> Volumes are based on aggregates in dry-rodded condition as described in AASHTO T19, Unit Weight of Aggregate. These volumes are selected from empirical relationships to produce concrete with a degree of workability suitable for usual reinforced concrete construction. For less workable types of concrete such as required for concrete pavement construction, they may be increased up to 10%. For the more workable concrete, as may be required for pumping, they may be reduced up to 10%.

4. Where indicated, trial mixes will be required to demonstrate the mix performance and the compatibility of mix components for the following:
  - (1) Fly Ash
  - (2) Ground Granulated Blast Furnace Slag
  - (3) Microsilica

- (4) Heavyweight Concrete
- (5) Flexural Strength (when required)
- (6) Unusual Materials and Applications

- 5. For the above trial mixes, the CONTRACTOR shall submit test results for slump, unit weight, air content, set times, and compressive strength (flexural strength for pavements) at 3, 7, and 28 days. The CONTRACTOR shall furnish materials to the ENGINEER for verification of trial mixes.
- 6. CONTRACTOR shall be responsible for determination of gradation, unit weight, specific gravity and absorption factor of the aggregates.
- 7. Trial mixes may be waived in writing by the ENGINEER at his discretion.

D. **Quality Control Tests:** The CONTRACTOR shall be responsible for determining gradation and moisture content of fine and coarse aggregates used in the concrete mixture and for testing the mixture at the job site for slump, unit weight, temperature, and air content (when used). The CONTRACTOR shall conduct operations to produce a mix complying with the reviewed and accepted mix design, except that variations will be permitted within specified control limits for individual samples.

E. **Mix Adjustments:** With prior notification given to the ENGINEER, the CONTRACTOR may adjust the ratio of fine to coarse aggregate as reviewed and accepted, by no more than 5 percent. In no case shall it be adjusted so as to materially affect the volume of concrete. If the proportions of the aggregate sizes used do not satisfy the gradation requirements specified herein due to changes in the gradation of one or more stockpiles, the proportions shall be adjusted to bring the combined aggregates back within specification limits. These minor adjustments for gradation will not require a new mix design. The mix produced shall be uniform, workable and within the specification limits of the Master Proportion Table for Portland Cement Concrete. When plant operations do not produce a uniform and workable mix, plant operations shall cease and corrective action shall be taken prior to restart.

- 1) When individual slump, air content, concrete temperature, or gradation measurements indicate that the mix is not uniform and may fall outside tolerance limits, the CONTRACTOR shall immediately make adjustments to keep the mix within specified limits. If the CONTRACTOR fails to make proper adjustments and the mix deviates from specification requirements or if the mix is obviously defective, the mix will be rejected.
- 2) For workability properties only, changes in mix proportions will be permitted provided the water-cement ratio is not exceeded, minimum cement factor is maintained, proper batch adjustments are made, and prior notification is given to the ENGINEER.
- 3) No changes in source of materials or percentages of cement, fly ash, ground granulated blast furnace slag, or microsilica shall be made until a new Mix Design form showing the new material or adjusted proportions has been submitted by the CONTRACTOR and approved.

### 3.6 SUBSTITUTIONS

- A. Mixtures may be substituted with approval in accordance with the table below:

#### **Portland Cement Concrete Mixture Substitutions**



Structural Class <sup>1</sup>	Substitute
AA (m)	No Substitutions
AA	AA(M)
A	AA(M), AA
D	AA(M), AA, A(M)
F	No Substitutions
P(X)	No Substitutions
P(M)	No Substitutions
P	P(M)
S	No Substitutions
Minor Structure Class <sup>1</sup>	
M	AA(M), AA, A(M), A, B
R	AA(M), AA, A(M), A, B, M
Y	No Substitutions

<sup>1</sup> The mixture being substituted shall meet the requirements of the Master Proportion Table for Portland Cement Concrete and the mix design for its class or type. The compressive strength of the substituted mix shall meet the strength requirements of the original mixture specified.

### 3.7 BATCHING AND MIXING

- A. **General:** Concrete shall be thoroughly mixed in a mixer of an approved size and type, which will ensure uniform distribution of materials through the mass.
- B. Pick-up and throw-over blades or mixing paddles in the mixing drum or mixing unit shall be replaced when worn beyond the limit recommended by the manufacturer. The contractor shall have available a copy of the manufacturer's design, showing dimensions and arrangements of blades in reference to original height and depth.
- C. Mixing operations shall begin within 30 minutes after addition of cement to the aggregates. When cement is charged into a mixer drum containing surface-wet aggregate and the ambient temperature is above 90°F, or when high early strength cement is used, this limit shall be reduced to 15 minutes. When there is an interruption to the mixing operations, the mixer shall be thoroughly cleaned. The entire contents of the mixer shall be removed from the drum before materials for a succeeding batch are placed therein. Materials composing a batch shall be deposited simultaneously in an operating mixer. A portion of mixing water shall entire in advance of cement and aggregates. No mixer having a rated capacity of less than one cubic yard shall be used nor shall a mixer be charged in excess of its rated capacity. The minimum size batch shall be one cubic yard. Mixers with worn blades or excessive build-up will be rejected. Concrete exposed to salt water or a corrosive environment shall be mixed for 2 minutes and the water content of the m mixture shall be carefully controlled.

- D. **Central Plant And Site Mixing:** Concrete shall be mixed for at least 50 seconds. Mixing time shall begin after all materials, including water, are in the mixer. Mixing time ends when the discharge chute opens. The mixer shall be equipped with an approved timing device, which will automatically lock the discharge lever when the drum has been charged and release it at the end of the mixing period. During mixing, the mixer shall be operated at a drum speed for which it has been designed as shown on the manufacturer's name plate on the mixer.
- E. **Truck Mixing:** Aggregates, cement, fly ash, ground granulated blast furnace slag and microsilica for concrete shall be measured as specified herein and charged into the drum at the proportioning plant.
1. Size of batch in truck mixers shall not exceed the maximum rated mixing capacity of the mixer as stated by the manufacturer and stamped on a metal plate on the mixer. When a truck mixer is used for complete mixing, each batch shall be mixed for not less than 70 nor more than 130 revolutions of the mixer drum at the rate of rotation designated as the mixing speed by the equipment manufacturer on the metal plate on the mixer. Any additional mixing shall be at the speed designated by the equipment manufacturer as the agitating speed. All materials, including mixing water, shall be in the mixer drum before actuating the revolution counter or taking an initial reading.
  2. When the prescribed amount of water is added at the batch plant and slump is on the low side at the jobsite it will be permissible to add a minimum of 75 percent of the mixing water at the time cement and aggregates are added at the batch plant and the remaining mixing water at the job site prior to discharging concrete into forms. Water added at the job site may be added in 1 or 2 increments with additional mixing within the range of 20 to 30 revolutions at designated mixer speed for each increment; however, the total of 130 revolutions shall not be exceeded. Water added at the jobsite shall not cause the maximum allowable water-cement ratio or slump of the batch to be exceeded.
  3. If water or superplasticizer is allowed to be added to a partial load, only a proportional amount will be added. The method of adding and mixing superplasticizer to the mix shall be in accordance with the manufacturer's recommendation. When the slump is more than the maximum specification limit, the batch will be rejected; additional mixing or agitation to reduce the slump will not be allowed even though the maximum time limit or number of revolutions have not been exceeded.
  4. Slump tests, unit weight, acceptance cylinders, and temperature measurements will not be made until all mixing water has been added to the batch.
- F. **Partial Mixing at Central Plant:** When partial mixing is allowed at a central plant, the mixing time at the central plant may be reduced to 30 seconds. Additional required mixing shall be completed in a truck mixer at mixing speed. Mixing time in the truck mixer shall be a minimum of 10 and a maximum of 70 revolutions.

### 3.8 TEMPERATURE LIMITATIONS

- A. **General:** Air temperature and mix temperature shall be determined at the point of placement in the shade away from artificial heat.

**B. Hot Weather Limitations:** Hot weather limitations shall apply to concrete for:

1. Bridge Decks, Approach Slabs, And Mass Concrete: Hot weather concreting practices will be required when the job site temperature in the shade and away from artificial heat is 80°F and rising. When internal temperature of plastic concrete reaches 85°F, the contractor shall prevent the temperature of succeeding batches from going beyond 90°F by approved methods. If necessary, forms shall be pre-cooled by approved methods immediately prior to concrete placement.

**C. Cold Weather Limitations:** Mixing and concreting operations for concrete mixes not containing ground granulated blast-furnace slag or Type IS cement shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40°F, and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F provided the high temperature forecasted by the U.S. Weather Service is above 40°F. For concrete mixes, containing ground granulated blast-furnace slag or Type IS cement, operations shall be discontinued at a descending air temperature in the shade and away from artificial heat of 55°F. Production shall not begin until the temperature at the point of placement is within the above limitations. Concrete shall not be placed if the U.S Weather Service forecasts the temperature to be less than 35°F within the 24-hour period following placement unless authorized in writing.

1. When concrete placement at lower air temperatures is authorized in writing, aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to prevent occurrence of overheated areas. If the air temperature is less than 35°F at the time of placing concrete, the ENGINEER may require water or aggregates to be heated to not less than 70° nor more than 150°F. After placement, the concrete shall be protected by additional covering, insulating materials, or other methods approved by the ENGINEER.

### 3.9 TIME LIMITATIONS

- A. The maximum allowable time from the addition of cement to the mix to complete discharge of the concrete shall be 90 minutes or a maximum of 300 revolutions, whichever may occur first. When transport is by non-agitator truck, the maximum allowable time from the addition of cement to the mix to complete discharge of the concrete shall be 45 minutes. In hot weather or any other conditions contributing to rapid loss of plasticity or uniformity of concrete, maximum allowable time may be reduced by the ENGINEER.

### 3.10 HAULING EQUIPMENT

- A. Wet batches of concrete may be transported in a truck mixer, agitator or other approved equipment. Non-agitator trucks will not be allowed for structural concrete, but will be permitted for pavement concrete when air-entrainment admixture is used. Maximum volume of mixed concrete transported in an agitator truck at agitation speed shall be in accordance with the manufacturer's specified rating.

### 3.11 PORTABLE MIXERS

- A. Portable mixers shall be approved in writing for mixing one cubic yard of concrete or less per day for minor structure concrete

### 3.12 DELIVERY

- A. Sufficient plant capacity and transporting equipment to ensure delivery at the required rate shall be provided. Rate of concrete delivery during concreting operations shall provide for proper handling, placing and finishing of concrete and maintain a workable surface. Methods of delivering and handling concrete shall facilitate placing with a minimum of re-handling and without damage to the structure or concrete.

### 3.13 ACCEPTANCE AND PAYMENT SCHEDULE

- A. Acceptance and payment schedules in the tables below will apply to all cast-in-place structural Portland cement concrete.

#### Acceptance and Payment Schedule Cast-In-Place Structural Concrete

Average Compressive Strength per Lot, PSI (28 to 31 days)					
Class A or S	Class AA	Class A(M) or AA(M)	Class D	Class F	Percent of Contract Price
3800 & Above	4200 & Above	4400 & above	3300 & above	3400 & above	100
3400 – 3799	3800-4199	4200-4199	3000-3299	---	98
3000 – 3399	3500-3799	4000-4199	2500-2999	---	90
Below 3000	Below 3500	Below 4000	Below 2500	Below 3400	50 or remove and replace <sup>2</sup>

<sup>1</sup>When concrete is part of an item or not a direct pay item, lot sizes, sampling and acceptance testing for the required quantities will be in accordance with Subsection 805.18. The value for each cubic yard required will be assessed at \$350 (\$460) for the purpose of applying payment adjustment percentages. The amount of payment adjustment for the quantity of concrete involved will be deducted from payment.

Acceptance and payment schedules shall apply to the contract item itself for cast-in-place piling.

<sup>2</sup>When the average compressive strength of **any batch in a lot** is less than 4000 psi for Class A(M) or AA(M), less than 3500 psi for Class AA, less than 3000 psi for Class A or S, less than 2500 psi for Class D, or less than 3400 psi for Class F, an investigation will be made. If concrete is allowed to remain in place, payment will be based on the average compressive strength for the lot. If concrete is not allowed to remain in place, the identifiable deficient areas shall be removed and replaced at no direct pay.

When the average compressive strength for a **lot** is less than 4000 psi for Class A(M) or AA(M), less than 3500 psi for Class AA, less than 3000 psi for Class A or S, less than 2500 psi for Class D, or less than 3400 psi for Class F, an investigation will be made. If concrete is allowed to remain in place, payment for the lot will be based on 50 percent of the contract price.

Any cores obtained in these investigations will be used for evaluation purposes only and payment will be based on original acceptance samples.

#### Acceptance and Payment Schedule Minor Structural Concrete

Average Compressive Strength, psi (28 to 31 days)		
Class M or Y	Class R	Percent of Contract Price <sup>1</sup>
3000 & Above	1800 & Above	100
Below 3000	Below 1800	50 or Remove <sup>2</sup>

<sup>1</sup>When concrete is part of an item or not a direct pay item, sampling and acceptance testing for the required quantities shall be in accordance with this section. The value for each cubic yard of concrete required will be assessed at \$350 for the purpose of applying payment adjustment percentages. The amount of payment adjustment for the quantity of concrete involved will be deducted from payment.

<sup>2</sup>When the average compressive strength is less than 3,000 psi for Class M or Y, and 1,800 psi for Class R, an investigation will be made. If concrete is allowed to remain in place, payment will be based on 50 percent of the contract price.

Any cores obtained in these investigations will be used for evaluation purposes only. Payment will be based on original acceptance samples.

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## SECTION 04232 - REINFORCED CONCRETE BLOCK MASONRY (REVISED 06/19/17)

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide reinforced concrete masonry units (CMU) and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

#### 1.2 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)

ACI 530                      Building Code Requirements and Specification for Masonry Structures

ACI 530.1                  Specification for Masonry Structures

- B. ASTM International (ASTM)

ASTM A951                Standard Specification for Steel Wire for Masonry Reinforcement

ASTM C90                 Standard Specification for Loadbearing Concrete Masonry Units

ASTM C140                Standard Test Methods for Sampling and Testing Concrete Masonry Unit and Related Units

ASTM C144                Standard Specification for Aggregate for Masonry Mortar

ASTM C150                Standard Specification for Portland Cement

ASTM C207                Standard Specification for Hydrated Lime for Masonry Purposes

ASTM C270                Standard Specification for Mortar for Unit Masonry

ASTM C404                Standard Specification for Aggregates for Masonry Grout

ASTM C476                Standard Specification for Grout for Masonry

ASTM C1019              Standard Test Method for Sampling and Testing Grout

- C. International Code Council (ICC)

IBC                         International Building Code

#### 1.3 CONTRACTOR SUBMITTALS, SAMPLING AND TESTING

- A. Furnish submittals in accordance with Section 01010.

- B. **Samples:** The CONTRACTOR shall submit the following samples:

1. Samples of concrete masonry unit colors with texture ranges indicated for selection of color. Full size samples of the blocks selected shall be submitted for final approval after color selection, if requested. If the required product is a colored and textured unit, the samples shall be colored and textured units.

2. Samples of mortar colors for color selection.
  3. A minimum 4-ft square free-standing sample panel shall be prepared for approval before starting masonry WORK. The panel shall remain at the Site for reference until masonry WORK is completed.
- C. **Documentation:** The CONTRACTOR shall submit the following documentation:
1. Reports from testing masonry units
  2. Reports from mortar and grout testing.
  3. Reports from prism testing.
- D. **Mix Designs:** The CONTRACTOR shall submit grout and mortar mix designs detailing the following at a minimum.
1. Proportions for components
  2. Mill tests for cement
  3. Admixture certification. Include chloride ion content.
  4. Aggregate gradation and certification
  5. Lime certification

#### 1.4 **QUALITY ASSURANCE**

- A. **Applicable Standards:** Concrete masonry shall conform to the International Building Code (IBC), American Concrete Institute ACI 530 - Building Code Requirements for Masonry Structures, ACI 530.1 - Specification for Masonry Structures, and other applicable codes and standards of the governing authorities.
- B. WORK shall conform to the standard of quality established by the approved free-standing sample panel.
- C. Concrete block masonry units shall be sampled and tested in accordance with ASTM C 140 - Test Methods of Sampling and Testing Concrete Masonry and Related Units.
- D. **Testing of Mortar and Grout:** The CONTRACTOR shall have the mortar and grout tested to assure compliance with the Specifications and the governing codes by a recognized testing laboratory approved by the ENGINEER. Test reports shall be submitted to the ENGINEER.
1. Tests shall be taken at the following times:
    - a. At commencement of masonry WORK, at least 2 test samples each of mortar and grout shall be taken on 3 successive Days.
    - b. At any change in materials or job conditions, at least 2 samples of each modified material, grout, and mortar shall be tested.



- c. Four random tests each of mortar and grout shall be made. The random test samples shall be taken when requested by the ENGINEER.
  - d. Additional samples and tests may be required whenever, in the judgment of the ENGINEER, additional tests beyond the random tests are necessary to determine the quality of the materials.
  - e. The costs of tests and test reports, except for any additional tests requested by the ENGINEER, shall be paid by the CONTRACTOR as part of the WORK. The costs of the additional tests and reports, when reports verify compliance with the Contract Documents, will be paid by the OWNER. When tests or reports do not verify compliance, the cost of every additional test and report shall be paid by the CONTRACTOR.
2. Samples shall be stored in a moist environment until tested, unless directed otherwise by the ENGINEER or the testing laboratory. Testing for mortar shall be in accordance with ASTM C 270 - Mortar for Unit Masonry. Grout shall be tested per ASTM C 1019 - Standard Test Method for Sampling and Testing Grout.
- E. **Unit Strength Testing:** The design compressive strength,  $f'_m$ , shall be based upon the unit strength method. Masonry construction shall not begin until the ENGINEER has reviewed the applicable submittals for strength of masonry and mortar and specified masonry compressive strength has been verified by prism testing. CONTRACTOR shall construct a set of five masonry prisms in accordance with ASTM C1314 modified in accordance with ACI 530.1 from the materials specified. Prisms shall be constructed under observation of the ENGINEER, special inspector, or testing laboratory personnel. The masonry prisms will be tested by the testing laboratory in accordance with the specified standards. Samples will be transported and tests made at the expense of the OWNER.
- F. **Extreme Weather Construction:** Cold weather construction shall be per the more stringent of ACI 530.1, IBC Section 2104.3, and local Code requirements. Hot weather construction shall be per the more stringent of ACI 530.1, IBC Section 2104.4, and local Code requirements.
- 1.5 **DELIVERY, STORAGE, AND HANDLING:**
- A. Cement, lime, and other cementitious materials shall be delivered and stored in dry, weather-tight sheds or enclosures, in unbroken bags, barrels, or other approved containers, plainly marked and labeled with the manufacturers' names and brands. Mortar and grout shall be stored and handled in a manner that prevents the inclusion of foreign materials and damage by water or dampness. Masonry units shall be handled with care to avoid chipping and breakage, and shall be stored as directed in ACI 530.1. Materials stored on newly constructed floors shall be stacked in such manner that the uniformly distributed loading does not exceed 30 psf. Masonry materials shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used.

## **PART 2 -- PRODUCTS**

### **2.1 CONCRETE MASONRY UNITS**

- A. Concrete masonry units shall conform to ASTM C 90 - Load-Bearing Concrete Masonry Units. Units shall be normal weight units unless indicated otherwise.

- B. Concrete masonry units shall be 8 inch by 8-inch by 16-inch modular size, with split faces. Units shall be integrally-colored with color selections from light and medium color range (white, black, and dark green are not included in color range).
- C. Bond beam, corner, lintel, sill, and other specially shaped blocks shall be provided where required or necessary. Specially shaped non-structural blocks may be constructed by saw cutting. Color and texture shall match that of adjacent units.
- D. Concrete masonry units hidden from view entirely may be natural color units the same size as other adjacent masonry units.

## 2.2 MATERIALS

- A. Portland cement shall be Type I or II, low alkali, conforming to ASTM C 150 - Portland Cement.
- B. Hydrated lime shall be Type S conforming to ASTM C 207 - Hydrated Lime for Masonry Purposes.
- C. Aggregate for mortar shall conform to ASTM C 144 - Aggregate for Masonry Mortar. Aggregate for grout shall conform to ASTM C 404 - Aggregates for Masonry Grout.
- D. Water for mixing shall be clear potable water.
- E. Reinforcing steel shall be deformed bars conforming to ASTM A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, Grade 60.
- F. Joint reinforcing shall conform ASTM A 951 - Masonry Joint Reinforcement.
- G. Admixture for mortar shall be **Master Builders PS-235** or **Rheomix-235, Sika Co., Sika Red Label**, or equal. The admixture shall not be detrimental to the bonding or help the process of efflorescence.
- H. Admixture for grout shall be **Sika Co., Sika Grout Aid**, Type II, **Master Builders Pozzolith**, normal, or equal.
- I. Veneer ties shall be per local governing code.

## 2.3 MORTAR

- A. Mortar for concrete block masonry shall conform to ASTM C 270 and IBC section 2103.7 for Cement-Lime, Type S, with a minimum 28 Day compressive strength of 1800 psi.
- B. Mortar for use with colored masonry units shall have integral color as approved by the ENGINEER. Mortar color shall match block color.

## 2.4 GROUT

- A. Grout shall conform to ASTM C 476 - Grout for Masonry and have a minimum 28 Day compressive strength of 2000 psi. Where the grout space is less than 4-inches, coarse aggregate shall be omitted.
- B. Admixtures may only be used when approved by the ENGINEER. When approved for use, admixtures shall be used in accordance with the manufacturer's published recommendations for the grout.

## **PART 3 -- EXECUTION**

### **3.1 GENERAL**

- A. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.
- B. WORK shall be performed in accordance with the provisions of ACI 530 and 530.1, the IBC, and the local codes for reinforced concrete hollow-unit masonry.
- C. The CONTRACTOR shall set or embed anchors, bolts, reglets, sleeves, conduits, and other items as required.
- D. Block cutting shall be by machine.
- E. Masonry units shall be supported off the ground and shall be covered to protect them from rain. Only clean, dry, uncracked units shall be incorporated.
- F. Reinforcing steel shall be cleaned of loose rust and scale, oil, dirt, paint, laitance, or other substances which may be detrimental to or reduce bonding of the steel and concrete.
- G. Immediately before starting WORK, the concrete upon which the masonry will be laid shall be cleaned with water under pressure.
- H. Full mortar joint for first course shall be provided.
- I. Units shall be shoved tightly against adjacent units to assure good mortar bond.
- J. Equipment for mixing and transporting the mortar and grout shall be clean and free from set mortar, dirt, or other foreign matter.

### **3.2 MIXING**

- A. Mortar shall be mixed by placing 1/2 of the water and sand in the operating mixer, after which the cement, lime, and remainder of the sand and water shall be added. After ingredients are in the mixer, they shall be mechanically mixed for not less than 5 minutes. Retempering shall be done on the mortar board by adding water within a basin formed within the mortar, and the mortar reworked into the water. Mortar that is not used within one hour shall be discarded.

### **3.3 ERECTION OF CONCRETE BLOCK MASONRY**

- A. Masonry WORK shall be erected in plane, plumb, level, straight and true to dimensions, and be executed in accordance with acceptable practices of the trade and the tolerances of ACI 530.1.
- B. Unless indicated otherwise, masonry shall be laid up in straight uniform courses with running bond.
- C. Masonry shall be erected to preserve the unobstructed vertical continuity of the cells measuring not less than 3-inches by 3-inches in cross-section. Walls and cross webs shall be full bedded in mortar. Head (or end) joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

### **3.4 JOINTS**

- A. Vertical and horizontal joints shall be uniform and approximately 3/8-inch wide. Exterior joints and interior exposed block joints shall be concave-tooled to a dense surface. Special care shall be used in tooling joints so as to match existing construction. Interior or exterior non-exposed masonry and masonry behind plaster shall have flush joints.

### **3.5 REINFORCEMENT**

- A. Deep cut bond beam blocks shall be used where horizontal reinforcing steel is embedded. H-block bond beams may be used at locations other than openings.
- B. Knock-out openings shall have no steel or joint reinforcing running through the opening. Head, jambs, and sill blocks shall be used to provide an even finish surface to install window when blocks are removed. Joints at heads, jambs, and sills shall be stacked and continuous.
- C. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 112 diameters of the reinforcement.

### **3.6 GROUTING**

- A. All cells and bond beam spaces shall be filled solidly with grout unless indicated otherwise. Grouting shall not be started until the wall has cured for 24 hours. Grout shall not be poured in more than 5-ft lifts.
- B. Grout shall be consolidated at time of pouring by puddling or vibrating. Where the grouting operation has been stopped for one hour or longer, horizontal construction joints shall be formed by stopping the grout pour 1-1/2 inches below the top of the uppermost unit.

### **3.7 PROTECTION**

- A. Wall surfaces shall be protected from droppings of mortar or grout during construction.

### **3.8 FINISHING AND CLEANING**

- A. Masonry shall not be wet-finished unless exposed to extreme hot weather or hot wind and then only by using a nozzle-regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.
- B. Finish masonry shall be cleaned and pointed in a manner satisfactory to the ENGINEER, based upon the standards established by the approved sample panel.

- END OF SECTION -

## SECTION 05500 - MISCELLANEOUS METALWORK (REVISED 09/19/2016)

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide miscellaneous metalwork and appurtenances, complete and in place, in accordance with the Contract Documents.

#### 1.2 CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01010.
- B. **Structural Steel:** The CONTRACTOR shall submit the following:
- 1) **Source Approval/Submittal:** The CONTRACTOR shall submit shop drawings for all structural steel fabrications. Shop Drawings shall conform to AISC recommendations and specifications and shall show all holes, etc. required for other work. Drawings shall include complete details showing all members and their connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams showing the sequence of erection. Mill certificates for all fabrications indicating compliance with all referenced specifications shall be submitted.
  - 2) **Acceptance:** Prior to acceptance of the WORK, the CONTRACTOR shall submit a signed certificate certifying compliance with the requirements of this specification section with each shipment of structural steel to the WORK.
  - 3) **Verification:** If desired, the ENGINEER may conduct inspection of all fabrications as indicated in Part 3 of this specifications section.
- C. **Aluminum Railings:**
- 1) **Source Approval/Submittal:** The CONTRACTOR shall submit shop drawings for all aluminum railings. Drawings shall include complete details showing all members and their connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams showing the sequence of erection. Mill certificates for all fabrications indicating compliance with all referenced specifications shall be submitted.
  - 2) **Acceptance:** Prior to acceptance of the WORK, the CONTRACTOR shall submit a signed certificate certifying compliance with the requirements of this specification section with each shipment of aluminum railing to the WORK.
- D. **Metal Grating:**
- 1) **Source Approval/Submittal:** The CONTRACTOR shall submit shop drawings for all metal grating. Drawings shall include complete details showing all members and their connections, anchor bolts, schedules for fabrication procedures, and diagrams showing the sequence of erection. Layout drawings for grating, showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and

details of grating hold down fasteners shall be submitted. Load and deflection tables shall be submitted for each style and depth of grating used.

- 2) Mill certificates for all fabrications indicating compliance with all referenced specifications shall be submitted.
- 3) **Acceptance:** Prior to acceptance of the WORK, the CONTRACTOR shall submit a signed certificate certifying compliance with the requirements of this specification section with each shipment of grating stair treads to the WORK.

#### E. Bolts and Anchors:

- 1) **Source Approval/Submittal:** The CONTRACTOR shall submit product data for all bolts and anchors. Anchors shall be submitted with an ICBO report listing the ultimate load capacity in tension and shear for each size and type of concrete anchor. CONTRACTOR shall submit manufacturer's recommended installation instructions and procedures for adhesive anchors. Upon review by ENGINEER, these instructions shall be followed specifically.
- 2) **Acceptance:** Prior to acceptance of the WORK, the CONTRACTOR shall submit a signed certificate certifying compliance with the requirements of this specification section with each shipment of bolts and anchors to the WORK.

#### F. Powder Driven Pins:

- 1) **Source Approval/Submittal:** The CONTRACTOR shall submit product data for all powder driven pins. Powder driven pins shall be submitted with an ICBO report listing the ultimate load capacity in tension and shear for each size and type of powder driven pins. CONTRACTOR shall submit manufacturer's recommended installation instructions and procedures for the pins. Upon review by ENGINEER, these instructions shall be followed specifically.
- 2) **Acceptance:** Prior to acceptance of the WORK, the CONTRACTOR shall submit a signed certificate certifying compliance with the requirements of this specification section with each shipment of powder driven pins to the WORK.

#### G. Impact Anchors:

- 1) **Source Approval/Submittal:** The CONTRACTOR shall submit product data for all impact anchors. Anchors shall be submitted with an ICBO report listing the ultimate load capacity in tension and shear for each size and type of impact anchor. CONTRACTOR shall submit manufacturer's recommended installation instructions and procedures for the pins. Upon review by ENGINEER, these instructions shall be followed specifically.
- 2) **Acceptance:** Prior to acceptance of the WORK, the CONTRACTOR shall submit a signed certificate certifying compliance with the requirements of

this specification section with each shipment of impact anchors to the WORK.

### 1.3 REFERENCE STANDARDS

#### A. Aluminum Association

AA Aluminum Association Designation System for Anodized Aluminum Finishes

#### B. American Association of State Highway and Transportation Officials

AASHTO HS-20 Standard Live Loads for Bridges

#### C. American Institute for Steel Construction

AISC LRFD Standard Specification for Structural Steel Buildings

AISC CSP Code of Standard Practice

#### D. American Welding Society (AWS)

AWS D1.1 Structural Welding Code

AWS WH Welding Handbook

#### E. ASTM International (ASTM)

ASTM A36 Standard Specification for Carbon Structural Steel

ASTM A48 Standard Specification for Gray Iron Castings

ASTM A53 Standard Specification for Pipe, Steel, Black and Hot – Dipped, Zinc Coated, Welded and Seamless

ASTM A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting for High – Temperature or High Pressure Service and Other Special Purpose Applications

ASTM A194 Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod

ASTM A325 Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 KSI

ASTM A500 Standard Specification for Cold – Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A992 Standard Specification for Structural Steel Shapes

F. Code of Federal Regulations

29CFR1910                                      General Occupational Industry Health and Safety Standards

G. International Organization for Standardization

ISO 898    Mechanical and Physical Properties for Fasteners

**PART 2 -- PRODUCTS**

**2.1 GENERAL REQUIREMENTS**

- A. **Corrosion Protection:** Unless otherwise indicated, fabricated steel metalwork which will be used in a corrosive environment and/or will be submerged in water/wastewater shall be coated in accordance with Section 09800 - Protective Coating and shall not be galvanized prior to coating. Other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication.
- B. **Stainless Steel:** Unless otherwise indicated, stainless steel metalwork and bolts shall be of Type 316 stainless steel. Where anaerobic conditions are noted, Type 304 stainless steel shall be used.
- C. **Aluminum:** Unless otherwise indicated, aluminum metalwork shall be of Alloy 6061-T6. Aluminum in contact with concrete, masonry, wood, porous materials, or dissimilar metals shall have contact surfaces coated in accordance with Section 09800.
- D. **Cast Iron:** Unless otherwise indicated, iron castings shall conform to the requirements of ASTM A 48, Class 50B or better.

**2.2 STRUCTURAL STEEL**

- A. **Structural Steel:** Structural steel shall comply with the table below:

Wide Flange Shapes	ASTM A 992
Other Shapes, Plates, Bars	ASTM A 36
Pipe, Pipe Columns, Bollards	ASTM A 53, Type E or S, Grade B standard weight unless noted otherwise
HSS	ASTM A 500 Grade B

- B. Bolts for connections shall be ASTM A 325, unless indicated otherwise. Bolts used to connect dissimilar metals shall be ASTM A 193 and A 194, Type 316 stainless steel.
- C. Welded anchor studs shall be headed concrete anchor studs (HAS), or deformed bar anchors (DBA), or threaded studs (TAS), as indicated on the Drawings and as supplied by **Nelson Stud Welding Company**, Lorain, OH; **Omark Industries, KSM Fastening Systems Division**, Seattle, WA, or Portland, OR; or equal.



- D. Structural steel shall be cleaned and coated in accordance with Section 09800 - Protective Coating.
- E. Steel members in contact with aluminum shall be galvanized as specified herein, unless indicated otherwise.
- F. Structural members shall be furnished full length without splices unless otherwise indicated or approved by the ENGINEER.

## 2.3 ALUMINUM RAILINGS

- A. **General:** Aluminum handrails and railings shall be component systems complete with anchors, attachments, balusters, brackets, caps, fasteners, gates (swing with self-latching hardware or be removable), posts, sleeves, trim, and any other related items required or necessary for a complete installation. Gates and removable rail sections shall be complete with hardware such as self-closing hinges, self-latching latches, hasps, etc. Railings shall conform to the International Building Code and OSHA General Industry Occupational Safety and Health Standards (29CFR1910).
- B. **Materials:** Materials shall conform to the following:
  - 1. **Aluminum:** Aluminum shall be U.S. Alloy 6063 T-5 or T-6. Aluminum pipe rail shall not be less than 1-1/2 inch diameter Schedule 40 pipe.
  - 2. **Electrolysis Protection:** Electrolysis protective material shall be in accordance with Section 09800.
  - 3. **Sleeves:** Sleeves shall be of galvanized steel or PVC.
  - 4. **Grout:** Grout for handrail posts shall consist of an inorganic, non-shrink, non-metallic premixed grout in accordance with Section 03315 - Grout with a minimum 28 Day compressive strength of 4,000 psi.
  - 5. **Fasteners:** Fasteners, screws, and bolts shall be concealed and shall be of stainless steel or aluminum.
  - 6. **Welding Rods:** Aluminum welding rods shall be of a type recommended by the aluminum manufacturer for anodized finished products.
  - 7. **Kickplates:** Kickplates shall be provided on railings, not set in curbs.
- C. **Finishes:** Pipe railing system including handrails, railings, tube caps, and other miscellaneous parts of rails shall be provided with a clear anodized finish, AA-M32C22A41.
- D. **Manufacturers or Equal**
  - 1. **C-V Pipe Rail** by **Crane Veyor Corp.**
  - 2. **Connectorail** by **Julius Blum and Co.**
  - 3. **Speed – Rail** by **Hollaender**

## 2.4 METAL GRATING

- A. **General:** Metal grating shall be of the design, sizes, and types indicated. Grating shall be completely banded at edges and cutouts using material and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Grating shall be supported around an opening by support members. Where grating is supported on concrete, embedded support angles matching grating material shall be used, unless indicated otherwise. Such angles shall be mitered and welded at corners.
1. Pieces of grating shall be fastened in 2 locations to each support.
  2. Where grating forms the landing at the top of a stairway, the edge of the grating that forms the top riser shall have an integral non-slip nosing, width equal to that of the stairway.
  3. Where grating depth is not given, grating shall be provided that will be within allowable stress levels and which shall not exceed a deflection of 1/4-inch or the span divided by 180, whichever is less. For standard duty plank and safety grating, the loading to be used for determining stresses and deflections shall be the uniform live load of the adjacent floor or 100 psf, whichever is greater or a concentrated load of 1000 pounds. For heavy duty grating, the loading used for determining stresses and deflections shall be AASHTO HS-20.
- B. **Material**
1. Except where indicated otherwise, bar grating shall be fabricated entirely of aluminum as follows: Bearing and banding bars, alloy 6061-T6; cross bars, alloy 6063-T5.
  2. Safety grating shall be fabricated of aluminum alloy 5052-H32.
  3. Plank grating shall be fabricated of aluminum alloy 6063-T6.
  4. Grating that may be partially or wholly submerged shall be fabricated entirely of stainless steel, Type 316.
- C. **Standard-Duty Grating**
1. No single piece of grating shall weigh more than 80 pounds, unless indicated otherwise. Standard duty grating shall be serrated bar grating.
  2. Cross bars shall be welded or mechanically locked tightly into position so that there is no movement allowed between bearing and cross bars.
- D. **Safety Grating**
1. Safety grating shall be made of sheet metal punched into an open serrated diamond pattern and be formed into plank sections. The open diamond shapes shall be approximately 1-7/8 inch by 11/16-inch in size. Safety grating shall be **Grip Strut** by **Metal Products Division, United States Gypsum Company; Deck Span** by **IKG Industries**, or equal.
- E. **Heavy-Duty Grating:** Heavy-duty grating shall be welded steel, galvanized after fabrication. Cross bars shall be welded in position.

## F. Plank Grating

1. Plank grating shall be extruded in 6-inch widths with a minimum of 6 integral 1-bar type bearing bars per plank. The top surface shall be solid with raised ribs, unless indicated otherwise. Where punched grating is required, the top surface shall be provided with a pattern of 3-inch by 19/32-inch rectangular openings spaced at 4-inches on center. The planks shall have continuous tongue and groove type interlock at each side, except that interlocking planks shall be arranged so that any 4-foot wide section may be removed independently from the other grating sections.
2. Plank grating shall be provided with a clear anodized finish, except that punched grating may have standard mill finish.

## 2.5 BOLTS AND ANCHORS

A. Unless otherwise indicated, stainless steel bolts, anchor bolts, nuts, and washers shall be Type 316 stainless steel, Class 2, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts. Threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.

1. Antiseize lubricant shall be classified as acceptable for potable water use by the NSF.
2. Antiseize lubricant shall be "PURE WHITE" by **Anti-Seize Technology**, Franklin Park, IL, 60131, AS-470 by **Dixon Ticonderoga Company**, Lakehurst, NJ, 08733, or equal.

## B. Bolt Requirements

1. The bolt and nut material shall be free-cutting steel.
2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
3. Bolts and nuts shall be installed with washers fabricated of material matching the base material of bolts, except that hardened washers for high strength bolts shall conform to the requirements of the AISC Specification. Lock washers fabricated of material matching the bolts shall be installed where indicated.
4. The length of each bolt shall be such that the bolt extends at least 1/8-inch beyond the outside face of the nut before tightening, except for anchor bolts, which shall be flush with the face of the nut before tightening.

C. **Adhesive Anchors and Rods:** Unless otherwise indicated, drilled concrete or masonry anchors shall be adhesive anchor and rod systems as specified below.

1. Adhesive anchors and rods shall employ an injectable adhesive. Adhesive shall be furnished in side-by-side refill packets that keep components separate prior to installation. Side – by – side refill packets shall accept static mixing nozzles which thoroughly combines components and allows injection directly into drilled hole. Only

injection tools and static mixing nozzles as recommended by manufacturer shall be used. Manufacturer's recommended instructions shall be followed. Injection adhesive shall be **HILTI – HY 500 MAX – SD** or equal.

2. Anchor rods shall be furnished with chamfered ends so that either end will accept a nut and washer. Alternatively, anchor rods shall be furnished with at 45 degree chisel end on one end to allow for easy insertion into an adhesive – filled hole. Anchor rods shall be manufactured to meet ISO 898 Class 5.8, ASTM A193 Grade B7 (high strength carbon steel anchor). Anchor rods shall be **HILTI HAS Rods** or equal.
- D. **Expanding-Type Anchors:** Expanding-type anchors if indicated or permitted, shall be galvanized steel expansion type **ITW Ramset/Redhead "Trubolt" anchors; McCullock Industries "Kwick-Bolt;"** or equal. Lead caulking anchors will not be permitted. Size shall be as indicated. Embedment depth shall be as the manufacturer recommends for the load to be supported. Expansion type anchors that are to be embedded in grout may be steel. Non-embedded buried or submerged anchors shall be stainless steel.
- E. **Non-Shrink Grouted Anchors:** Anchors, if indicated or permitted, shall be grouted with a non-shrink cementitious grout in accordance with the manufacturer's recommendation. Embedment depth shall be as the manufacturer recommends for the load to be supported. Non-shrink grout material shall be Class B or C in accordance with Section 03315 - Grout.

## **PART 3 -- EXECUTION**

### **3.1 GENERAL**

- A. **Measurements:** The CONTRACTOR shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The CONTRACTOR shall review the Drawings, and any discrepancies shall be reported to the ENGINEER for clarification prior to starting fabrication.

### **3.2 STRUCTURAL STEEL**

- A. **Fabrication:** Structural steel shall be fabricated in accordance with the Drawings, AISC Specifications, and as shown on the Shop Drawings. Materials shall be properly marked and match-marked for field assembly. Where finishing is required, assembly shall be completed including bolting and welding of units, before start of finishing operations.
- B. **Connections:** Shop and field connections shall be bolted or welded as indicated. All connections shall develop full strength of members joined and shall conform to AISC standard connections. Unless otherwise indicated, welds shall conform to AISC LRFD Specification for Structural Steel Buildings.
- C. **Welded Construction:** The CONTRACTOR shall comply with the current AWS D1.1 Code for procedures, appearance, and quality of welds and welders, and methods used in correcting welding work. All welded architectural metal work where exposed to view shall have welds ground smooth. Shielded metal arc welding method or gas metal arc welding methods shall be used for welding structural steel.
- D. **Holes for Other Work:** Holes shall be provided as necessary or as indicated for securing other work to structural steel framing, and for the passage of other work through steel framing members. No torch cut holes will be permitted.

- E. **Shop Paint Primer:** Shop paint primer shall be applied in accordance with Section 09800. Omit shop applied primer at field weld locations, for the portion of a member to be embedded in concrete, and where galvanizing with no further coating is required.
- F. **Delivery, Storage, and Handling:** Structural members shall be loaded in such a manner that they may be transported and unloaded without being excessively stressed, deformed, or otherwise damaged. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The CONTRACTOR shall repair or replace damaged materials or structures as directed.
- G. **Erection:** The CONTRACTOR shall comply with the AISC Specifications and Code of Standard Practice, and with indicated requirements. High-strength bolts shall be installed in accordance with the AISC Specification for Structural Joints using ASTM A 325 Bolts. The connections shall be the friction type, unless indicated otherwise. Anchor bolts and other connectors required for securing structural steel to in-place WORK and templates and other devices for presetting bolts and other anchors to accurate locations shall be furnished by the CONTRACTOR. The CONTRACTOR shall be responsible for designing and installing any temporary bracing required for the safe erection of all structural steel members.
- H. **Field Assembly:** Structural frames shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastening. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed. Individual members of the structure shall be leveled and plumbed within AISC tolerances. Required leveling and plumbing measurements shall be established on the mean operating temperature of the structure.
- I. **Misfits at Bolted Connections:** Where misfits in erection bolting are encountered, the ENGINEER shall be immediately notified. The CONTRACTOR shall submit a method to remedy the misfit for review by the ENGINEER. The ENGINEER will determine whether the remedy is acceptable or if the member must be refabricated. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. Correction of misfits is part of the WORK.
- J. **Gas Cutting:** Gas cutting torches shall not be used in the field for correcting fabrication errors in the structural framing, except when approved by the ENGINEER. Gas-cut sections shall be finished equal to a sheared appearance.
- K. **Touch – Up Painting:** Immediately after erection, field welds, bolted connections, and abraded areas shall be cleaned of the shop paint primer. Touch-up paint primer shall be applied by brush or spray which is the same thickness and material as that used for the shop paint. Galvanized surfaces which have been field welded or damaged shall be repaired in accordance with Section 05500. Finish painting of all structural steel shall be as indicated in Section 09800.

### 3.3 RAILINGS

- A. **Aluminum Railings:** Aluminum railing fabrication and installation shall be performed by craftsmen experienced in the fabrication of architectural metalwork. Exposed surfaces

shall be free from defects or other surface blemishes. Dimensions and conditions shall be verified in the field. Joints, junctions, miters, and butting sections shall be precision fitted with no gaps occurring between sections, and with surfaces flush and aligned. Electrolysis protection of materials shall be provided.

- B. **Steel Railings:** Field welding of steel pipe handrail joints will be permitted only if approved by the ENGINEER, and then only in accordance with its instructions.

### 3.4 WELDING

- A. **Method:** Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
- B. **Quality:** In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as indicated by the AWS Code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

### 3.5 GALVANIZING

- A. Structural steel plates shapes, bars, and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts, and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153.
- B. Field repairs to damaged galvanizing shall be made by preparing the surface and applying a coating.
  - 1. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush off blast cleaning (SSPC SP7), over an area extending at least 4-inches into the undamaged area.
  - 2. Coating shall be applied to at least 3-mils dry film thickness. Use **Zinc-Clad XI** by **Sherwin-Williams**, **Galvax** by **Alvin Products**, or **Galvite** by **ZRC Worldwide**.

### 3.6 DRILLED ANCHORS

- A. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, cleaned and dry. Drilled anchors shall not be installed until the concrete has reached the required 28-day compressive strength. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

- END OF SECTION -

## SECTION 09800 - PROTECTIVE COATINGS (REVISED 10/02/2017)

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide protective coatings, complete and in place, in accordance with the Contract Documents.
- B. Definitions
  - 1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
  - 2. The term "DFT" means minimum dry film thickness, without any negative tolerance.
- C. The following surfaces shall not be protective coated:
  - 1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.
  - 2. Stainless steel
  - 3. Machined surfaces
  - 4. Grease fittings
  - 5. Equipment nameplates
  - 6. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.
  - 7. Galvanized steel, unless specifically noted to be coated on the drawings.
- D. The coating system schedules included herein and/or on the drawings summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.

#### 1.2 REFERENCE STANDARDS

- A. American Water Works Association (AWWA)  
AWWA/ANSI C213 Fusion Bonded Epoxy Coating
- B. ASTM International (ASTM)  
ASTM C309 Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete

ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension

ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

C. Code of Federal Regulations

29CFR1910.1200 Occupational Safety and Health Standards

D. United States Environmental Protection Agency (US EPA)

Method 524.1 Measurement of Volatile Organic Compounds in Water by Purge and Trap Gas Chromatography/Mass Spectrometry

Method 524.2 Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry

E. Federal Specifications

TT-P-28 Paint, Aluminum, Heat Resisting

F. National Association of Corrosion Engineers (NACE)

TM-01-70 Standard Test Method – Visual Standard for Surfaces of New Steel Air – Blast Cleaned with Sand Abrasive

TM-01-75 Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit and Shot

G. National Sanitation Foundation (NSF)

NSF 61 Drinking Water System Components – Health Effects

H. Society for Protective Coatings (SSPC)

SSPC SP1 Surface Preparation – Solvent Cleaning

SSPC SP2 Surface Preparation – Hand Tool Cleaning

SSPC SP3 Surface Preparation – Power Tool Cleaning

SSPC SP5 Surface Preparation – White Metal Blasting

SSPC SP6 Surface Preparation – Commercial Blasting

SSPC SP7 Surface Preparation – Brush Off Blasting

SSPC SP10 Surface Preparation – Near White Blasting

1.3 **CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING**

- A. **General:** Submittals shall be furnished in accordance with Section 01010 unless indicated otherwise below.



- B. **Submittal/Source Approval:** Submittals shall include the following information and be submitted at least 30 days prior to protective coating work:
1. **Coating Materials List:** Submit a coating materials list showing the manufacturer and the coating number, keyed to the coating systems herein.
  2. **Paint Manufacturer's Information:** For each coating system to be used, the following data:
    1. Paint manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.
    2. Technical and performance information that demonstrates compliance with the system performance and material requirements.
    3. Paint manufacturer's instructions and recommendations on surface preparation and application.
    4. Colors available for each product (where applicable).
    5. Compatibility of shop and field applied coatings (where applicable).
    6. Material Safety Data Sheet for each product used.
- C. **Piping and Valve Identification:** Submit product information for piping and valve identification materials.

#### 1.4 **SPECIAL CORRECTION OF DEFECTS REQUIREMENTS**

- A. **Warranty Inspection:** A warranty inspection may be conducted during the eleventh month following completion of all coating and painting work. The CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. All defective work shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the warranty inspection to another date within the one-year correction period, or may cancel the warranty inspection altogether. If a warranty inspection is not held, the CONTRACTOR is not relieved of its responsibilities under the Contract Documents.
- B. **Extended Maintenance of Chemical Tank Lining Systems:** The CONTRACTOR shall promptly repair any defects in the chemical resistant sheet lining system for a period of 2 years after the lining has been placed into service. Such maintenance shall include repair of the chemical tank and any equipment or facilities damaged by the corrosive action of the chemicals.
- C. **Steel Reservoir Coating System Inspection:** The CONTRACTOR shall conduct an inspection during the eleventh month after the date when the reservoir was filled with water and placed into service. The CONTRACTOR shall require a representative of the coating material manufacturer to attend the inspection. All coating defects shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. If a warranty inspection is not held during or before the eleventh month, the CONTRACTOR is not relieved of its warranty responsibilities under the Contract Documents. If the CONTRACTOR fails to conduct an 11 month inspection for reasons not attributed to the OWNER, the CONTRACTOR is not relieved of the warranty

responsibilities under the Contract Documents, and the warranty period shall be extended until the 11 month inspection is conducted and defective work is repaired.

## 1.5 PIPING AND VALVE IDENTIFICATION

- A. The CONTRACTOR shall provide identification for exposed piping and valves, complete and in place, in accordance with the Contract Documents.

## PART 2 -- PRODUCTS

### 2.1 GENERAL

- A. **Suitability:** The CONTRACTOR shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.
- B. **Material Sources:** Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of bid opening, that product will not be accepted, and the CONTRACTOR shall propose a substitution product of equal quality that does comply. Unless indicated otherwise, proposed substitute materials will be considered as indicated above. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.
- C. **Compatibility:** In any coating system only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- D. **Containers:** Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.
- E. **Colors:** All colors and shades of colors of all coats of paint shall be as indicated or selected by the ENGINEER. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the ENGINEER.
- F. Substitute or "Or-Equal" Products
  - 1. To establish equality of products in accordance with the Contract Documents, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:
    - 1. Quality
    - 2. Durability
    - 3. Resistance to abrasion and physical damage
    - 4. Life expectancy

5. Ability to recoat in future
  6. Solids content by volume
  7. Dry film thickness per coat
  8. Compatibility with other coatings
  9. Suitability for the intended service
  10. Resistance to chemical attack
  11. Temperature limitations in service and during application
  12. Type and quality of recommended undercoats and topcoats
  13. Ease of application
  14. Ease of repairing damaged areas
  15. Stability of colors
2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the CONTRACTOR shall provide the ENGINEER with the names of not less than 10 successful applications of the proposed manufacturer's products that comply with these requirements.
  3. If a proposed substitution requires changes in the WORK, the CONTRACTOR shall bear all such costs involved as part of the WORK.

## 2.2 INDUSTRIAL COATING SYSTEMS

- A. **System 3 - Aluminum Silicone Resin:** Aluminum silicone resin material shall be suitable for a service temperature of up to 1,000 degrees F, and shall comply with Federal Specification TT-P-28 - Paint, Aluminum, Heat Resisting (1200 degrees F).
  1. Option 1:
    1. Prime coat (DFT = 0.7-1.0 mils), **Sherwin Williams N43S150 Aluminum** or equal.
    2. Finish coat (DFT = 0.7-1.0 mils), **Sherwin Williams N43S150 Aluminum** or equal
    3. Total system DFT = 1.4-2.0 mils.
  2. Option 2:
    1. Prime coat (DFT = 3-4 mils), **Carboline Thermaline** or Equal
- B. **System 4 - Aliphatic Polyurethane:** Two component aliphatic acrylic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, resistance to chemical fumes and severe weathering

and with a minimum solids content of 58 percent by volume. Primer shall be a rust inhibitive two component epoxy coating with a minimum solids content of 68 percent by volume.

1. Prime coat DFT = 4 mils, **Ameron 385, Carboline 890, Tnemec 69, Sherwin – Williams Macropoxy 646 FC Epoxy B58-600 Series**, or equal.
2. Finish coat (one or more, DFT = 3 mils), **Ameron Amershield, Carbothane 134 HG, Tnemec 1074U, Sherwin – Williams Acroline 218 HS Polyurethane B65-600 Series**, or equal.
3. Total system DFT = 7 mils.
4. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture.

C. **System 5 - Inorganic Zinc/Polyurethane:** The inorganic zinc primer shall be a water or solvent based, self-curing, zinc silicate two-component inorganic coating which contains at least 85 percent of metallic zinc by weight in the dried film, and is recommended by the coating manufacturer as a primer for this system. The intermediate coat shall be a high-build two component epoxy with a solids content of at least 69 percent by volume. Finish coats shall be a 2-component aliphatic acrylic or polyester polyurethane coating material that provides superior color and gloss retention, resistance to chemical fumes and severe weathering, and a minimum solids content of 58 percent by volume.

1. Prime coat DFT = 3 mils, **Tnemec 90-98, Carboline Carbozinc 11, Sherwin Williams Zinc Clad II ES**, or equal.
2. Intermediate coat DFT = 4 mils, **Tnemec N69, Carboline Carboguard 890, Sherwin Williams Macropoxy 646 FC**, or equal.
3. Finish coats (one or more, DFT = 3 mils), **Tnemec 1074U, Carboline Carbothane 134HG, Sherwin Williams Acrolon 218 HS** or equal.
4. Total system DFT = 10 mils.
5. Intermediate coat shall be applied in excess of 4 mils DFT or in more than one coat as necessary to completely cover the inorganic zinc primer and prevent application bubbling of the polyurethane finish coat.
6. More than one finish coat shall be applied as necessary to produce a finish with uniform color and texture. If the inorganic zinc primer is used as a pre-construction or shop applied primer, all damaged and uncoated areas shall be spot abrasive blasted and coated after construction using the indicated material.

D. **System 6 - Inorganic Zinc, Silicone Topcoat:** Self curing, zinc silicate coating material shall be a two component inorganic coating material that contains at least 85 percent of metallic zinc by weight in the dried film. System shall be suitable for a service temperature of up to 500 degrees F.

1. Option 1
  1. Prime coat (DFT = 2.0-3.0 mils), **Sherwin Williams Zinc Clad II ES** or equal.

2. Finish coat (DFT = 2.0-2.5 mils), **Sherwin Williams Heat Flex HiTemp 500** or equal
  3. Total system DFT = 4-5 mils.
2. Option 2
1. Prime coat (DFT = 3 mils), **Carboline Carbozinc 11**, or equal
- E. **System 12 - Aliphatic Polyurethane, Fiber Glass:** Two-component aliphatic polyurethane coating material shall provide superior color and gloss retention, resistance to splash from acid and alkaline chemicals, and resistance to chemical fumes and severe weathering. A primer, tie coat, or mist coat shall be used as recommended by the manufacturer.
1. Prime coat (Tie coat), **Ameron 385, Tnemec 66, Carboline Carboguard 890, Sherwin – Williams Macropoxy 646 FC Epoxy B58-600 Series**, or equal.
  2. Finish coats (2 or more, DFT = 3 mils), **Ameron Amershield, Tnemec 1074U, Carboline Carbothane 134 HG, Sherwin – Williams Acrolon 218 HS Polyurethane B65-600 Series**, or equal.

### 2.3 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

- A. **Material Sources:** The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated above.
- B. **System 100 - Amine Cured Epoxy:** High build, amine cured, epoxy resin shall have a solids content of at least 80 percent by volume, and shall be suitable for long-term immersion service in potable water and municipal wastewater. For potable water service, the coating material shall be listed by the NSF International as in compliance with NSF Standard 61 - Drinking Water System Components - Health Effects.
1. Prime coat and finish coats (3 or more, DFT = 16 mils), **Ameron 395, Tnemec 104 for Water or Tnemec N140 for all other, Carboline Carboguard 891 HS, Sherwin – Williams Macropoxy 5500**, or equal.

### 2.4 SPECIAL COATING SYSTEMS

- A. **System 200 - PVC Tape:** Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils.
- B. **System 207 – Coal Tar Epoxy:** Two coat coal tar epoxy with minimum solids content of 72% by volume. Total DFT = 16.0 mils. **Carboline Bitumastic 300, Tnemec Series 46H-413, Sherwin Williams HiMil Sher Tar**, or equal.
- C. **System 208 - Aluminum Metal Isolation:** Two coats of a high build polyamide epoxy paint such as **Tnemec 66, PPG Amercoat 385, Carboguard 890, Sherwin Williams Macropoxy 646 FC**, or equal (8 mils). Total thickness of system DFT = 8.0 mils.

## **PART 3 -- EXECUTION**

### **3.1 MANUFACTURER'S SERVICES**

- A. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems attributable or associated with the manufacturer's products.

### **3.2 WORKMANSHIP**

- A. Skilled craftsmen and experienced supervision shall be used on all WORK.
- B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough cleaning and an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given to insure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.
- C. All damage to surfaces resulting from the WORK shall be cleaned, repaired, and refinished to original condition.

### **3.3 STORAGE, MIXING, AND THINNING OF MATERIALS**

- A. **Manufacturer's Recommendations:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.
- B. All protective coating materials shall be used within the manufacturer's recommended shelf life.
- C. **Storage and Mixing:** Coating materials shall be stored under the conditions recommended by the Material Safety Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

### **3.4 PREPARATION FOR COATING**

- A. **General:** All surfaces to receive protective coatings shall be cleaned as indicated prior to application of coatings. The CONTRACTOR shall examine all surfaces to be coated, and shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application. Surfaces to be coated shall be dry and free of visible dust.
- B. **Protection of Surfaces Not to be Coated:** Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

- C. All hardware, lighting fixtures, switchplates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.
- D. Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.
- E. **Protection of Painted Surfaces:** Cleaning and coating shall be coordinated so that dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.

### 3.5 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:
  - 1. Solvent Cleaning (SSPC SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
  - 2. Hand Tool Cleaning (SSPC SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
  - 3. Power Tool Cleaning (SSPC SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
  - 4. White Metal Blast Cleaning (SSPC SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
  - 5. Commercial Blast Cleaning (SSPC SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
  - 6. Brush-Off Blast Cleaning (SSPC SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
  - 7. Near-White Blast Cleaning (SSPC SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

### 3.6 METAL SURFACE PREPARATION (UNGALVANIZED)

- A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these specifications and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.
- B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this Section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers, NACE Standard TM-01-70 - Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive and TM-01-75 - Visual Standard for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit.
- C. All oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPC SP1 - Solvent Cleaning prior to blast cleaning.
- D. All sharp edges shall be rounded or chamfered and all burrs, and surface defects and weld splatter shall be ground smooth prior to blast cleaning.
- E. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. Abrasives for submerged and severe service coating systems shall be clean, hard, sharp cutting crushed slag. Automated blasting systems shall not be used for surfaces that will be in submerged service. Metal shot or grit shall not be used for surfaces that will be in submerged service, even if subsequent abrasive blasting is planned to be one with hard, sharp cutting crushed slag.
- F. The abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.
- G. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.
- H. Compressed air for air blast cleaning shall be supplied at adequate pressure from well maintained compressors equipped with oil and moisture separators that remove at least 95 percent of the contaminants.
- I. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.
- J. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.
- K. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.
- L. If the required abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP2 or SSPC SP3 be used.



- M. Shop applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP1 before the abrasive blast cleaning work has been started.
- N. Shop primed equipment shall be solvent cleaned in the field before finish coats are applied.

### 3.7 **SURFACE PREPARATION FOR GALVANIZED FERROUS METAL**

- A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used, followed by brush off blast cleaning per SSPC SP7.
- B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

### 3.8 **SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL RESERVOIR INTERIORS**

- A. **General:** All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.
- B. **Abrasive Blast Cleaning:** The CONTRACTOR shall provide the degree of cleaning indicated in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC SP6. Areas of tightly adhering coatings shall be cleaned to SSPC SP7, with the remaining thickness of existing coating not to exceed 3 mils.
- C. **Incompatible Coatings:** If coatings to be applied are not compatible with existing coatings the CONTRACTOR shall apply intermediate coatings per the paint manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.
- D. **Unknown Coatings:** Coatings of unknown composition shall be completely removed prior to application of new coatings.
- E. **Water Abrasive or Wet Abrasive Blast Cleaning:** Where indicated or where Site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged and severe service coating systems unless indicated.

### 3.9 **PLASTIC, FIBER GLASS AND NONFERROUS METALS SURFACE PREPARATION**

- A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.
- B. Non-ferrous metal surfaces shall be solvent-cleaned to remove all soluble surface contaminants followed by brush-off blast cleaning to remove insoluble contaminants and to achieve a uniformly profiled surface.
- C. All surfaces shall be clean and dry prior to coating application.

### 3.10 **SHOP COATING REQUIREMENTS**

- A. Unless otherwise indicated, all items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field after installation with the indicated or selected color. The methods, materials, application equipment and all other details of shop painting shall comply with this section. If the shop primer requires topcoating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.
- B. All items of equipment, or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.
- C. The interior surfaces of steel water reservoirs, except for Part A surfaces, shall have all surface preparation and coating work performed in the field.
- D. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.
- E. For certain small pieces of equipment the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- F. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being topcoated, or less time if recommended by the coating manufacturer.
- G. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

- H. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.

### 3.11 APPLICATION OF COATINGS

- A. The application of protective coatings to steel substrates shall be in accordance with SSPC PA1 - Paint Application Specification No. 1.
- B. Cleaned surfaces and all coats shall be inspected prior to each succeeding coat. The CONTRACTOR shall schedule such inspection with the ENGINEER in advance.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe painting for these areas.
- F. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- G. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.
- H. Coatings shall not be applied under the following conditions:
  - 1. Temperature exceeding the manufacturer's recommended maximum and minimum allowable.
  - 2. Dust or smoke laden atmosphere.
  - 3. Damp or humid weather.
  - 4. When the substrate or air temperature is less than 5 degrees F above dewpoint.
  - 5. When air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dewpoint within 8 hours after application of coating.
  - 6. When wind conditions are not calm.
- I. Dewpoint shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychrometric tables.
- J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.
- K. The finish coat on all work shall be applied after all concrete, masonry, and equipment installation is complete and the work areas are clean and dust free.

### 3.12 CURING OF COATINGS

- A. The CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.
- B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.
- C. **Forced Air Ventilation of Steel Reservoirs and Enclosed Hydraulic Structures:** Forced air ventilation is required for the application and curing of coatings on the interior surfaces of steel reservoirs and enclosed hydraulic structures. During application and curing periods, continuously exhaust air from a manhole in the lowest shell ring, or in the case of an enclosed hydraulic structure, from the lowest level of the structure using portable ducting. After all interior coating operations have been completed, provide a final curing period for a minimum of 10 days, during which the forced ventilation system shall operate continuously. For additional requirements, refer to the specific coating system requirements in Part 2 above.

### 3.13 SHOP AND FIELD INSPECTION AND TESTING

- A. General: The CONTRACTOR shall give the ENGINEER a minimum of 3 days advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.
- B. All such work shall be performed only in the presence of the ENGINEER, unless the ENGINEER has granted prior approval to perform such work in its absence.
- C. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the WORK, shall not relieve the CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.
- D. Scaffolding shall be erected and moved to locations where requested by the ENGINEER to facilitate inspection. Additional illumination shall be furnished to cover all areas to be inspected.
- E. **Inspection Devices:** The CONTRACTOR shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gauges shall be made available for the ENGINEER'S use at all times while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the ENGINEER.
- F. **Holiday Testing:** The CONTRACTOR shall holiday test all coated ferrous surfaces inside a steel reservoir, other surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures and surfaces coated with any of the submerged and severe service coating systems. Areas that contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.
  - 1. Coatings With Thickness Exceeding 20 Mills: For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as **Tinker &**

**Razor Model AP-W, D.E. Stearns Co. Model 14/20**, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.

2. Coatings With Thickness of 20 Mills or Less: For surfaces having a total dry film coating thickness of 20 mils or less: **Tinker & Razor Model M1 non-destructive type holiday detector, K-D Bird Dog**, or equal shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as **Kodak Photo-Flo**, or equal, shall be added to the water prior to wetting the detector sponge.

G. **Film Thickness Testing:** On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as **Mikrotest model FM, Elcometer model 111/1EZ**, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

H. **Surface Preparation:** Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standards TM-01-70 and TM-01-75.

### 3.14 COATING SYSTEM SCHEDULES - FERROUS METALS

A. Coating System Schedule, Ferrous Metal - Not Galvanized:

	Item	Surface Prep.	System No.
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Near white metal blast cleaning SSPC SP10	(5) inorganic zinc/polyurethane
FM-3	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in water	White metal blast cleaning SSPC SP5	(100) amine-cured epoxy
FM-4	Surfaces exposed to high temperature (between 251 and 500 degrees F).	Near white metal blast cleaning SSPC SP10	(6) inorganic zinc, silicone resin
FM-5	Surfaces exposed to high temperature (between 501 and 1000 degrees F).	Near white metal blast cleaning SSPC SP10	(3) aluminum silicone resin
FM-6	Buried small steel pipe and conduit.	Removal of dirt, grease, oil	(200) PVC tape

FM-14	Structural steel, miscellaneous	Near white metal blast cleaning SSPC SP10	Galvanized per Section 05500.
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	metalwork, and supports for prefabricated metal buildings.		
FM-18	Buried pipe couplings, valves, and flanged joints (where piping is ductile or cast iron, not tape-coated), including factory-coated surfaces.	As specified by reference specification	(205) polyethylene encasement
FM-19	Structural steel plate dividing walls in drainage pump station sump	White metal blast cleaning SSPC SP5	(207) Coal Tar Epoxy

### 3.15 COATING SYSTEM SCHEDULE, NON-FERROUS METAL, PLASTIC, FIBER GLASS

- A. Where isolated non-ferrous parts are associated with equipment or piping, the CONTRACTOR shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames or hatches. Only primers recommended by the coating manufacturer shall be used.

	Item	Surface Prep.	System No.
NFM-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC SP1	(4) aliphatic polyurethane
NFM-3	Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC SP1	(208) aluminum metal isolation
NFM-4	Polyvinyl chloride plastic piping, indoors and outdoors, or in structures, not submerged.	Solvent cleaned SSPC SP1	(7) acrylic latex
NFM-5	Fiber glass surfaces.	See plastic, fiber glass and nonferrous metals surface preparation as specified herein	(12) aliphatic polyurethane fiber glass
NFM-6	Buried non-ferrous metal pipe.	Removal of dirt, grease, oil	(200) PVC tape

- END OF SECTION -

## SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

### PART 1 -- GENERAL

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide equipment and appurtenant WORK, complete and operable, in accordance with the Contract Documents.
- B. The provisions of this Section shall apply to all equipment except where otherwise indicated.
- C. **Equipment Arrangement:** Unless specifically indicated otherwise, the arrangement of equipment shown on the Drawings is based upon information available at the time of design and is not intended to show exact dimensions particular to a specific manufacturer in all cases. Some aspects of the Drawings are diagrammatic and some features of the illustrated equipment arrangement may require revision to meet the actual equipment requirements. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the installation of equipment.

#### 1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:
  - 1. American Society for Testing and Materials (ASTM).
  - 2. American National Standards Institute (ANSI).
  - 3. American Society of Mechanical Engineers (ASME).
  - 4. American Water Works Association (AWWA).
  - 5. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).
  - 6. American Welding Society (AWS).
  - 7. National Fire Protection Association (NFPA).
  - 8. Federal Specifications (FS).
  - 9. National Electrical Manufacturers Association (NEMA).
  - 10. Manufacturer's published recommendations and specifications.
  - 11. General Industry Safety Orders (OSHA).
- B. The following standards are referenced in this Section:

ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ASME B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys
ASME B46.1	Surface Texture
ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
ASME B1.20.1	General Purpose Pipe Threads (Inch)
ASME B31.1	Power Piping
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
AWWA D100	Welded Steel Tanks for Water Storage
ASTM A 48	Gray Iron Castings
ASTM A 108	Steel Bars, Carbon, Cold-Finished, Standard Quality

### 1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01010.
- B. **Shop Drawings:** Furnish complete drawings and technical information for equipment, piping, valves, and controls. Where indicated or required by the ENGINEER, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements proposed by the CONTRACTOR.
- C. **Spare Parts List:** The CONTRACTOR shall obtain from the manufacturer and submit at the same time as Shop Drawings a list of suggested spare parts for each piece of equipment. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.
- D. Torsion and Vibration Analyses
  - 1. The CONTRACTOR shall arrange for and submit torsional and lateral vibration analyses for the following equipment types:
    - a. Engine drives except engine generators.
    - b. Pumps, blowers, and compressors with constant speed drives of 500 horsepower and greater.
    - c. Pumps, blowers and compressors with variable speed drives of 100 horsepower and greater.
    - d. Vertical pumps with universal joints and extended shafts.



- e. Other equipment as indicated.
  - 2. An experienced specialist from the equipment manufacturer shall perform a complete torsional and lateral vibration analysis of each distinct equipment, motor, and variable speed drive. These analyses shall identify the dry and wet lateral critical speeds plus the torsional critical speeds of the system. Appropriate lateral and critical speed maps shall be produced and submitted.
  - 3. No active critical speed shall be allowed within 25 percent of the operating speed range. No fabrication of the equipment shall be started until the analyses have been approved by the ENGINEER.
- E. Certifications that equipment and equipment supports comply with seismic and wind design criteria from Code.

#### 1.4 QUALITY ASSURANCE

- A. **Costs:** Responsibility shall be the CONTRACTOR's for performing and paying the costs of inspection, startup, testing, adjustment, and instruction services performed by factory representatives. The OWNER will pay for costs of power and water. If available, the OWNER's operating personnel will provide assistance in the field testing.
- B. **Inspection:** The CONTRACTOR shall inform the local authorities, such as building and plumbing inspectors, fire marshal, OSHA inspectors, and others, to witness required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, and related items to obtain required permits and certificates, and shall pay inspection fees.
- C. **Quality and Tolerances:** Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.
- 1. Machine work shall be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30-feet or less in length, and not greater than 1/8-inch for members over 30-feet in length.
  - 2. Castings shall be homogeneous and free from non-metallic inclusions and defects. Surfaces of castings which are not machined shall be cleaned to remove foundry irregularities. Casting defects not exceeding 12.5 percent of the total thickness and where defects will not affect the strength and serviceability of the casting may be repaired by approved welding procedures. The ENGINEER shall be notified of larger defects. No repair welding of such defects shall be carried out without the ENGINEER'S written approval. If the removal of metal for repair reduces the stress resisting cross-section of the casting by more than 25 percent or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then the casting may be rejected. Costs of casting new material shall be the CONTRACTOR'S responsibility as part of the WORK.
  - 3. Materials shall meet the physical and mechanical properties in accordance with the reference standards.
- D. **Machine Finish:** The type of finish shall be the most suitable for the application and shall be shown in micro-inches in accordance with ANSI B46.1. The following finishes shall be used:

1. Surface roughness not greater than 63 micro-inches shall be required for surfaces in sliding contact.
2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.
3. Rough finish not greater than 500 micro-inches shall be required for other machined surfaces.
4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.

## **PART 2 -- PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- A. Noise Level:** When in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 105 dBA for one hour exposure per day.
- B. High Noise Level Location:** The CONTRACTOR shall provide one personal hearing protection station at each high noise level location. Locations are defined as follows:
  1. **Outdoor Location:** Any single equipment item or any group of equipment items that produce noise exceeding OSHA noise level requirements for a 2 hour exposure. Where such equipment is separated by a distance of more than 20-feet, measured between edges of footings, each group of equipment shall be provided with a separate hearing protection station.
  2. **Indoor Location**
    - a. Any single equipment item or any group of equipment items located within a single room not normally occupied, that produces noise exceeding OSHA noise level requirements for a 2 hour exposure.
    - b. Any single equipment item or any group of equipment items located within a single room normally occupied by workers, that produces noise exceeding OSHA noise level requirements for an 8 hour exposure.
- C. Personal Hearing Protection:** The CONTRACTOR shall furnish 3 pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, provided at an approved location near the noise producing equipment.
- D. Drive Trains and Service Factors:** Service factors shall be applied in the selection or design of mechanical power transmission components. All components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque, speed, and horsepower. All of the applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears and gear drives, drive chains,

sprockets, and V-belt drives. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification
Blowers centrifugal or vane lobe	1.0 1.25	Uniform Moderate Shock
Pumps centrifugal or rotary reciprocating progressing cavity	1.0 1.8 1.0	Uniform Moderate Shock Uniform
Mixers constant density variable density rapid mixer flocculator sludge mixer surface aerator	1.0 1.25 1.25 1.25 2.5 2.5	Uniform Moderate Shock Moderate Shock Moderate Shock Moderate Shock Heavy Shock
Grit Handling Equipment	1.25	Moderate Shock
Mechanical Bar Screens	1.0	Uniform
Cranes or Hoists	1.25	Moderate Shock

**E. Mechanical Service Factors**

	Mechanical Service Factors	
	Electric Motor	Internal Combustion Engine
Uniform	1.25	1.50
Moderate Shock	1.50	1.75
Heavy Shock	2.00	2.25

**F.** For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.

**G.** For service factors of electric motors, see the electrical specifications.

**H.** Where load classifications are not indicated, service factors shall be for standard load classifications and for flexible couplings.

**I. Welding:** Unless otherwise indicated, welding shall conform to the following:

1. Latest revision of AWWA D100.
  2. Latest revision of AWWA C206.
  3. Composite fabricated steel assemblies that are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent entrance of air or moisture.
  4. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.
  5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.
- J. Protective Coating:** Equipment shall be painted or coated in accordance with Section 09800 - Protective Coating, unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.
- K. Protection of Equipment:** Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided, to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall be energized and shafts shall be rotated. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned, and recoated to restore it to original condition.
- L. Identification of Equipment Items**
1. At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.
  1. After installation, each item of equipment shall be given permanent identification. Identification shall consist of stainless steel plate, 1/16-inch thick, at least 4-inches by 6 inches, lettering embossed into the plate, at least 1-inch tall.
- M. Vibration Isolators:** Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

- N. **Shop Fabrication:** Shop fabrication shall be performed in accordance with the Contract Documents and the Shop Drawings.
- O. **Controls:** Equipment and system controls shall be in accordance with Division 17 - Instrumentation.

## 2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

- A. **Equipment Supports:** Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of: that noted in the general structural notes or as required by the governing building code, or 10 percent of gravity. Submitted design calculations for equipment supports shall bear the signature and seal of an engineer registered in the State wherein the project is to be built, unless otherwise indicated. Calculations shall account for forces and distribution of forces on supporting structures resulting from normal operation, normal operation plus seismic loadings, and normal operation plus wind loadings.
  - 1. Wall-mounted equipment weighing more than 250 pounds or which is within 18-inches above the floor shall be provided with fabricated steel supports. Pedestals shall be of welded steel. If the supported equipment is a panel or cabinet or is enclosed with removable sides, the pedestal shall match the supported equipment in appearance and dimensions.
  - 2. Seismic requirements: Freestanding and wall-hung equipment shall be anchored in place by methods that satisfy the building code. Calculations shall be performed and signed and stamped for equipment weighing more than 400 pounds. Calculations shall analyze lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. Calculations shall include the distribution of forces imposed on the supporting structure and anchors, verifying that each anchor can develop the required resistance forces.
  - 3. Wind requirements: Exterior freestanding equipment shall be anchored in place by methods that satisfy the building code. Calculations shall be performed and signed and stamped, analyzing lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. Calculations shall include the distribution of forces imposed on the supporting structure and anchors, verifying that each anchor can develop the required resistance forces.
- B. **Anchors:** Anchor bolts shall be in accordance with Section 05500 - Miscellaneous Metalwork. CONTRACTOR shall determine the size, type, capacity, location, and other placement requirements of anchorage elements. Anchoring methods and leveling criteria in the manufacturer's literature shall be followed. Submit methods and criteria with the Shop Drawings.
- C. **Equipment Foundations:** Mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 3.5-inch high concrete bases, unless otherwise indicated. Equipment foundations are indicated on Drawings. The CONTRACTOR through the equipment manufacturer shall verify the size and weight of equipment foundation to insure compatibility with equipment.

## 2.3 COUPLINGS

- A. Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Horizontal and end suction pumps	Gear or flexible spring
Vertical turbine pumps	3 piece spacer for solid shaft or double nut for hollow shaft
Vertical nonclog pumps, close coupled	Flexible disc pack
Vertical nonclog pumps with extended shaft	Flexible disc pack or Universal joint with carbon fiber composite shaft and steady bearing support(s)
Belt conveyors	Gear coupling for fractional to 7.5 horsepower, Silicone filled fluid coupling for 10 hp and larger
Single stage centrifugal blowers	Flexible disc pack

- B. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.
- C. **Differential Settlement:** Where differential settlement between the driver and the driven equipment may occur, 2 sets of universal type couplings shall be provided.
- D. **Taper-Lock** or equal bushings may be used to provide for easy installation and removal of shafts of various diameters.

## 2.4 SHAFTING

- A. **General:** Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.
- B. **Design Criteria:** All shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications, in accordance with ASME B106.1M - Design of Transmission Shafting. Where shafts are subjected to fatigue stresses, such as frequent start and stop cycles, the mean stress shall be determined by using the modified Goodman Diagram. The maximum torsional stress shall not exceed the endurance limit of the shaft after application of the factor of safety of 2 in the

endurance limit and the stress concentration factor of the fillets in the shaft and keyway. Stress concentration factor shall be in accordance with ASME Standard B17.1 - Keys and Keyseats.

- C. Materials:** Shafting materials shall be appropriate for the type of service and torque transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.
1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.
  2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.
  3. Other grades of carbon steel alloys shall be suitable for service and load.
  4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.
- D. Differential Settlement:** Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with 2 sets of universal type couplings shall be provided.

## **2.5 GEARS AND GEAR DRIVES**

- A.** Unless otherwise indicated, gears shall be of the spur, helical, or spiral-bevel type, designed and manufactured in accordance with AGMA Standards, with a service factor suitable for load class, mechanical service and thermal rating adjustment, a minimum L-10 bearing life of 60,000 hours, and a minimum efficiency of 94 percent. Peak torque, starting torque, and shaft overhung load shall be checked when selecting the gear reducer. Worm gears shall not be used unless specifically approved by the ENGINEER.
- B.** Gear speed reducers or increasers shall be of the enclosed type, oil- or grease-lubricated and fully sealed, with a breather to allow air to escape but keep dust and dirt out. The casing shall be of cast iron or heavy-duty steel construction with lifting lugs and an inspection cover for each gear train. An oil level sight glass and an oil flow indicator shall be provided, located for easy reading.
- C.** Gears and gear drives that are part of an equipment assembly shall be shipped fully assembled for field installation.
- D.** Material selections shall be left to the discretion of the manufacturer, provided the above AGMA values are met. Input and output shafts shall be adequately designed for the service and load requirements. Gears shall be computer-matched for minimum tolerance variation. The output shaft shall have 2 positive seals to prevent oil leakage.
- E.** Oil level and drain locations shall be easily accessible. Oil coolers or heat exchangers with all required appurtenances shall be provided when necessary.
- F.** Where gear drive input or output shafts from one manufacturer connect to couplings or sprockets from a different manufacturer, the CONTRACTOR shall have the gear drive manufacturer furnish a matching key taped to the shaft for shipment.

## 2.6 DRIVE CHAINS

- A. Power drive chains shall be commercial type roller chains meeting ASME Standards.
- B. A chain take-up or tightener shall be provided in every chain drive arrangement to provide easy adjustment.
- C. A minimum of one connecting or coupler link shall be provided in each length of roller chain.
- D. Chain and attachments shall be of the manufacturer's best standard material and be suitable for the process fluid.

## 2.7 SPROCKETS

- A. **General:** Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.
- B. **Materials:** Unless otherwise indicated, materials shall be as follows:
  - 1. Sprockets with 25 teeth or less, normally used as a driver, shall be made of medium carbon steel in the 0.40 to 0.45 percent carbon range.
  - 2. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be made of minimum 0.20 percent carbon steel.
  - 3. Large diameter sprockets with Type C hub shall be made of cast iron conforming to ASTM A 48, Class 30.
- C. Sprockets shall be accurately machined to ASME Standards. Sprockets shall have deep hardness penetration in tooth sections.
- D. Finish bored sprockets shall be furnished complete with keyseat and set screws.
- E. To facilitate installation and disassembly, sprockets shall be of the split type or shall be furnished with **Taper-Lock** bushings as required.
- F. Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving with stainless steel tubing and grease fitting extended to an accessible location. Steel collars with set screws may be provided in both sides of the hub.

## 2.8 V-BELT DRIVES

- A. V-belts and sheaves shall be of the best commercial grade and shall conform to ASME, MPTA, and RMA Standards.
- B. Unless otherwise indicated, sheaves shall be machined from the finest quality gray cast iron.
- C. Sheaves shall be statically balanced. In some applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 fpm may be required to be of special materials and construction.



- D. To facilitate installation and disassembly, sheaves shall be provided complete with **Taper-Lock** or **QD** bushings as required.
- E. Finish bored sheaves shall be complete with keyseat and set screws.
- F. Sliding motor bases shall be provided to adjust the tension of V-belts.

**2.9 DRIVE GUARDS**

- A. Power transmission trains, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform with the OSHA Safety and Health Standards (29CFR1910). The guards shall be constructed of minimum 10 gauge expanded, flattened steel with smooth edges and corners, galvanized after fabrication, and securely fastened. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

**2.10 BEARINGS**

- A. **General:** Bearings shall conform to the standards of the American Bearing Manufacturers Association, Inc. (ABMA).
- B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.
- C. Re-lubricatable type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.
- D. Lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.
- E. **Anti-Friction Type Bearing Life:** Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of 5 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of Service	Design Life, years	L-10 Design Life, hours
	(whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

- F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.
- G. **Sleeve Type Bearings:** Sleeve-type bearings shall have a cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings

shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer.

- H. **Plate Thrust Bearings:** Thrust bearings shall be the **Kingsbury** Type, designed and manufactured to maintain the shaft in the fixed axial position without undue heating or the necessity of adjustment or attention. Bearings shall be oil lubricated to suit the manufacturer's standard method of lubrication for the specific bearing. If bearing cooling is required, manufacturer shall provide necessary piping, filters, and valves.

## 2.11 PIPING CONNECTIONS

- A. **Pipe Hangers, Supports, and Guides:** Pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with Section 15006 - Pipe Supports.
- B. **Flanges and Pipe Threads:** Flanges on equipment and appurtenances shall conform to ASME B16.1, Class 125, or B16.5, Class 150, unless otherwise indicated. Pipe threads shall be in accordance with ASME B1.20.1 and Section 15000 - Piping, General.
- C. **Flexible Connectors:** Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with the requirements of Section 15000. Flexible connectors shall be harnessed or otherwise anchored to prevent separation of the pipe where required by the installation.
- D. **Insulating Connections:** Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the Section 15000.

## 2.12 GASKETS AND PACKINGS

- A. Gaskets shall be in accordance with Section 15000.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be **Garlock No. 432, John Crane "Everseal,"** or equal.
- C. Packing around rotating shafts (other than valve stems) shall be "O"-rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the ENGINEER, in accordance with Section 11100 - Pumps, General.

## 2.13 NAMEPLATES

- A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

## 2.14 TOOLS AND SPARE PARTS

- A. **Tools:** The CONTRACTOR shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by **Snap On, Crescent, Stanley**, or equal. The set of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.
- B. Spare parts shall be furnished as indicated in the individual equipment sections. All spare parts shall be suitably packaged in a metal box and labeled with equipment numbers by means of stainless steel or solid plastic nametags attached to the box.

## 2.15 EQUIPMENT LUBRICANTS

- A. The CONTRACTOR shall install lubricants for all equipment during storage and prior to initial testing of the equipment. After successful initial testing, final testing, and satisfactory completion startup testing as specified in Section 01660 - Equipment Testing and Plant Startup, the CONTRACTOR shall conduct one complete lubricant change on all equipment. In addition, the CONTRACTOR shall be responsible for the proper disposal of all used lubricants. The OWNER will then be responsible for subsequent lubricant changes

## PART 3 -- EXECUTION

### 3.1 SERVICES OF MANUFACTURER

- A. **Inspection, Startup, and Field Adjustment:** Where required by individual sections, an authorized, experienced, and competent service representative of the manufacturer shall visit the Site for the number of days indicated in those sections to witness or perform the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.
  - 1. Installation of equipment
  - 2. Inspection, checking, and adjusting the equipment and approving its installation
  - 3. Startup and field testing for proper operation, efficiency, and capacity
  - 4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements
- B. **Instruction of the Owner's Personnel**
  - 1. Where required by the individual equipment sections, an authorized training representative of the manufacturer shall visit the Site for the number of days indicated in those sections to instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
  - 2. The representative shall have at least 2 years experience in training. A resume of the representative shall be submitted.

3. Training shall be scheduled 3 weeks in advance of the scheduled session.
  4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Review comments from the ENGINEER shall be incorporated into the material.
  5. The training materials shall remain with the trainees after the session.
  6. The OWNER may videotape the training for later use by the OWNER's personnel.
- C. **Vibration Monitoring:** For the equipment types listed in paragraph 1.3D, the CONTRACTOR shall arrange for at least two Site visits by the manufacturer's specialist during testing of the equipment covered by torsional and vibration analysis submittals to measure the amount of vibration and prepare written recommendations for keeping the vibration within acceptance limits. If vibration readings exceed the specified or the applicable referenced standard vibration limits for the type of equipment, the CONTRACTOR shall make necessary corrections for the equipment to meet the acceptance criteria.

### 3.2 INSTALLATION

- A. **General:** Equipment shall be installed in accordance with the manufacturers written recommendations.
- B. **Alignment:** Equipment shall be field tested to verify proper alignment.

### 3.3 PACKAGED EQUIPMENT

- A. When any system is furnished as pre-packaged equipment, the CONTRACTOR shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with subcontractors to avoid later change orders.
- B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the CONTRACTOR shall coordinate such features with the ENGINEER and provide all material and labor necessary for a complete installation as required by the manufacturer.

### 3.4 FIELD ASSEMBLY

- A. Studs, cap screws, bolt and nuts used in field assembly shall be coated with "**Never Seize**" compound or equal.

### 3.5 WELDING

- A. Welds shall be cleaned of weld-slag, splatter, etc. to provide a smooth surface.

### 3.6 FIELD TESTS

- A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or no overheating of bearings or motor.
- B. The following field testing shall be conducted:

1. Start equipment, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable Standards.
  2. Obtain concurrent readings of motor voltage, amperage, capacity, vibration and bearing temperatures.
  3. Operate equipment indicated in the Special Provisions.
- C. The ENGINEER shall witness field-testing. The CONTRACTOR shall notify the ENGINEER of the test schedule three days in advance.
- D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and resettled until it satisfies the requirement.

- END OF SECTION -

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## SECTION 11312 – DEWATERING SUMP SYSTEM

### PART 1 -- PRODUCTS

#### 1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide a sump dewatering system, inclusive of pump, vault, control panel, and appurtenances, complete and operable, in accordance with the Contract Documents.
- B. The pump shall operate manually only, by an on – off switch controlled at the location of the control panel which is to be field - determined by the ENGINEER during construction.
- C. Figure 11312-A is part of this specification section.

#### 1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01010.
- B. **Pump Shop Drawings:** Shop Drawings shall contain the following information:
  - 1. Pump name, identification number, and specification section number.
  - 2. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions. Performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be furnished for each centrifugal pump equipped with a variable speed drive.
  - 3. The CONTRACTOR shall require the manufacturer to indicate the limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.
  - 4. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.
  - 5. Data for the electric motor proposed for each pump.
  - 6. Wiring diagram of field connections with identification of terminations between local control panels, junction terminal boxes, and equipment items.
  - 7. Complete electrical schematic diagram.
- C. **Pump Technical Manual:** The Technical Manual shall contain the required information for each pump.
- D. **Pump Spare Parts List:** A spare parts list shall contain the required information for each pump.

- E. **Pump Factory Test Data:** Signed, dated, and certified factory test data for each pump system which requires factory testing, submitted before shipment of equipment.
- F. **Pump Certifications**
  - 1. Manufacturer's certification of proper installation.
  - 2. CONTRACTOR'S certification of satisfactory field testing.
- G. **Precast Sump Shop Drawings:**
  - 1. Show dimensions, locations, lifting inserts, reinforcement, and joints
  - 2. Structural design calculations for vaults, signed by a licensed engineer registered in the State of Louisiana.
- H. **Manufacturer's Certification for Vaults:** Written certification that the vault complies with the requirements of this Section.
- I. **Control Panel Shop Drawings:**
  - 1. Show dimensions, location, electrical schematic and all other information as deemed necessary by the ENGINEER to ensure compliance with the requirements of the Contract Documents.

**PART 2 -- GENERAL**

**2.1 GENERAL DESCRIPTION**

A. Identification

Equipment number	01-E2
Quantity	1
Location	Dewatering Sump

- B. **Operating Conditions:** The WORK of this Section shall be suitable for long term operation under the following conditions:

Duty	Constant
Drive	Constant Speed
Ambient environment	Submerged
Ambient temperature, degrees F	40 F – 120 F
Fluid service	Screened Stormwater



Fluid temperature, degrees F	40F to 104F
Maximum size spheres to pass, in. dia	3
Sump classification in accordance with National Electrical Code	Unclassified
Pump removal method	Rails
Power supply	240-volt 3-phase 60 Hz

- C. **Performance Requirements:** Pump shall comply with the performance requirements detailed within the drawings.
- D. **Pump Dimensions:** Pumps and accessories shall fit within the precast sump as shown on the figure. Any modifications required to fit the wet well shall be at the expense of the CONTRACTOR.

## 2.2 PUMP REQUIREMENTS

### A. General

1. Each pump shall be capable of continuous operation at full load with a water level of 36-inches above the invert of the wet pit, without cavitation or overheating of the motor.
2. Each pump, with its cable and appurtenances, shall be able to withstand continuous submergence to a minimum depth of 65 feet, whether running or off, without leakage.
3. Each pump shall be able to operate for short periods at zero static suction head without causing any damage to any part of the unit.

- B. **Pump Construction:** Construction of submersible non-clog pumps shall conform to the following requirements:

Connections	Machined metal-to-metal quick disconnect type, for withdrawal of unit from above without disconnecting pipe. When lowered into place, the pump shall automatically connect and lock into the discharge pipe, allowing for zero leakage at all anticipated pump heads.
Pump Design	Single stage, centrifugal type, close-coupled to sealed or submersible electric motor, for operation in dry or wet pit, without external cooling.

Impeller	Maximum 3-port non-clog type with replaceable wear rings on impeller and in casing, to handle raw unscreened sewage, solids, and fibrous materials.
Bearings	Permanently-lubricated, heavy-duty axial and radial ball or roller bearings top and bottom, with a minimum L-10 life of 50,000 hours, at continuous, maximum load and speed, supported by detailed calculations, to be submitted with the Shop Drawings.
Seals	Dual mechanical tandem, one stationary and one revolving shaft seals with individual springs, tungsten carbide or silicon carbide ring, each not requiring any maintenance, and capable of withstanding 1.5 times pump shutoff head. The seals shall be oil lubricated, with moisture detector probes, alarm, and test circuits.
Oil Chamber	To supply oil for lubrication and cooling of the shaft seals.
Support	Cast duckfoot bend or discharge elbow with machined face, anchored to sump floor.
Cables	Include necessary cables for power connection, moisture detection, and overload protection, sheathed, coded, and suitable for submersible pumps, and of sufficient length for direct connection to the terminal boxes indicated. Cables shall be connected to the pumps and tested at the factory.
Lifting Devices	Type 316 stainless steel guide rails with brackets and stainless steel lifting system of sufficient operating length, or with a stainless steel guide cable system with hooks and tension device, all rated at least 5 times the weight of the pump and motor. Provide positive connection of the rails to the existing pump deck, inclusive of stainless steel spacer or standoff as required for proper alignment to pass the pump through the existing pump deck

C. Materials

Pump, volute, oil casing, sliding bracket, motor frame	cast iron
Impeller	cast iron, statically and dynamically balanced
Pump shaft	Type 420 stainless steel, or 1045 carbon steel with Type 420 stainless steel sleeve
Exposed bolts, nuts, washers	Type 316 stainless steel
Mechanical seals	Independently operating tandem tungsten-carbide or silicon carbide and carbon rings with stainless steel springs
Wear rings	Type 304 or 416 stainless steel and nitrile rubber with steel insert, with a Brinnell hardness of 300 on impeller and 350 on case

D. Pump Manufacturer, or Equal

1. Hydromatic, Model S6L500

2.3 PUMP MOTOR

- A. **Approval:** The pumping system, including the motor and wiring, shall be approved by a nationally approved testing agency. The system shall be rated Class I, Division 1, Group C and D service as determined by the National Electric Code and approved by a nationally recognized testing agency (UL or FM) at the time of opening Bids. The CONTRACTOR shall include in the Bid a copy of the certificate of approval.
- B. **Insulation:** The pump motors shall be designed for continuous duty in hazardous locations. The stator and stator leads shall be moisture-resistant, triple varnished and insulated according to Class F, capable of withstanding a temperature rise of up to 155 degrees C. The allowable temperature rise of the motor at full load condition shall not exceed 80 degrees C.
- C. **Stator:** The motor stator shall be mounted in an oil-filled, watertight casing and shall not be fixed in place by externally-mounted screws which may cause leakage in the motor.
- D. **Motor Rating:** Motors shall have service factors of 1.10 or greater. For motors driven by variable frequency drives, motor horsepower shall be the greater of:
  1. Non-overloading conditions throughout the pump curve.
  2. 1.15 times the horsepower required by the pump at maximum indicated flow.
- E. **Junction Box:** The motor shall have a junction box capable of being sealed completely from the stator casing to prevent leakage through the junction box into the stator housing should a motor cable be damaged or have some other means to prevent leakage into the junction box under any condition.

- F. **Cable Entry:** The cable entry water seal design shall be such that it precludes specific torque requirements to ensure a watertight and submersible seal. It shall permit no entry of water into any high voltage area even if the cable is severed below the water level.
- G. **Cooling System:** Each pump shall be provided with an adequately designed cooling system using a wastewater jacket and thermal radiator integrally cast with the stator casing. Cooling medium channels and ports shall be non-clogging by virtue of their dimensions. Wastewater jackets are not required for motors that are designed to operate continuously at full load with ambient cooling.
- H. **Motor Protection:** Integral thermal sensors in the motors, one for each phase, shall be provided to monitor stator temperatures. These sensors shall be used in conjunction with and supplemented by external motor over-current protection located at the control panel.

## 2.4 PUMP CONTROL PANEL

- A. The CONTRACTOR shall furnish and install control panels with controls as specified in these specifications, and as shown on the drawings. All panels listed below shall be supplied by the manufacturer/vendor of the system to which it is connected and which it controls. Unless more stringent requirements are required in other sections or articles of these specifications, all control panels shall be manufactured by an Underwriters Laboratory (UL) Certified 508A and 698A panel manufacturer. Provide UL Certification number with submittals.
- B. The control panel shall contain at a minimum the following equipment:
  - 1. NEMA 4x stainless steel enclosure - Hoffman or equal with 3 point or ¼ turn latches and inner swing outdoor (s). No equipment shall be mounted on the outer door.
  - 2. Main distribution block as required;
  - 3. Thermo-magnetic circuit breakers for each motor;
  - 4. On/Off switch for pump;
  - 5. Pump high temp trip circuit with automatic reset
  - 6. Adjustable seal fail relays for seal leak indication only.
  - 7. Seal leak indicator light
  - 8. Pump run indicator light
  - 9. Elapsed time meters
- C. Panels shall enclose and be wired for all motor branch components, circuit breakers, switches, pilot lights, relays, and other AC and DC control components as required to perform functions as described in this and other sections of the specifications. Terminal strips shall be provided for connection of all external wiring. Terminal strips shall be heavy-duty types with barriers between points. Nameplates shall have white letters on black laminated phenolic plastic background glued to enclosure.

- D. Control Equipment: Control equipment shall be 22 or 30mm Square D, Allen Bradley, Cutler Hammer, ABB or equal as follows:
  - 1. Push Buttons – Flush Button, Momentary Contact
  - 2. Selector Switches – Standard Operator, Maintained Contact
  - 3. Pilot Lights – Light Emitting Diode (LED)

## 2.5 PUMP SUMP

- A. The dewatering pump shall be installed within a pre – cast concrete sump as specified herein and indicated on the drawings.
- B. The CONTRACTOR shall provide precast vaults designed for the indicated applications and of the sizes indicated on the drawings.
- C. The minimum structural member thickness for vaults shall be 5-inches. Cement shall be Type I/II Portland cement as specified in ASTM C 150. The minimum 28-day concrete compressive strength shall be 5,000 psi. All reinforcing steel shall be embedded in the concrete with a minimum clear cover as recommended by ACI 318.
- D. Design Loading: Loads on vaults in all areas shall be calculated from:

$$L = 150H$$

Where: L = loading in psf

H = depth of fill in feet

- E. Where joints are designed in pre-cast concrete vaults, such joints shall be interlocking to secure proper alignment between members and prevent migration of soil through the joint. Structural sections at joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint.
- F. Where openings for access to the vault are required, the full clear space opening indicated shall be provided, without obstructions from brackets or supports. For large openings where brackets or supports are designed to protrude into the opening for support of required covers, such brackets or supports shall be designed to be easily removed and replaced with a minimum of effort and without cutting or welding.

## 2.6 SPARE PARTS

- A. **General:** The pumps shall be backed by supplies of spare parts from stock, and after-sales service from a factory trained and authorized maintenance facility, located within 500 miles from the Site.

## 2.7 CABLE HOLDERS

- A. The CONTRACTOR shall provide and install stainless steel cable holders and hooks fabricated from Type 316 Stainless Steel plate. Sharp corners shall be ground smooth to prevent abrasion and cutting of electrical cable insulation. The cable holder shall be of sufficient length and strength to provide support for each separate cable, except that the

pump power and lift cables may use the same hook position, provided the cables do not foul one another and the lift cable is easily accessed from the hatch opening.

## **PART 3 -- EXECUTION**

### **3.1 SERVICES OF MANUFACTURER**

- A. **Inspection, Startup, and Field Adjustment:** An authorized service representative of the manufacturer shall visit the Site to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.
1. Installation of the equipment
  2. Inspection, checking, and adjusting the equipment
  3. Startup and field testing for proper operation
  4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements

### **3.2 FACTORY TESTING AND SHIPMENT**

- A. The following procedures shall be included with the factory test prior to shipment:
1. Verification of the pump characteristic curves by testing at 1/4, 1/2, 3/4, and full flow and recording the measured head and motor current for each flow.
  2. Verification of cavitation-free service and absence of motor overheating during conditions simulating the actual operating conditions after installation, whether submerged, semi-submerged, or dry.
  3. Pump seals shall be designed for complete water tightness at 65-foot submergence for 30 minutes and data on factory testing and quality control shall be submitted with the Shop Drawings.
  4. Parts shall be properly lubricated and protected so that no damage or deterioration will occur even during a prolonged delay from the time of shipment until installation is completed and the pumps are ready for operation.
  5. Finished ferrous surfaces not painted shall be properly protected to prevent rust and corrosion.
  6. The finished surfaces of exposed flanges shall be protected by strong wooden blind flanges.
  7. Each pump shall be properly crated to protect against damage during shipment.

### **3.3 INSTALLATION**

- A. **General:** Pumping equipment shall be installed in accordance with the manufacturer's written recommendations.

- B. **Alignment:** Equipment shall be field tested to verify proper alignment and freedom from binding, scraping, shaft runout, or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.
- C. **Lubricants:** The CONTRACTOR shall provide the necessary oil and grease for initial operation.
- D. The CONTRACTOR shall ensure that anchor bolts are set only after the discharge piping has been properly installed, to ensure exact fit with embedded piping components.
- E. Precast concrete sections shall be transported and handled with care in accordance with the manufacturer's written recommendations. Where lifting devices are provided in pre-cast sections, such lifting devices shall be used as intended. Where no lifting devices are provided, the CONTRACTOR shall follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.
- F. Buried pre-cast concrete vaults shall be assembled and placed in excavations on properly compacted soil foundations as indicated. Pre-cast concrete vaults shall be set to grade and oriented to provide the required dimensions and clearances from pipes and other structures.
- G. Prior to backfilling, all cracks and voids in pre-cast concrete vaults shall be filled with non-shrink grout or polyurethane sealant, or both. Around pipe and conduit penetrations, openings shall be sealed with polyurethane sealant. With the authorization of the ENGINEER, grout or a closed-cell flexible insulation may be used as filler material prior to placing a final bed of polyurethane sealant.

### 3.4 **PROTECTIVE COATING**

- A. Materials and equipment shall be coated as required in Section 09800 - Protective Coating for the service indicated or shall be given a factory – applied finish suitable for the fluid service.

### 3.5 **FIELD TESTS**

- A. Each pump system shall be field tested after installation to demonstrate:
  - 1. Satisfactory operation without excessive noise and vibration.
  - 2. No material loss caused by cavitation.
  - 3. No overheating of bearings.
  - 4. Indicated head, flow, and efficiency at design point.
- B. Field testing will be witnessed by the ENGINEER. The CONTRACTOR shall furnish 3 Days advance notice of field testing.
- C. In the event any pumping system fails to meet the indicated requirements, the pump shall be modified or replaced and re-tested as above until it satisfies the requirements.

- D. After each pumping system has satisfied the requirements, the CONTRACTOR shall certify in writing that it has been satisfactorily tested and that final adjustments have been made. Certification shall include the date of the field tests, a listing of persons present during the tests, and the test data.
- E. The CONTRACTOR shall be responsible for costs of field tests, including related services of the manufacturer's representative, except for power and water, which the OWNER will bear. If available, the OWNER's operating personnel will provide assistance in field testing.

### 3.6 SERVICES OF MANUFACTURER

- A. **Inspection, Startup, and Field Adjustment:** The service representative of the manufacturer shall be present at the Site for 2 Days, to furnish the services required by Section 11100.
- B. **Instruction of OWNER'S Personnel:** The training representative of the manufacturer shall be present at the Site for 2 Days to furnish the services required by Section 11100.
- C. For the purposes of this paragraph, a Day is defined as an 8 hour period at the Site, excluding travel time.
- D. The ENGINEER may require that the inspection, startup, and field adjustment services above be furnished in 3 separate trips.

- END OF SECTION -



**SECTION 16100 – GENERAL SPECIFICATIONS FOR ELECTRICAL INSTALLATION  
(REVISED 05/03/2018)**

**PART 1 -- GENERAL**

**1.1 THE REQUIREMENT**

- A. The CONTRACTOR shall furnish all work, labor, tools, superintendence, material, equipment and operations necessary to provide for complete and workable electrical systems as defined by the contract documents.
- B. The CONTRACTOR shall be responsible for inspecting the project site and checking the existing conditions and ascertaining the conditions to be met for installing the work and adjusting his bid accordingly.
- C. All electrical equipment shall be listed by and shall bear the label Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.
- D. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 FR 1926, as applicable), state building standards, and applicable local codes and regulations.
- E. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

**1.2 REFERENCE STANDARDS**

- A. ASTM International (ASTM)
  - ASTM B209                      Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate
- B. Code of Federal Regulations
  - 29 CFR 1910                      Occupational Safety and Health Standards
  - 29 CFR 1926                      Safety and Health Regulations for Construction
- C. National Fire Prevention Association (NFPA)
  - NFPA 70                              National Electric Code (NEC)
- D. Underwriter's Laboratory (UL)
  - UL                                      Underwriter's Laboratory (Various Listings as Applicable)

**1.3 CONTRACTOR SUBMITTALS, SAMPLING, AND TESTING**

- A. The CONTRACTOR shall furnish submittals in accordance with Section 01010.
- B. **Submittal/Shop Drawing:** The CONTRACTOR shall submit detailed product data for all electrical materials and equipment to be supplied. Submittals shall include sufficient data for the ENGINEER to completely evaluate the proposed products and materials for

compliance with the specifications. The CONTRACTOR shall supply additional information as required by the ENGINEER upon request.

- C. **Submittal/Shop Drawing:** The CONTRACTOR shall submit copies of all electrical permits, releases, and certificates of inspection as provided by authorities having jurisdiction.

#### 1.4 QUALITY ASSURANCE

- A. **Permits, Codes, and Regulation:** The CONTRACTOR shall secure all permits, licenses, and inspection as required by all authorities having jurisdiction. The CONTRACTOR shall give all notices and comply with all laws, ordinances, rules, regulations and contract requirements bearing on the work. The minimum requirements of the electrical systems installations shall conform to the latest edition of the National Electrical Code as well as state and local codes. Codes and ordinances having jurisdiction and specified codes shall serve as minimum requirements; but, if the Contract Documents indicate requirements which are in excess of those minimum requirements, then the requirements of the Contract Documents shall be followed.
- B. **Scheduling of Electrical Work:** The CONTRACTOR shall schedule the electrical work such that a minimum amount of down time is required during the placing of the electrical system in operation.
- C. **Classified Areas:** Work in classified areas shall comply with NEC Chapter 5.
- D. **Working Space:** The CONTRACTOR shall provide a minimum working space of 4' in front of all electrical equipment that requires periodic operation or inspection
- E. **Electrical Demolition:** The CONTRACTOR shall disconnect and remove all existing electrical and instrumentation located in buildings or areas to be renovated. Verify that the equipment is not being used and not going to be used. All removed equipment shall be turned over to the OWNER for selection of items that he wishes to keep in stores. All other items shall be properly disposed of by the equipment that is not to remain in service at the completion of this project and which is CONTRACTOR.
- F. **Coordination with Factory Servicemen:** The CONTRACTOR shall coordinate his work with the factory serviceman of the various vendors and shall provide whatever assistance is necessary to place the entire system in operation.
- G. **Coordination with the Serving Utility:** All work on the service entrance from weather head or pad mounted transformer to utilization equipment shall be per local power company requirements. Where there is conflict with plans and specifications with the power company requirements, the power company requirements shall govern. The CONTRACTOR shall notify the ENGINEER in advance of making a change for the ENGINEER's approval. In some instances, larger wire and conduit sizes may be required. The CONTRACTOR shall anticipate this requirement and include it in the bid price. The CONTRACTOR shall coordinate all work with the local power company including scheduling and applying for service, furnishing, and/or installing all metering equipment and installing all service entrance weather heads at elevation as required by power company and NEC. The CONTRACTOR shall seal all conduits entering panels with duct seal where it is possible that water or moisture can enter the electrical equipment. Utilize weather heads for all overhead service wire entering conduit. Where service conduit is installed by power company, the CONTRACTOR shall furnish a properly sized weather head to the power company to prevent water from entering any panel in which it terminates.

- H. **Electrical Technicians:** The CONTRACTOR shall employ and pay for qualified electrical technicians as necessary to insure proper installation, connection, testing, and placing into proper service electrical equipment. The CONTRACTOR shall utilize experienced personnel only. Coordinate all work with other vendor's technicians and service personnel.
- I. **Grounding:** The CONTRACTOR shall furnish and install a complete grounding system to provide a safe operating environment. Additional wires for grounding may be required in certain conduit runs. Install as required per NEC. Additional ground rods may also be required to obtain the minimum ground resistance required by NEC. Furnish and install as required to meet the requirements of NEC.
- J. **Guarantee:** All workmanship and equipment shall be guaranteed against defects in material and workmanship for a period of time as specified in other sections of these specifications, except equipment specifically indicated in these specifications as having an extended warranty period, to the effect that any defective equipment shall be repaired or replaced without cost or obligation to the OWNER.

#### 1.5 DELIVERY, STORAGE, AND HANDLING:

- A. The CONTRACTOR shall fully protect all materials and equipment against damage from any cause. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry. The CONTRACTOR shall replace or refinish all damaged materials or equipment, including face plates of panels and switchboard sections, at no additional expense to the OWNER.

### PART 2 -- PRODUCTS

#### 2.1 GENERAL

- A. All equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. All equipment and materials shall be the products of experienced and reputable manufacturer's in the industry. Similar items in the WORK shall be products of the same manufacturer. All equipment and materials shall be of industrial grade standard of construction.
- B. Where a NEMA enclosure type is indicated in a non-hazardous location, the CONTRACTOR shall utilize that type of enclosure, despite the fact that certain modifications such as cutouts for control devices may negate NEMA rating.
- C. On all devices indicate to display dates, the year shall be displayed as 4 digits.

#### 2.2 WIRE AND CABLE

- A. Wire and Cable shall be as follows:
  - 1. **Single Conductor:** All single conductor wire for power and control 480 volts and below shall be stranded copper 600 volts U.L. type THW or THWN. Wire for 120 volt general lighting may be solid copper 600-volt type THW or THWN..
  - 2. **Multi-Conductor:** Control cable shall be stranded copper 600 volt U.L. type TC 75 Degrees C wet, 90 degrees C dry and shall consist of individual color coded

conductors insulated with 15 mils PVC insulation and 4 mils clean nylon jacket, moisture resistant fillers, lapped core tape and overall PVC jacket.

3. **Instrument Cable:** Instrument cable for 4-20 ma service unless specified otherwise herein or on drawings shall be single twisted pair stranded copper 90 degree C 600 volt U.L. with 21 mils PVC insulation and nylon jacket, aluminum polyester shield tape and 45 mils overall jacket. Size shall be #16 AWG unless shown otherwise or on drawings.

### 2.3 CONNECTORS

- A. Mechanical Connectors shall be copper alloy bolted pressure type with bronze hardware. Such connectors unless otherwise indicated shall be Square D, OZ/Gedney, T&B, or equal. Type and manufacturer shall be as indicated below:

TYPE	MANUFACTURER
Single Conductor to Flat Plate Connector	Square D Type LU, OZ Type XLH, or Equal
Multiple Conductor to Flat Plate Connector	Square D LU Series T&B Type 32000DB or Equal
One – Bolt Parallel Connector	Square D Type CPT, T&B Type TP or Equal
Split Bolt Parallel Connector	Square D Type CPS, T&B Type TP or Equal
Two Bolt Parallel Connector	Square D Type K.R., OZ Type 5TS or equal
Splice Connector	Square D Type SS, OZ Type XW, or Equal
Cross Connector	Square D Type XP, OZ Type T, or Equal
Ground Rod Connector	Square D Type CG, OZ Type ABG, or equal
Flush Floor Connector	Square D Type GCJ, OZ Type VG, or equal

- B. Insulated spring wire connectors shall be plated spring steel with thermoplastic jacket. Connectors shall be rated at 150 degrees C continuous.
- C. Insulated set screw connectors shall consist of copper body with flame retardant, 600 V class insulated shell that threads over set screw body.
- D. Terminal connectors for flat head terminal screws shall be locking spade type with vinyl insulated compression indent tubular wire shaft.
- E. Terminal strip connectors shall be channel-mounted type with tin plated solderless box lugs contained within nylon insulated separable carriers.

- F. Furnish terminal strips complete with channels, channel mounting hardware, and closures, and fittments.

## 2.4 INSULATING PRODUCTS

- A. General purpose electrical tape shall be 7 mil thick stretchable vinyl plastic with pressure adhesive backing, 3M "Scotch #33, Plymouth "Slipknot Grey", or equal.
- B. Insulating void filling tape shall be stretchable ethylene propylene rubber with high tack and fast fusing surfaces. Tape shall be rated for 90 degrees C continuous, 130 degrees C overload and it shall be moisture proof. Void filling tape shall be 3M "Scotch #23," Plymouth "Plysafe", or equal.
- C. Arc – proof tape shall be flame retardant, self-extinguishing compound. Tape shall be resistant to ultraviolet, water, salt water, raw sewage and acids. Arc proof tape shall be "3M" Scotch #7700, Plymouth "Plyarc", or equal.
- D. Insulation putty filler tape shall be elastic, moisture proof rubber compound suitable for bedding and rounding out irregular surfaces.
- E. Conduit insulation putty shall be waterproof, stretchable, non-hardening compound suitable for duct seal.

## 2.5 CONDUIT

- A. The CONTRACTOR shall furnish and install all conduit as shown and sized on the drawings and as required. All conduit on this project shall be of the following types:
  - 1. Above – Ground Conduit: Schedule 40 Rigid Aluminum
  - 2. Underground Conduit in Non – Hazardous Areas: Schedule 40 PVC buried 2'-0". The CONTRACTOR shall install electrical warning tape 12" above conduit.
  - 3. Underground Conduit in Hazardous Areas and from Pump Station Wet Wells to Control Panel: Schedule 40 rigid galvanized steel, PVC coated inside and out. The CONTRACTOR shall utilize PVC coated inside and out EYS seal – off fittings. The CONTRACTOR shall install electrical warning tape 12" above conduit. As as conduit it terminated between the wet well and the control panel, temporally seal conduit with suitable compound, conduit caps or plugs to prevent gasses and moisture from entering the panel from the wet well. Gases and moisture will destroy the control panel. CONTRACTOR will be responsible for any damage to the panel caused by gasses or moisture entering the panel.

## 2.6 CONDUIT FITTINGS

- A. Conduit fittings shall be compatible with the conduit system used. Outdoor enclosures shall be weatherproof. Insulating bushings shall be non-combustible high impact thermosetting phenolic with 150 degrees C temperature rating and shall not support combustion.

## 2.7 CONDUIT BODIES AND BOXES

- A. Conduit bodies and boxes for pulling and installation of outlets shall be compatible with the conduit system and shall be as follows:

CONDUIT BODIES AND BOXES		
Item	Galvanized Rigid Steel System	Rigid Aluminum System
Outlet Bodies	Threaded Zinc Coated Malleable Iron w/ Gasketed Cast Metal, Crouse – Hinds Form 7 or Equal	Threaded Copper Free Aluminum w/ Gasketed Sheet Aluminum Covers, Crouse – Hinds Form 9 or Equal
Outlet Boxes	Threaded Zinc Coated Malleable Iron w/ Gasketed Cast Metal, Crouse Hinds FD, FS, and DS or Equal. Outdoor or Wet Locations to Have Covers	Threaded Copper Free Aluminum w/ Gasketed Cast Aluminum Outdoor Covers, Crouse – Hinds FD, FS and DS or Equal

## 2.8 SUPPORT DEVICES

- A. Single opening slotted channel supports shall be 2" deep x 1 5/8" wide. Double opening slotted channel supports shall be 4" deep x 1 5/8" wide. All slotted channel members shall be manufactured of ASTM 6063 T 6 aluminum. Furnish nuts, clamps, and hardware that shall be compatible with the slotted channel members.
- B. Conduit clamps for use with slotted channel members shall consist of locking aluminum straps with aluminum hardware. All such straps and hardware shall be manufactured of hardened aluminum alloy with less than 0.5% copper content.
- C. After-set concrete inserts shall be expansion shield type with stainless steel hardware, 500 pounds minimum pull out resistance.
- D. Beam clamps shall be hot dipped galvanized malleable iron. Furnish right angle, edge, or parallel types as required.
- E. Nest – back supports shall consist of one hole pipe clamp with conduit wall spacer clamp back, all manufactured of hot dipped galvanized malleable iron.
- F. One hole pipe clamps shall be manufactured of hot dipped galvanized malleable iron.
- G. Surface mounted swivel joints shall be double closed "U" brackets of plated malleable iron with attachment openings top and bottom.
- H. Adjustable screw mounted swinging hangers shall be manufactured of plated steel. Mounting bracket shall have four screw holes.
- I. All thread rod shall be stainless steel, 3/8" diameter (min. size).

## 2.9 CONNECTING LUGS

- A. In many instances, due to the long distances between equipment and voltage drop limitation, larger wire sizes may be required that would normally be expected for some

items of equipment. The CONTRACTOR and equipment vendor shall identify these requirements and provide proper lugs to match the wire sizes.

## 2.10 IDENTIFICATION AND TAGGING

- A. Individual phases and routing of each power and control circuit shall be identified by appropriate identifying permanent tags, at points near each end of the cables. Yellow plastic tags 2 1/2" x 3 1/2" available from Tags Unlimited., New Orleans, LA or equal shall be used for cable I.D. A Sanford Sharpie or equal fine point marker shall be used for writing.
- B. All equipment and electrical devices shall be identified. The CONTRACTOR and manufacturer shall be responsible for properly identifying and tagging equipment as to safe operation under adverse conditions by personnel normally associated with the proposed facility. Additional signs as the ENGINEER may require for safety shall be furnished and installed by the CONTRACTOR at no additional cost to the OWNER.
- C. Voltage warning labels where shown or required by N.E.C or local codes shall be waterproof vinyl with permanent red letters "DANGER 480V (or 240V)", or with other voltage designations. Letters shall be at least 2" high.

## 2.11 WIRING DEVICES

- A. All wiring devices shall be specification grade and shall meet NEMA WD1 1971 requirements. Furnish types of wiring devices as follows:
  - 1. 2P/3W grounding, 20A/125V, NEMA 6 20R; Single receptacle: Hubbell #5361, Arrow Hart #5361, or equal.
  - 2. GFCI receptacle shall be Square D "GFSR 115 B" with NEMA 5 15R style receptacle or "GFSR 120 B" with NEMA 6 20R style receptacle. GFCI receptacle shall be in duplex configuration; that is, top half shall contain test and reset button and bottom half shall contain protected receptacle.
  - 3. Single pole, single throw 20A tumbler switch: Hubbell #1223, Arrow Hart #1992, or equal.
  - 4. Single pole, double throw (three way) 20A tumbler switch: Hubbell #1224, Arrow Hart #1993, or equal.
  - 5. Double pole, double throw (four way) 20A tumbler switch: Hubbell #1224, Arrow Hart #1994, or equal.
  - 6. Double pole, single throw 20A, tumbler switch: Hubbell #1222, Arrow Hart #1992 or equal.
  - 7. Single pole, single throw, momentary center off 20A tumbler switch: Hubbell #1556, Arrow Hart #1995, or equal.
  - 8. Manual motor starters shall be furnished complete with overloads and shall be Square D Type KO Z, Westinghouse MS TO1, or equal.
  - 9. Furnish other types of wiring devices as may be indicated and specified on the drawings.

## 2.12 LIGHTING

- A. The CONTRACTOR shall furnish, install, and aim lighting fixtures as specified herein and as indicated on the luminaire schedule.
- B. **Luminaire Fixture “A”:** Luminaire fixtures identified as fixture “A” on the luminaire schedule and on the drawings shall be a light – emitting diode high bay style light. The fixtures shall be constructed of a die – cast aluminum housing with a removable die – cast aluminum driver casting. The LED’s shall be protected by a minimum 0.16” thick tempered clear glass. Input voltage shall be 120 volts. The fixture shall be provided with 6kV surge protection. The fixture shall be installed with a surface mount bracket which shall allow for flexibility in adjustment for a total range of 150 degrees. Fixtures shall be UL Listed for wet locations and shall be suitable for use under covered ceilings. The fixtures shall be capable of operating in ambient temperatures from -40 degrees F to 131 degrees F. Input watts shall not exceed 200 watts. Color temperature shall be 5000K. Fixtures shall be warranted for a minimum of 5 – years.

1. **Manufacturers (or equal):**

- a. Lithonia CS JEBL 24 50K 80 CRI WH

- C. **Luminaire Fixture “B”:** Luminaire fixtures identified as fixture “A” on the luminaire schedule and on the drawings shall be a light – emitting diode (LED) flood light with a wall mount bracket suitable for the mounting type required on the drawings. The fixtures shall be constructed of die – cast aluminum with heat sink fins. LED drivers shall be mounted in direct contact with the casting and the housing shall be completely sealed against moisture and environmental contaminants. Color temperature shall be 5000K. The fixtures shall be IP 66 rated and CSA certified. The installation connection shall be rated to withstand up to a 1.5G vibration load rating per ANSI C136.31.

1. **Manufacturers (or equal)**

- a. Lithonia HLF 1 LED or equal.

- D. **Luminaire Fixture “C”** Luminaire fixtures identified as fixture “A” on the luminaire schedule and on the drawings shall be a light – emitting diode (LED) flood light with a slip fitting suitable for the pole mounting type required on the drawings. The fixtures shall be constructed of die – cast aluminum with heat sink fins. LED drivers shall be mounted in direct contact with the casting and the housing shall be completely sealed against moisture and environmental contaminants. Color temperature shall be 5000K. The fixtures shall be IP 66 rated and CSA certified. The installation connection shall be rated to withstand up to a 1.5G vibration load rating per ANSI C136.31.

1. **Manufacturers (or equal)**

- a. Lithonia HLF 1 LED or equal.

- E. **Luminaire Fixture “D”** Luminaire fixtures identified as fixture “A” on the luminaire schedule and on the drawings shall be a light – emitting diode (LED) flood light with a slip fitting (selected by the supplier) which is compatible for the existing pole for which the fixture is to be mounted. The fixtures shall be constructed of die – cast aluminum with heat sink fins. LED drivers shall be mounted in direct contact with the casting and the housing shall be completely sealed against moisture and environmental contaminants. Color temperature shall be 5000K. The fixtures shall be IP 66 rated and CSA certified.



The installation connection shall be rated to withstand up to a 1.5G vibration load rating per ANSI C136.31.

1. **Manufacturers (or equal)**

- a. Lithonia HLF 1 LED or equal.

2.13 **ULTRASONIC LEVEL SENSING SYSTEMS**

- A. The CONTRACTOR shall furnish and install ultrasonic level sensing systems as indicated on the drawings. Each level sensing system shall be integrated with the existing main engine control panel in the safehouse.
- B. Basic System Description: The level sensing systems shall be multi-functional level control system (level system) shall employ acoustic echo-ranging technology to determine the distance between the transducer and monitored surface, as a basis for display, output, and digital communication. The level system shall consist of a microprocessor-based level controller and an ultrasonic transducer (transducer) for single point operation. The level controller shall be operator configurable to meet specific application requirements by implementation of available signal processing and process control functions, in any allowable combination.
- C. **Signal Processing:** The level controller shall:
  1. Employ an ultrasonic transceiver suitable for providing excitation to, and processing resultant signals from the attached ultrasonic transducer.
  2. Create a digitized echo profile, and apply patented Sonic Intelligence echo processing techniques to select and verify the echo representing the reflective surface monitored.
  3. Employ Auto False Echo Suppression with the ability to automatically reject signals created by obstructions in the sound wave beam path and determine true material level.
  4. Calculate the distance between the transducer face and reflective surface based on the echo selected. The calculated distance may be converted to represent: material level, differential level\*, average level\*, space, material volume, vessel ullage, pumped volume, or head, open channel flow rate, and/or total flow volume. (\* Additional transducer required.)
  5. Compensate temperature-induced variation in the acoustic wave propagation velocity in air. This compensation shall be based on the signals received from the ultrasonic transducer, and/or a TS-3 temperature sensor, or an operator entered value representing the air temperature of the transmission medium.
  6. Include a calibration method and/or enable manual operator value entry, to set a fixed acoustic wave propagation velocity for transmission mediums other than air.
- D. **Process Control:** The level controller shall provide:
  1. Two analog signal outputs, directly or inversely proportional and scalable to the configured process variable.

2. Six relay contact outputs based on the level conversion or other process variable as set by the user configurable relay parameters.
  3. Two discrete inputs that may be configured to override normal Process Control Functions.
  4. One analog signal input that may be scaled to a monitored process variable, to be used as a basis for level controller Process Control Functions.
- E. **Process Control Functions:** The level controller shall provide an assortment of process control functions that may be user implemented in any allowable combination.
1. 0/4–20 mA output directly / inversely proportional and scalable to:
    - a. Level, space, or distance
    - b. Volume (geometric, piecewise linear, or cubic spline approximation derived)
    - c. Head or flow (exponential, defined flume or weir, or approximation derived)
    - d. Volume rate (derived from change in volume per time interval)
    - e. Dual point average or dual point differential level (two transducers required).
  2. 0/4-20 mA input configurable to represent level measured by alternate device
  3. Pre-configured application selections for:
    - a. Duplex wetwell or reservoir pump control by level or rate of change
    - b. Screen rake control
    - c. General alarms
  4. Alarms based on on/off setpoints:
    - a. High, Low, High High, or Low Low level
    - b. Level in bounds, out of bounds, rate of change
    - c. Temperature
  5. Loss of Echo or Cable Fault alarm
  6. Pump Control - Fixed roster, alternating duty assist or back-up, service ratio duty assist or back-up, or FIFO duty assist
  7. Pump Control Modifiers – pump run-on, pump start and power resumption delays, wall cling reduction, independent pump group rotations, and pump cycle activated flush operation.
  8. Pump Control Overrides based on discrete inputs such as point level switches or pump fault sensors.
  9. Special Device Control – remote totalizer, flow sampler.

10. Remote relay state control via communications.
11. Failsafe operation on measurement loss, including independent mA output and relay operation configuration.

F. **Digital Communications:** The level controller shall:

1. Store data related to the digitized echo profiles, distance calculation, signal processing functions, process control functions, and system configuration.
2. Map stored data to Modbus type read/write and read only registers, as defined by the level controller supplier.
3. Provide access to stored data via:
  - a. RS232 port with RJ-11 connector for use with SIMATIC PDM.
  - b. RS-485 port with screw terminals for external connection to the RS-485 modem or any compatible RS-485 communications network.
4. SmartLinx port for use with an interchangeable SmartLinx card for direct connection to the corresponding industrial bus protocol.

G. **User Interface:** The level controller shall enable user access to read only and read/write enabled data, using any of the following methods:

1. Direct or scroll access to data stored in numerical parameters, using the hand programmer and graphic LCD display.
2. IBM PC compatible computer access to data and digital echo profiles, using the SIMATIC PDM instrument configuration package.
3. HMI, SCADA, PLC, or DCS system access to data stored in Modbus registers via digital communications.

H. **System Specifications:**

1. **Range:** 0.3 to 15 m (1 to 50') dependent on transducer
2. **Accuracy:** 0.25% of range or 6 mm (0.24"), whichever is greater
3. **Resolution:** 0.1% of span, or 2 mm (0.08"), whichever is greater
4. **Programming:** Primary: Handheld programmer, Secondary: PC running Dolphin Plus software
5. **Temperature Comp:** Range: -50 to 150°C (-58 to 302°F) Source: Integral transducer sensor, and/or TS-3 temperature sensor, or Programmable fixed temperature
6. **Temperature Error:** Sensor: 0.09% of range Fixed: 0.17% per °C deviation from programmed value

I. **Level Controller Specifications:**

1. **Power:** AC version: 100-230 Vac  $\pm$  15%, 50 / 60 Hz, 36 VA (17W) DC version: 12-30 Vdc, 20W
  2. **Enclosure:** Polycarbonate, Indoor/Outdoor Type 4X / NEMA 4X / IP 65 240mm (9.5") x 1.75mm (6.9") 1.37 kg (3.02 lb)
  3. **Ambient Temperature:** -20 to 50°C (-5 to 122°F)
  4. **Memory:** 1MB static RAM with battery backup 512kB flash EPROM
  5. **Display:** Back lit LCD
  6. **Excitation:** Transducer: 315V peak, 44 kHz nominal frequency Differential or average level algorithm (Additional transducer required)
  7. **mA O/P:** 0-20 mA or 4-20 mA, directly or inversely proportional, scalable and configurable 750 ohm maximum load, isolated +/- 0.1% resolution
  8. **Relays:** All relays rated 5A at 250Vac, non-inductive 4 Form A control relays, 2 Form C alarm relays
  9. **Discrete I/P:** 2 discrete inputs configurable to override control functions Logical 0 = < 0.5 Vdc; logical 1 = 10 to 50 Vdc 3 mA maximum draw
  10. **mA O/P:** 0-20 or 4-20 mA, configurable as level input from another device (availability model dependent)
  11. **Comm's:** RS-232 running Modbus RTU and ASCII via RJ-11 connector RS-485 running Modbus RTU and ASCII via terminal block Industrial bus protocol via SmartLinx card (optional)
- J. **Transducer Specifications:** The ultrasonic transducer used with the level controller shall be available in distinct models to suit various application conditions.
1. **Range:** 0.6 to 8 meters (2 to 26 feet)
  2. **Beamwidth:** 12 degrees
  3. **Temperature:** -20 to 60C (-5 to 140F)
  4. **Temperature Sensor:** Integral
  5. **Cable:** Length of shielded twisted pair, suitable for temperature rating Extendable by installer to 365 meters (1200 feet) total length
  6. **Approvals:** CE compliant, CSA, FM, Cenelec, ATEX
- K. **Manufacturers, or Equal**
1. **Level Controller**
    - a. Siemens, Hydro – Ranger 200, or equal
  2. **Transducers**

- a. Siemens, Echomax, as required to meet application, or equal.

## 2.14 **FLOAT SWITCH AND PANEL**

### A. **Float Switches and Transceivers:**

1. The floats shall use fiber optic cable to transmit a beam of light from a transmitter in the control panel to the float where the beam makes and breaks depending on the tilt of the float. The receiver in the control panel shall detect the presence or absence of light and operate a relay in the receiver. The float shall have no electrical components or metallic wires that could cause arcs and sparks in an explosive atmosphere.
2. The float switch shall be mercury and lead free and shall be made of all safe, recyclable materials. The float switch housing shall be polypropylene. It shall be a simple robust device designed for many years of dependable service. The beam eclipser shall be stainless steel in an inert non-toxic dampening fluid that prevents chatter due to wave action. The viscosity of the fluid shall not change significantly over the range of -50 to +155F (-45 to +70C). The transceivers (transmitter and receiver combination) shall be dual din rail mounted units capable of connection to 2 floats. Provide one dual transceiver for every 2 floats. The fiber optic cable shall be custom made for the float and shall consist of dual plastic fibers with an overall specially blended PVC sheath for flexibility. No special tools or experience shall be required for connection of the optical cable to the transceivers. The cable shall be connected with and sealed at the float housing using a double seal method that will prevent water from entering the float even if the outer sheath is damaged. The float color shall be two tone with the lighter color on the dome for easier viewing underwater when tilted up.
3. The transceivers shall operate in ambient temperatures of -15 to +130F (-25 to +55C). The transceivers shall operate at 12 VDC and shall be protected against accidental polarity reversal. The system shall operate in the visible and infrared light region with wavelengths between 400 and 1200 nm. The output relays in the receivers shall have the capability of being connected normally open or normally closed. The transceivers shall have a green led power-on light and red led lights on each channel indicating that the light beam is being received – float tilted up. The floats shall operate in liquid temperatures of +32 to +130F (0 to +55C). The floats shall have an ambient air standby operating temperature rating of -15 to +155C (-25 to +70C).
4. The optical float control panel shall contain an interposing control relay with a normally open contact. Closure of the contact shall signal the main engine control panel to initiate emergency start of the engine in accordance with the control panel programming. The interposing relay shall be suitable for 24 Volts direct current and 110 Volts alternating current.

## 2.15 **MISCELLANEOUS MATERIAL**

- A. Empty raceway pullcords shall be glass fiber reinforced tape that is foot marked along its length, Thomas "True Tape", Greenlee "Foot Marked", or equal.
- B. Conduit thread compound for use with joining dissimilar metals and aluminum threads shall be conductive, non-galling, and corrosion inhibiting lithium based compound.

- C. Cable pulling compound shall be non-injurious to raceways, conductors, and insulation. Compound shall be non-toxic, non-hardening type.
- D. Ground rods shall be copper clad steel in lengths and diameters as indicated and shall be Blackburn, Hubbard, or equal.

### **PART 3 -- EXECUTION**

#### **3.1 GENERAL**

- A. Except where specifically noted or shown, the locations and elevations of equipment are approximate and are subject to small revisions as may prove necessary or desirable at the time the work is installed. Final locations shall be confirmed with the ENGINEER in advance of construction.
- B. Where equipment is being furnished under another Section, request from the ENGINEER accepted drawings that will show exact dimensions of required locations of connections. Install the required facilities to the exact requirements of the accepted drawings.
- C. All work shall be done in the best and most workmanlike manner by qualified, careful electricians who are skilled in their trade. The standards of work required throughout shall be of the first class only and electricians whose work is unsatisfactory to the ENGINEER shall be instantly dismissed from the work upon written notice from the ENGINEER. All work must meet the approval of the ENGINEER.
- D. Unless shown in detail, the Drawings are diagrammatic and do not give exact details as to elevations and routing of conduits, nor do they show all offsets and fittings; nevertheless, install the conduit system to conform to the structural and mechanical conditions of the construction. Unless locations and routing of exposed conduits are shown, confirm locations and routing prior to installation with the ENGINEER.
- E. Holes for raceway penetration into sheet metal cabinets and boxes shall be accurately made with a hole punch. Cutting openings with a torch or other device that produces a jagged, rough-cut will not be acceptable.
- F. Cabling inside equipment shall be carefully routed, trained and laced. Cables so placed that they obstruct equipment devices will not be acceptable.
- G. Equipment shall be set level and plumb. Supporting devices installed shall be set and so braced that equipment is held in a rigid, tight fitting manner.
- H. The CONTRACTOR shall verify the electrical capacities of all motors and electrical equipment furnished under other Sections, or furnished by the OWNER, and request wiring information from the ENGINEER if wiring requirements are different from that specified under this Section. Do not make rough ins until equipment verifications have been received.
- I. The CONTRACTOR shall install all controllers, instruments, Distributed Control System Equipment (if specified), terminal boxes, pilot devices, and miscellaneous items of electrical equipment that are not integrally mounted with the equipment furnished under other Sections. All such equipment shall be securely mounted and adequately supported in a neat and workmanlike manner.

- J. All materials and equipment shall be installed in strict accordance with printed recommendations of the manufacturer. Installation shall be accomplished by workers skilled in the work. Installation shall be coordinated in the field with other trades to avoid interferences.

### **3.2 EXCAVATION AND BACKFILLING**

- A. Earthwork necessary for the installation of the work shall be performed as detailed in Division 02. This shall include shoring and pumping in ditches to keep them dry until the work in question has been installed. All shoring required to protect the excavation and safeguard employees shall be properly performed.
- B. All excavations shall be made to the proper depth, with allowances made for floors, slabs, forms, beams, piping, finished grades, etc. Ground under conduits shall be well compacted before conduits are installed.
- C. All excavated material not suitable and not used in the backfill shall be removed.
- D. The CONTRACTOR shall field check and verify the locations of all underground utilities prior to any excavating and shall avoid disturbing these as far as possible. In the event existing utilities are broken into or damaged, they shall be repaired so as to make their operation equal to that before the trenching was started.
- E. Where the excavation required the opening of existing walks, drives, or other existing pavement, these facilities shall be cut as required to install new lines and to make connections to existing lines. The sizes of the cut shall be held to minimum consistent with the work to be installed. After installation of new work is completed and the excavation has been backfilled in accordance with above, repair existing walks, drives or other existing pavement to match existing installation.

### **3.3 CUTTING AND PATCHING**

- A. Cutting and patching required under this section shall be done in a neat workmanlike manner. Cutting lines shall be uniform and smooth.
- B. The CONTRACTOR shall utilize concrete saws for large cuts in concrete and use core drills for small round cuts in concrete.
- C. Where openings are cut through masonry walls, provide lintel or other structural supports to protect the remaining masonry. Adequate support shall be provided during the cutting operations to prevent damage to masonry.
- D. Where large openings are cut through metal surfaces, attach metal angles around the opening.
- E. The CONTRACTOR shall patch concrete openings that are to be filled with non-shrinking cementing compound. Finished concrete patching shall be troweled smooth and shall be uniform with surrounding surfaces.

### **3.4 WATERPROOFING**

- A. The CONTRACTOR shall furnish and install waterproof flashing for each penetration of exterior walls and roofs.

- B. Flashing for conduit penetrations through built up roofs shall be made with pitch pans filled full with pitch. Conduit penetrations through poured concrete roofs shall be made with sleeves and annulus caulked.
- C. Penetrations through walls at below ground elevations shall be waterproofed by conduit sealing fittings or other methods as indicated. This includes all conduit that is located and/or terminated in areas that can transport sewer gases from raw sewage to control panels and other equipment. All local control panels, control stations and motors shall have conduit sealing fittings installed.
- D. Interiors of raceways that are likely to have water ingress such as runs from hand-holes into below grade installations shall have water-stops installed to prevent water from entering into installations.

### **3.5 PROTECTION**

- A. The CONTRACTOR shall provide suitable protection for all equipment, work and property against damage during construction.
- B. The CONTRACTOR shall assume full responsibility for material and equipment stored at the site.
- C. Conduit openings shall be closed with caps during installation. All outlet boxes and cabinets shall be kept free of concrete, plaster, dirt and debris.
- D. Equipment shall be covered and tightly sealed against entrance of water, dust, dirt and debris.
- E. All dry transformers prior to energization shall be protected against moisture and dirt absorption by a suitable covering. Also, maintain heat inside the covering by suitable means to prevent condensation.
- F. Interiors of electrical equipment shall be kept clean and dry prior to energization.

### **3.6 DUCT LINE AND PULLBOXES**

- A. The CONTRACTOR shall excavate, backfill, remove excess soil, and furnish material for and install duct lines wherever shown on the plans. Conduit encased in concrete shall have three inch minimum covering of concrete on outside walls of ducts bank, and one inch minimum of concrete between the outside walls of adjacent conduits. The top of the ducts shall in general be 1'-6" below ground unless specifically shown otherwise on the drawings or is required to be deeper by N.E.C. or other codes.
- B. It shall be the CONTRACTOR's responsibility to determine in advance any conflicts of duct banks with underground obstructions of electrical or any other disciplines and report these anticipated conflicts to the ENGINEER well in advance of operations such that the conflicts can be easily and economically resolved by all parties.
- C. Conduit shall be firmly secured by driving reinforcing rod 12" in ground and tying with No. 10 wire.
- D. Where excavation has been made to a greater depth than that required, backfill shall be tamped solid and level to the required depth. All concrete forms shall be removed after the concrete has set, and all trenches shall be backfilled and tamped.



- E. Pull boxes shall be installed as shown on the plans.

### 3.7 RACEWAY INSTALLATION

- A. The CONTRACTOR shall install the raceway system to provide the facility with the utmost degree of reliability and maintenance free operation. The raceway system shall have the appearance of having been installed by competent workmen. Kinked conduit, conduit inadequately supported or carelessly installed do not give such reliability and maintenance free operation and will not be accepted.
- B. Raceway shall be installed for all wiring runs except as otherwise indicated.
- C. Exposed raceways shall be installed with their lines parallel to the lines of the building or structure to which they are attached.
- D. Conduit runs that enter bottom of floor mounted enclosures that are open on the bottom shall be each equipped with grounding bushing on each conduit.
- E. Conduit entries into sheet metal enclosures located inside shall be made with double locknuts and capped with molded bake-lite grounding type bushings. Threaded penetration shall expose enough threads to adequately thread on bushing.
- F. Conduit entries into NEMA 3, 3R, 4 or 12 enclosures located outside and in wet or damp location inside, shall be made with field applied watertight hubs. Install locknut inside and cap each conduit with grounding bushing.
- G. Conduit runs into boxes, cabinets, and the like shall be set in a neat manner. Vertical runs shall be set plumb. Conduits set crooked or out of plumb shall be replaced.
- H. Conduits entrances into enclosures shall be carefully planned. Cutting away of enclosure structure, torching and/or cutting away sills, braces and structural members of the enclosure will not be acceptable.
- I. The CONTRACTOR shall utilize approved hole cutting tools for entrances into sheet metal enclosures. Use of cutting torch or incorrect tools will not be acceptable. Holes shall be carefully planned and then cleanly cut and they shall be free from burrs, jagged edges, and torn metal.
- J. Make up of some conduit runs will require union fittings or split couplings. Install such fittings where required.
- K. Liquid-tight conduit shall be used for connections to motors, solenoids, pressure switches, limit switches, unit heaters, fans, motorized louvers, and other devices that may need to be removed for servicing. Each run of liquid-tight flex shall be joined with liquid-tight flex connectors. Make up each connection tightly; finished connector shall have minimum of 100 pounds pull out resistance.
- L. Empty conduits shall have pull tape installed the length of each run. The CONTRACTOR shall identify each terminal as to location of the other end. The CONTRACTOR shall utilize blank waterproofs label with waterproof ink. Exposed open ends of empty conduits shall be capped.
- M. Conduit bodies shall be installed in exposed runs of conduit where indicated and also wherever required to overcome obstructions and to provide access to wires. Covers for such fittings shall be accessible and unobstructed by the adjacent construction.

- N. All raceway systems shall be adequately and safely supported. Loose, sloppy and inadequately supported raceways will not be acceptable and shall be replaced. Supports shall be installed at intervals not greater than those set forth under Article 300 of N.E.C. unless shorter intervals are otherwise indicated; or, unless conditions require shorter intervals of supports.

### 3.8 WIRING INSTALLATION

- A. Conductors for power and control wiring shall be sized as indicated and where no size is given, the conductor size shall be #12 AWG.
- B. Color of power wire insulation and color of phase indicating tape shall be as follows:
- C. All wiring shall be installed in raceways, except as otherwise specified. No wire or cable shall be drawn into a raceway until the raceway run has been completed, swabbed, and outfitted with specified bushings and fittments.
- D. The CONTRACTOR shall not exceed wire and cable manufacturer's recommended pulling tensions. Cable pulling compound shall be used as a lubricant for difficult pulls.
- E. The CONTRACTOR shall carefully handle wire and cable. The CONTRACTOR shall not kink, scrape or damage conductors or their insulation.
- F. Feeder and branch circuit wiring shall be installed from supply to load without splice, unless otherwise indicated. Branch circuits may be spliced for receptacle, lighting, and small appliance load inside appropriate junction boxes, and inside lighting fixtures.
- G. Except as otherwise specified, taps and splices with #10 AWG, and smaller shall be made with insulated spring wire connectors. Such connectors in damp or wet locations shall have opening in wire nut filled with silicone rubber cement and then wrapped with a layer of EPR tape or spring wire connectors manufactured for this use shall be used.
- H. Motor connections made with #10 AWG and smaller wire shall be made up with set screw copper lugs and with threaded on set screw copper lugs and with threaded on insulating jacket. Where motors are located in damp or wet locations, fill opening under jacket with silicone rubber and cover connector with a layer of EPR tape.
- I. Taps and splices in #8 AWG and larger wires shall be made up with copper alloy connectors. Apply over each connector a bedding of insulation putty. Then, apply at least four layers, half lapped each layer of EPR tape. Finally, apply at least four layers half lapped each layer of electrical tape.
- J. Each wiring connection shall be made up tightly so that resistance of connection is as low as one-foot length of associated largest conductor resistance.
- K. Numbered marking labels shall be installed to identify circuit numbers from panelboards and to identify control wiring. Install labels on each wire in each panelboard, junction, and pullbox, and device connection. See "Identifying and Tagging" sections of these specifications.
- L. The CONTRACTOR shall install numbered marking labels on each control wire termination at each terminal strip. Number selected shall correspond to manufacturer's terminal numbers.

- M. Where control wiring terminates onto flat head type terminals, equip each such wire with crimp type locking spade connector.
- N. All wiring inside enclosure shall be neatly trained and laced. Bundle wires into groups and lace with plastic tie wraps.
- O. The CONTRACTOR shall install "DANGER 480V (or 240V)" labels on motor control equipment, and on other enclosures such as safety switches, wire ways, and large enclosures that contain 480V (or 240V) wiring.
- P. The CONTRACTOR shall install wiring devices where indicated. Each wiring device shall be set with axes plumb and installed with its yoke screws so as to adequately support device and provide grounding means to box. Where ganged devices are shown, install them into ganged boxes.
- Q. Each item of equipment shall be adequately and thoroughly grounded. The CONTRACTOR shall comply with Article 250 of N.E.C.
- R. Equipment grounding conductors into equipment shall be grounded to equipment ground bus or ground lug. Where no ground lugs are provided, the CONTRACTOR shall install ground lug and bond EGC thereto.
- S. Where grounding bushings are installed, the CONTRACTOR shall bond EGC there to end and furthermore ground each bushing lug to equipment ground bus or ground lug.

### **3.9 GROUNDING SYSTEM**

- A. The CONTRACTOR shall furnish and install a complete grounding system as shown on the Drawings consisting primarily of bare copper conductor and copper clad steel ground rods. All electrical equipment shall be tied to this system either with cable shown or the metallic conduit system per N.E.C. Attach grounding system to metallic buildings as required by N.E.C. weather specifically shown on drawings or not.

### **3.10 MANUFACTURE OF ELECTRIC CONTROL PANELS**

- A. All electrical control panels including unit motor starters shall be factory assembled. In no case shall the electrician assemble and wire internal components in the field. The only onsite wiring that will be allowed inside panels is connections of external wiring to factory installed terminal strips.

### **3.11 NAMEPLATES**

- A. The CONTRACTOR shall install nameplates on all electrical equipment and devices including remote operating stations that clearly identifies the device. Nameplates shall be sized appropriately for the device and shall be attached with stainless steel screws or double sided tape suitable for outdoor use, 3M Scotch Brand Very High Bond 4930 or equal. Tape shall cover the entire surface of the nameplate.
- B. A nameplate schedule indicating proposed wording and sizes shall be submitted to the ENGINEER for approval

### **3.12 OVERLOAD HEATERS**

- A. The CONTRACTOR shall submit to the ENGINEER Motor Overload Heaters and Circuit Breaker Data Sheets which shall contain actual nameplate information on the motors

and motor starters which he shall inspect and record. He shall use the appropriate charts and tables supplied with the starting equipment and select, for approval by the ENGINEER, the manufacturer's recommended overload heaters and circuit breaker settings. Along with the data sheet he shall also submit a copy of the manufacturer's charts and tables. Motors shall not be started until overload heaters and circuit breaker settings are approved by the ENGINEER

### **3.13 CLEANUP**

- A. The CONTRACTOR shall remove all temporary labels, dirt, paint, grease and stains from all exposed equipment. Upon completion of work clean equipment and the entire installation so as to present a first class job suitable for occupancy. No loose parts or scraps of equipment shall be left on the premises.
- B. Equipment paint scars shall be repaired with paint kits supplied by the equipment manufacturer, or with an approved paint.
- C. Clean interiors of each item of electrical equipment. At completion of work all equipment interior shall be free from dust.

### **3.14 ELECTRICAL TESTS**

- A. Each run of power and control wiring shall be tested prior to connection of line and load. Make tests with 1000V dc hand crank megger. Each run of wiring shall be tested phase to phase and/or phase to neutral, and phase to ground. Test results for each test shall be equal to or greater than 5 megaohms with 1000V dc applied. Defective wiring shall be replaced and retested. All tests shall be made in the presence of the ENGINEER.
- B. High voltage cables, where used, shall be Hi Pot tested in accordance with test procedures as outlined in other sections of these specifications or as directed.
- C. All equipment shall be put through a trial run in test to ascertain the performance complies with the intent of the specifications. All run - in tests shall be made in the presence of the ENGINEER.

- END OF SECTION -