

REQUEST FOR PROPOSAL

Felix C. Davis Wastewater Treatment Plant  
North Charleston Sewer District

BLOWER EQUIPMENT PRESELECTION

PREPARED FOR

North Charleston Sewer District

PREPARED BY

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## NOTICE OF REQUEST FOR PROPOSALS

The North Charleston Sewer District (NCSD) will preselect a blower equipment supplier as part of the Aeration Upgrade and Rehabilitation Project. Blower suppliers who intend to submit a price and offer to provide equipment to NCSD, via the General Contractor for the project, must provide all materials requested herein and be preselected by NCSD via this RFP process. The preselected blower equipment supplier will be listed in the specifications and the equipment price will be included in the bid form. The General Contractor will be required to contract with the preselected blower equipment manufacturer at the previously negotiated equipment price with provisions for cost escalation dependent on delivery date as specified herein.

Proposals for Blower Equipment shall be received electronically by **North Charleston Sewer District** by **2:00 p.m.** local time on **November 30, 2023**.

Only blower manufacturers herein referred to as “suppliers” and the specific blower equipment conforming to the enclosed specifications and determined to be acceptable will be preselected for the project.

NCSD reserves the right to modify the technical specifications for the equipment described in this request prior to issuing the final Construction Documents. Such modification will not impact the outcome of this preselection process but will require the supplier to comply with the modifications. If the modification is a material change, a revised price negotiation will be considered.

Although an equipment manufacturer will be preselected, neither the preselection nor any preselection rating will relieve any bidder or supplier from meeting the requirements of the final Construction Documents.

The anticipated Selection Schedule is summarized below:

<b><u>Milestone</u></b>	<b><u>Date</u></b>
Issue Request for Proposals	November 3, 2023
Questions Due By	November 20, 2023 by 2 PM local time
Supplier Proposals Due	November 30, 2023 by 2 PM local time

## REQUEST FOR PROPOSAL

### INTRODUCTION

The Felix C. Davis Wastewater Treatment Plant (WWTP) is a 32-mgd design annual average flow activated sludge facility. Aging infrastructure and inefficient equipment require replacement of the existing process aeration blowers. There are currently five operating multistage centrifugal blowers and one inoperable single-stage integral-gear blower installed in the blower building at the Felix C. Davis WWTP. All existing blowers will be removed and replaced with new blowers. All blowers are currently fed from an existing 4,160V power distribution. Preliminary analysis indicates significant additional electrical cost will be incurred, and facility footprint will be lost for blower packages requiring low-voltage (480V) electrical feed compared to those that can accommodate the existing 4,160V service.

Two blower technologies are being considered for this project: single-stage integral-gear centrifugal blowers and high-speed direct drive centrifugal (turbo) blowers. NCSO intends to pre-select a single blower technology and equipment supplier. The blower package will be purchased and installed by a General Contractor under a contract with NCSO.

The anticipated bid and construction milestone dates are as follows:

<u>Anticipated Milestone</u>	<u>Estimated Date</u>
Anticipated Bid Advertisement	September 2024
Anticipated Contractor NTP	October 2024
Anticipated Delivery of Blowers	October 2025

### INTERPRETATIONS AND ADDENDA

All questions regarding the RFP are to be submitted to the Engineer via email. Interpretations or clarifications considered necessary by the Engineer in response to such questions will be issued by addenda and emailed to all Suppliers. Questions received less than 10 days prior to the date for opening of proposals will not be answered.

### PREPARATION OF PROPOSALS

1. Submit proposals directly to NCSO via email to [purchasing@ncsd.sc.gov](mailto:purchasing@ncsd.sc.gov).
2. A complete and responsive proposal must include the following:
  - a. Complete and executed Cost Proposal Form.
  - b. Supplemental Information requested in Appendix A.
3. The proposal as originally submitted shall be complete to allow for a full analysis without the need for additional information. No supplementary explanation is assumed or intended. However, the Engineer reserves the right to clarify or request further information after opening of proposals.

## EVALUATION OF PROPOSALS

1. Competitive proposals are being solicited which include capital cost information as well as guaranteed minimum performance criteria to be used for the evaluation and selection process.
2. The selection of the Equipment Supplier will follow a value-based process that includes a weighted evaluation based on the following criteria:
  - a. Life-Cycle Costs (Capital and O&M)
  - b. Performance
  - c. Operation & Maintenance
  - d. Constructability
  - e. Supplier Experience with Similar Blowers
  - f. Electrical Requirements
3. NCSD reserves the right to accept or reject any or all proposals submitted and waive minor defects, informalities, and technicalities. NCSD will evaluate each proposal and will select the Supplier, which in NCSD's opinion, has submitted the proposal best suited to the needs and goals of the Project and deemed to be in compliance with the requirements of the RFP including the attached specifications.
4. NCSD will select an Equipment Supplier to provide blowers as part of the Aeration Upgrade and Rehabilitation Project. The selected blowers will be included in the design and named in the final Construction Documents.
5. NCSD intends to negotiate with the preselected manufacturer. If a negotiated price can be reached, the preselected manufacturer will be listed in the technical specification and the negotiated price will be included in the bid form.
6. The preselected Equipment Supplier will contract directly with the General Contractor and be bound by its required schedule and contract.

### COST PROPOSAL FORM

- In submitting this proposal, Supplier represents that supplier has examined and carefully studied the documents provided in this RFP and the following Addenda, receipt of which is hereby acknowledged:

Addendum No.	Addendum Date
_____	_____
_____	_____

- The proposed price shall include all products, delivered to the site, and services required for a complete and fully functional system, as further defined in the technical specifications. The Supplier shall attach a list of all blower package components and accessories and all Supplier services included in their cost.
- Complete the cost table below based on compliance with the Appendix B technical specifications.

Base Cost Proposal	No.	Unit	Unit Price	Total Price
Shop Drawings	1	LS		
Blowers		EA		
Field and Start-Up Services	1	LS		
<b>Total Base Cost (USD)</b>				

- As described in Appendix A, the Supplier is allowed to suggest deviations from the technical specifications. For these deviations list cost adjustments, if any, relative to these deviations in the table below. Add additional line items as needed.

Deviations from Technical Specification	No.	Unit	Unit Price	Total Price
Item 1:				
Item 2:				
Item 3:				

5. The cost shall remain valid from the date of anticipated equipment delivery for one hundred eighty (180) days. For time extending beyond this period, the cost will be adjusted once through Change Order by the ratio of the Producer Price Index (PPI) and will be coordinated directly with the Contractor with written confirmation of the proposed change based on PPI provided to NCSD. Baseline PPI shall be the date of submittal of the proposal, and adjusted based on the average PPI for the 12 months immediately prior to the date of advertisement for bid.
6. Payment may be requested by Supplier via the Construction Contractor upon delivery of the full equipment package, acceptance by Engineer, and suitable storage at or near the site in order for NCSD to establish title to such materials and equipment or otherwise protect NCSD's interest.

This Proposal is submitted by:

Printed Name and Title: \_\_\_\_\_

Supplier Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

## APPENDIX A

### SUPPLEMENTAL INFORMATION REQUIREMENTS

#### GENERAL

In addition to the Cost Proposal Form, proposals shall include the information requested herein, at a minimum. Each Supplier shall review the requirements of this Request for Proposal document and provide additional information the supplier deems necessary.

The response information shall be provided in the forms provided below, or a reasonable facsimile of the provided forms. Suppliers choosing to use reasonable facsimiles of the forms should maintain both the format and the content of the provided forms. Copies of the forms in MS Word format will be provided by email upon request.

*Failure to submit all required information, back-up documentation, and completed forms may be cause for rejection.*

#### PROCUREMENT, FABRICATION AND INSTALLATION HISTORY

A. Provide the information requested in the following table:

Parameter	Units	Value	Submittal Requirements
Equipment Lead Time			
Purchase Order to Shop Drawing Submittal	Weeks		
Shop Drawing Approval to Delivery	Weeks		
Number of North American Installations of the Proposed Blower model	-		Provide List
Year of First Installation of the Proposed Blower model	-		Provide Description
State and/or Country of Primary Blower Manufacturing	-		

#### TECHNICAL DATA

A. Provide information requested in the following table related to the proposed equipment.

Parameter	Units	Value
Total No. of Duty Blowers to Meet Design Point <sup>1</sup>	-	
Min. Turndown Flow at Min. Temperature <sup>2</sup>	scfm <sup>4</sup>	
Power Consumption at Design Conditions <sup>3</sup>	kW	
Rated Noise Level (at 3ft from any point of the blower or ancillary equipment)	dB	



Parameter	Units	Value
Max Dimensions of Blower Skid in inches	L x W x H	
Max Dimension of Largest Component in inches	L x W x H	
Total Weight of Blower Skid	Lbs	
Weight of Largest Component	Lbs	
Clearance Required Around Blower Skid	Inches	
Electrical Voltage at Blower Package Connection	V	
Full Load Amperage at Blower Package Conditions	A	
Heat Emission of Individual Blower at Design Point	BTU/hr	

1. Duty blowers need to provide a total capacity of 36,000 scfm at the site elevation and design inlet conditions stipulated in the specifications.
2. Refer to Section 43 11 11 and 43 11 12 for design inlet and ambient conditions.
3. Total power consumption of all blowers operating in order to provide design capacity of 36,000 scfm.
4. Standard cubic feet per minute (scfm) is defined airflow rate in terms of standard conditions (68°F, 14.7 psia and 36% relative humidity)

B. Suppliers shall review the technical specifications included within this RFP. Indicate whether the proposed equipment will conform to the requirements of the applicable technical specifications below.

Specification	Conformance? (Circle One)
Section 43 11 11 – Direct-Drive Single-Stage Centrifugal Blowers	YES/NO
Section 43 11 12 – Integral-Gear Single Stage Centrifugal Blowers	YES/NO

C. The Supplier can request deviations from the specification for consideration by the Engineer. Where the Supplier’s proposal does not meet the requirements of the technical specifications, provide a detailed list of all deviations from the specified requirements and explain why the Supplier believes the deviations are advantageous to the District. If there is a cost adjustment associated with the deviation, list in the cost proposal form.

D. For each exception, describe the reason for the exception and describe the alternative proposed by the Supplier with supporting documentation. For each exception taken, provide evidence that the proposed alternative has been successfully used at other similar installations.

E. All blowers are currently fed from an existing 4,160V power distribution. Preliminary analysis indicates significant additional electrical cost will be incurred, and facility footprint will be lost for blower packages requiring low-voltage (480V) electrical feed compared to those that can accommodate the existing 4,160V service. The Supplier shall confirm whether the proposed blower packages can be served by 4,160V power. If the blowers cannot be served directly from the 4,160V service, the Supplier is encouraged to propose on ancillary equipment (i.e. step-down transformers integrated into the blower

packages) that can be included under their scope of supply to integrate the existing 4160V electrical feed to serve their proposed blowers. The ancillary equipment shall be provided as a cost adder to the manufacturer's base blower bid.

## PERFORMANCE

Complete the following Blower Performance Tables and provide performance curves for the blowers. Performance curves shall be developed in terms of standard conditions of 14.7 psia, 68°F, and 36% relative humidity as well as the design criteria specified in Paragraph 2.02 of the technical specifications.

Criteria	Units	Design Operating Points				
		No. 1	No. 2	No. 3	No. 4	No. 5
Inlet Air Flow	scfm	9,100	12,000	13,700	16,200	19,900
Discharge Pressure	psig	7.00	7.05	7.10	7.15	7.25
Inlet Air Temperature	°F	70	70	70	70	70
Inlet Air Relative Humidity	%	70	70	70	70	70
Barometric Pressure	psia	14.69	14.69	14.69	14.69	14.69
Inlet Pressure	psia	0.1	0.1	0.1	0.1	0.1
No. of Blowers Operating						
Inlet Air Flow per blower	scfm					
Maximum Wire Power	kW					
Usage Factor	%	20%	20%	20%	20%	20%
Wire Power Draw * Usage Factor	kW					
Total Maximum Wire Power	kW					

- For blowers with external harmonic filters, an assumed harmonic filter efficiency of 95% shall be used to convert wire power at the blower enclosure to wire power at the harmonic filter as follows: Wire Power Draw at Blower/0.95 \* Usage Factor.

*Note:* The blowers shall not exceed the maximum wire horsepower consumption for the operating points and inlet conditions given above. Maximum wire power draw specified for each design point shall be wire to air power and include all power demands and losses associated with the blower package, including but not limited to the motor, variable frequency drive, harmonic filter (if internal to the blower enclosure), cooling system losses (including those associated with pre-heating of inlet air due to recycling of cooling air to the blower inlet within the package), and any additional electrical requirements. Wire power shall be as measured at the electrical connection to the blower package and shall be based on fully closed blower packages if blowers are housed within an enclosure. **Performance data based on or assuming a blower package with an open enclosure is not acceptable for blower technologies installed in enclosures.**

The total maximum wire power shall be calculated as the sum of the maximum wire power for each operating blower at the design operating points multiplied by the usage factor for the operating points given above. The maximum wire power draw for each design point shall be submitted with the shop drawings (at a later date, through the Contractor) **with no tolerances and shall be confirmed during the PTC-13 factory performance tests.**

**MAINTENANCE AND SPARE PARTS**

A. Provide the following data related to vendor-supplied service.

Item	Units	Value	Submittal Requirements
Location of closest service center to North Charleston, SC	-		
5-Year Service Contract Cost (not part of base bid)	USD		Provide a description of service contract scope

B. Spare Parts

Item	Units	Value	Submittal Requirements
5-Year Cost of Spare Parts			List of recommended spare parts

C. Provide maintenance information requested in the following table for the proposed equipment as applicable. Supplier shall expand the table as needed to include all other items that will typically require replacement over the 20-year service life of the blowers. The table shall include cost of each replacement part, repair and replacement intervals, and indicate if part must be replaced by a certified technician.

Parameter	Units	Value	Certified Technician Service Required?
Expected Oil Change Interval	Months		YES/NO
Oil Change Volume, per blower	Gallons		YES/NO
Cost of recommended oil, per gallon	USD		YES/NO
Is oil only available through manufacturer?	Yes/No		YES/NO
Expected Coolant Change Interval	Months		YES/NO
VFD Fan Replacement Interval	Months		YES/NO
VFD Fan Replacement Cost	USD		YES/NO
VFD Replacement Interval	Months		YES/NO
VFD Replacement Cost	USD		YES/NO
UPS Replacement Interval	Months		YES/NO
UPS Replacement Cost	USD		YES/NO
Harmonic Filter Replacement Interval	Months		YES/NO

<b>Parameter</b>	<b>Units</b>	<b>Value</b>	<b>Certified Technician Service Required?</b>
Harmonic Filter Replacement Cost	USD		YES/NO
Mag Bearing Controller Replacement Interval	Months		YES/NO
Mag Bearing Controller Replacement Cost	USD		YES/NO
Mag Bearing Cooling Fan Replacement Interval	Months		YES/NO
Mag Bearing Cooling Fan Replacement Cost	USD		YES/NO

D. In addition, provide the following data related to estimated life of wearing parts, cost of replacement, and indicate if part must be replaced by a certified technician (as applicable).

<b>Parameter</b>	<b>Units</b>	<b>Estimated Life</b>	<b>Estimated Cost of Parts</b>	<b>Certified Technician Service Required?</b>
Replacement Bearings	Hours of Operation			YES/NO
Replacement Seals	Hours of Operation			
Replacement Filters	Hours of Operation			

## **DRAWINGS AND PERFORMANCE CURVES**

Proposals are to be accompanied by the following Drawings:

1. Dimensional drawings, plans and details showing general construction and assembly, dimensions, materials of construction, and finishes.
2. Dimensional drawing showing clearance required around each side of equipment for regular servicing and maintenance.
3. Provide performance curves for the blowers.
4. Provide .STP or .RVT files compatible with Revit of proposed blowers.

**APPENDIX B**

**TECHNICAL SPECIFICATIONS**

**APPENDIX C**

**EXISTING BLOWER ROOM LAYOUT**

**SECTION 01 33 00**  
**SUBMITTAL PROCEDURES**

**PART 1 – GENERAL**

**1.01 SUMMARY**

A. Section includes:

1. Contractor shall provide submittals in accordance with the General Conditions as modified by the Supplementary Conditions, and this Section.
2. Contractor is responsible to confirm and correct dimensions at the Site, for information pertaining to the fabrication processes and to techniques of construction, and for coordinating the work of all trades. Contractor's signature of submittal's stamp and letter of transmittal shall be Contractor's representation that Contractor has met their obligations under the Contract Documents relative to that submittal.

B. Related Sections:

1. Section 01 25 00 – Substitution Procedures.
2. Section 01 78 23 – Operation and Maintenance Data.
3. Section 01 78 39 – Project Record Documents.
4. Section 01 78 43 – Spare Parts and Extra Material.
5. Section 01 79 00 – Instruction of Owner's Personnel.

**1.02 ADMINISTRATIVE REQUIREMENTS**

A. Types of Submittals: When type of submittal is not specified and is not specified in this Section, Engineer will determine type of submittal.

1. Action/Informational Submittals:

- a. Shop Drawings.
- b. Product data.
- c. Delegated design submittals in accordance with the General Conditions and as modified by the Supplemental Conditions.
- d. Samples.
- e. Testing plans, procedures, and testing limitations.



- f. Design data not sealed and signed by a design professional retained by Contractor, Subcontractor, or Supplier.
  - g. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, potential Hazardous Environmental Conditions, and similar reports.
  - h. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting.
  - i. Sustainable design submittals (other than sustainable design closeout documentation).
  - j. Lesson plans for training and instruction of Owner's personnel.
2. Closeout Submittals:
- a. Maintenance contracts.
  - b. Operations and maintenance data.
  - c. Bonds, such as maintenance bonds and bonds for a specific product or system.
  - d. Warranty documentation.
  - e. Record documentation.
  - f. Sustainable design closeout documentation.
  - g. Software.
3. Maintenance Material Submittals:
- a. Maintenance materials schedule and checklist.
  - b. Spare parts.
  - c. Extra stock materials.
  - d. Tools.
4. Quality Assurance Submittals:
- a. Performance affidavits.
  - b. Certificates.

- c. Source quality control submittals (other than testing plans, procedures, and testing limitations), including results of shop testing.
- d. Field or Site quality control submittals (other than testing plans, procedures, and testing limitations), including results of operating and acceptability tests at the Site.
- e. Supplier reports.
- f. Special procedure submittals, including health and safety plans and other procedural submittals.
- g. Qualifications statements.

**B. Submittal Requirements:**

- 1. Contractor shall submit electronic copy of submittals for Engineer's review via Procore Document Management, unless otherwise specified in individual Specification Sections. Acceptable electronic formats are Adobe PDF, Microsoft Word, Autodesk DWF and AutoCAD.
- 2. Submittal shall be accompanied by letter of transmittal containing date, project title, Contractor's name, number and title of submittal, list of relevant Specification Sections, notification of deviations from Contract Documents, and other material required for Engineer's review.
- 3. Submittals with internet hyperlinks and other references to online content shall not be considered, reviewed, and included as part of the submittal review procedure. Hyperlinks and other electronic references shall not be used to comply with specified requirements of the Contract Documents, unless specifically stated in the individual technical Specification Section.

**C. Scheduling:**

- 1. Provide submittals well in advance of the Work following Engineer's approval or acceptance of the associated submittal. Work covered by a submittal will not be included in progress payments until approval or acceptance of related submittals has been obtained in accordance with the Contract Documents.
- 2. Submittals shall be provided by Contractor with at least thirty (30) working days for review and processing.

**1.03 SCHEDULE OF SUBMITTALS**

**A. Schedule of Submittals, as specified in this Section:**

- 1. Timing:
  - a. Provide submittal within time frames specified in the Contract Documents.

- b. Provide updated Schedule of Submittals with each submittal of the updated Progress Schedule.
  2. Content: In accordance with the General Conditions as modified by the Supplementary Conditions, and this Section. Requirements for content of preliminary Schedule of Submittals and subsequent submittals of the Schedule of Submittals are identical.
    - a. Identify submittals required in the Contract Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Indicate submittals that are on the Project's critical path.
    - b. Indicate the following for each submittal:
      - 1) Date when submittals are requested and received from Supplier.
      - 2) Date when certification is received from Supplier and when submitted to Engineer.
      - 3) Date when submittals are submitted to Engineer and returned with disposition from Engineer.
      - 4) Date when submittals are revised by Supplier and submitted to Engineer.
      - 5) Date when submittals are returned with "Furnish as Submitted" (FAS) or "Furnish as Corrected" (FAC) disposition from Engineer.
      - 6) Date when approved submittals are returned to Supplier.
      - 7) Date of Supplier scheduled delivery of equipment and material.
      - 8) Date of actual delivery of equipment and material.
      - 9) Whether submittal will be for a substitution or "equal". Procedures for substitutions and "or equals" are specified in the General Conditions and the Section 01 25 00 – Substitution Procedures.
      - 10) For submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of other contractors.
  3. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules.
  4. Coordinate Schedule of Submittals with the Progress Schedule.
  5. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate submittals on the Project's critical path, or that places

extraordinary demands on Engineer for time and resources, is unacceptable. Do not include submittals not required by the Contract Documents.

6. In preparing Schedule of Submittals:
  - a. Considering the nature and complexity of each submittal, allow sufficient time for review and revision.
  - b. Reasonable time shall be allowed for: Engineer's review and processing of submittals, for submittals to be revised and resubmitted, and for returning submittals to Contractor.
  - c. Identify and accordingly schedule submittals that are expected to have long anticipated review times.

#### **1.04 ACTION/INFORMATIONAL SUBMITTALS**

- A. Provide the following Submittals in accordance with the individual Specification Sections, including, but not limited to, the following:

1. Product Data:
  - a. Catalog cut-sheets
  - b. Descriptive bulletins/brochures/specifications
  - c. Material of construction data, including details on all components including applicable ASTM designations.
  - d. Lifting, erection, installation, and adjustment instructions, and recommendations.
  - e. Finish/treatment data, including interior and exterior shop coating systems.
  - f. Equipment/material weight/loading data, including total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations following installation. Size, placement, and embedment requirements of anchor bolts.
  - g. Complete information regarding location, type, size, and length of all field welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.
  - h. Motor data including horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and full load; slip at full load; running, full load, and locked rotor current values; safe

running time-current curves; motor protective devices; and interconnection diagrams.

- i. Engineering design data, calculations, and system analyses
  - j. Digital system documentation
  - k. Operating sequence descriptions
  - l. Software/programming documentation
  - m. Manufacturer's instructions
2. Shop Drawings:
- a. Equipment and material layout drawings, including panel layout drawings.
  - b. System schematics and diagrams including, but not limited to, piping systems; HVAC and ventilation systems; process equipment systems; electrical operating systems; wiring diagrams; controls, alarm and communication systems.
  - c. Layout and installation drawings (interior and exterior) for all pipes, valves, fittings, sewers, drains, heating and ventilation ducts, all electrical, heating, ventilating and other conduits, plumbing lines, electrical cable trays, lighting fixture layouts, and circuiting, instrumentation, interconnection wiring diagrams, communications, power supply, alarm circuits, etc.
  - d. Layout and installation drawings shall show connections to structures, equipment, sleeves, valves, fittings, etc.
  - e. Drawings shall show the location and type of all supports, hangers, foundations, etc., and the required clearances to operate valves, equipment, etc.
  - f. Drawings for pipes, ducts, conduits, etc., shall show all 3 inch and larger electrical conduits and pressure piping, electrical cable trays, heating and ventilation ducts or pipes, structure, manholes or any other feature within four (4) feet (measured as the clear dimension) from the pipe duct, conduit, etc., for which the profile is drawn.
  - g. Equipment and material schedules.
3. Delegated design submittals, which include documents prepared, sealed, and signed by a design professional retained by Contractor, Subcontractor, or Supplier for materials and equipment to be incorporated into the completed Work. Delegated design submittals do not include submittals related to temporary construction unless specified otherwise in the related Specification Section.

Delegated design submittals include: design drawings, design data including calculations, specifications, certifications, and other submittals prepared by such design professional.

**B. Samples:**

**1. General Requirements:**

- a. Conform submittal of Samples to the General Conditions as modified by the Supplementary Conditions, this Section, and the Specification Section in which the Sample is specified.
- b. Furnish at the same time Samples and submittals that are related to the same unit of Work or Specification Section. Engineer will not review submittals without associated Samples and will not review Samples without associated submittals.
- c. Samples shall clearly illustrate functional characteristics of product, all related parts and attachments, and full range of color, texture, pattern, and material.

**2. Submittal Requirements:**

- a. Securely label or tag Samples with submittal identification number. Label or tag shall not cover, conceal, or alter appearance or features of Sample. Label or tag shall not be separated from the Sample.
- b. Submit number of Samples required in Specifications. If number of Samples is not specified in the associated Specification Section, provide at least one identical Samples of each item required for Engineer's approval. If Contractor requires Sample(s) for Contractor's use, notify Engineer in writing and provide additional Sample(s). Contractor is responsible for furnishing, shipping, and transporting additional Samples.
- c. Deliver one Sample to Engineer's field office at the Site. Deliver balance of Samples to location directed by Engineer.

**1.05 CLOSEOUT SUBMITTALS**

- A. Provide the following Closeout Submittals in accordance with the individual Specification Sections, including, but not limited to, the following:
1. Maintenance contracts
  2. Bonds for specific products or systems
  3. Warranty documentation
  4. Sustainable design closeout documentation.

5. Software programming and documentation.
- B. On documents such as maintenance contracts and bonds, include on each document furnished original signature of entity issuing the document.
- C. Operations and Maintenance Data: Submit in accordance with Section 01 78 23 – Operations and Maintenance Data.
- D. Record Documentation: Submit in accordance with Section 01 78 39 – Project Record Documents.
- E. Disposition: Dispositions and meanings are the same as specified for Informational Submittals.

#### **1.06 MAINTENANCE MATERIAL SUBMITTALS**

- A. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section. Furnish in accordance with Section 01 78 43 – Spare Parts and Extra Materials.
- B. Disposition: Dispositions and meanings are the same as specified for Informational Submittals.

#### **1.07 CONTRACTOR'S RESPONSIBILITIES**

- A. Contractor shall review, coordinate, and verify submittals with Subcontractors, Manufacturers, and Suppliers, including field measurements at Site, in accordance with the General Conditions and as modified by Supplemental Conditions prior to submitting material for Engineer's review.
- B. Contractor shall clearly and concisely indicate and mark equipment and material being submitted to meet the intent of the Contract Documents. Equipment and material not being submitted shall be deleted, stricken through, or otherwise designated not being submitted. Equipment and material data sheets shall be included once with cross references throughout the submittal. Multiple equipment and material data sheets for the same item within a submittal may receive a rejected disposition until corrected.
  1. Individual Specification Sections require a Compliance, Deviations, and Exceptions (CD&E) letter to be included with the submittal. When specified, submittals provided without the CD&E letter shall receive a rejected disposition without review.
  2. CD&E letter requirements:
    - a. Include a copy of entire Specification section with each paragraph and subparagraph noted with "C", "D", or "E" to indicate if equipment and material being provided is in compliance (C), deviates (D), or exceptions (E) are taken with the Contract Documents.

- 1) Compliance (C): Full compliance with the specified requirement.
  - 2) Deviation (D): Deviation from the specified requirement.
  - 3) Exception (E): Exception with the specified requirement.
- b. Include all comments, deviations and exceptions taken to the Contract Documents by the Contractor and Equipment Manufacturer/Supplier.
  - c. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable.
  - d. Address deviations and exceptions taken to each Contract Drawing related to the Specification section.
- C. Contractor shall provide Contractor's stamp of approval certifying submittal material has been reviewed and conform to the Contract Documents prior to submitting material for Engineer's review.
- D. Contractor shall provide written notice of deviations or variations that submittal may have with the Contract Documents.
- E. Contractor shall provide bound, dated, labeled, tabulated, and consecutively numbered submittals as specified in the individual Specification Section. Label shall contain the following:
1. Specification Section.
  2. Referenced Drawing number.
  3. Subcontractor or Supplier name.
  4. Type of equipment and/or materials.
- F. Contractor shall perform the following after receiving Engineer's review disposition:
1. Order, fabricate, or ship equipment and materials included in the submittal (pending Engineer's review of source quality control submittals) with the following disposition:
    - a. "Furnish as Submitted" (FAS).
    - b. "Furnish as Corrected" (FAC).
    - c. "Furnish as Corrected – Confirm" (FACC), only portions of Work that do not require resubmittal for Engineer's review.
  2. Resubmittal requirements:



- a. Partial resubmittal of “Furnish as Corrected – Confirm” (FACC) returned dispositions, until Engineer’s disposition is either “Furnish as Submitted” (FAS) or “Furnish as Corrected” (FAC).
- b. Full resubmittal of material with Engineer’s disposition of “Revise and Resubmit” (R&R), until Engineer’s disposition is “Furnish as Submitted” (FAS), “Furnish as Corrected” (FAC), or “Furnish as Corrected – Confirm” (FACC) that requires a partial resubmittal.
- c. Contractor shall be responsible for Engineer’s charges to Owner if submittals are not approved within the number of specified submittals in accordance with the General Conditions. Engineer’s charges shall include, but not limited to, additional review effort, meetings, and conference calls with Contractor, Subcontractor, or Supplier.

**1.08 ENGINEER’S REVIEW**

- A. Engineer’s review of the Contractor’s submittal shall not relieve Contractor’s responsibility under the Contract Document in accordance with the General Conditions and as modified in the Supplemental Conditions. An acceptance of a submittal shall be intended to mean the Engineer does not have specific objection to the submitted material, subject to conformance with the Contract Drawings and Specifications.
- B. Engineer’s review of Contractor’s submittal shall be confined to general arrangement and compliance with the Contract Documents, and shall not be for the purpose of checking dimensions, weights, clearances, fittings, tolerances, interferences, coordination of Subcontractor work, etc.
- C. Review Dispositions:
  - 1. “Furnish as Submitted” (FAS) – No exceptions are taken.
  - 2. “Furnish as Corrected” (FAC) – Minor corrections are noted for Contractor’s correction.
  - 3. “Furnish as Corrected – Confirm” (FACC) – Corrections are noted and partial resubmittal shall be made as noted.
  - 4. “Revise and Resubmit” (R&R) – Corrections are noted and complete resubmittal shall be made. Submittal does not conform to applicable requirements of the Contract Documents and is not acceptable. Revise submittal and re-submit to indicate acceptability and conformance with the Contract Documents.
  - 5. “Receipt Acknowledged” (RA) –
    - a. Information included in submittal conforms to the applicable requirements of the Contract Documents and is acceptable. No further action by Contractor is required relative to this submittal, and the Work covered by the submittal

may proceed, and products with submittals with this disposition may be shipped or operated, as applicable.

- b. Information included in submittal is for Project record purposes and does not require Engineer's review or approval.
  
- 6. "Rejected" (R) – Information included in submittal does not conform to the applicable requirements of the Contract Documents and is unacceptable. Contractor shall submit products and materials as specified in the Contract Documents or provide required information for substitution as specified in the Contract Documents for consideration by Engineer.
  
- D. Electronic Submittal Return to Contractor: Electronic submittals shall be returned electronically with dispositions provided.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

**<sup>1</sup>SECTION 09 90 00  
PAINTING**

**PART 1 – GENERAL**

**1.01 THE REQUIREMENT**

- A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.
- B. Section Includes:
  - 1. Paint Materials
  - 2. Shop Painting
  - 3. Field Painting
    - a. Surface Preparation
    - b. Piping and Equipment Identification
    - c. Schedule of Colors
    - d. Work in Confined Spaces
    - e. OSHA Safety Colors

**1.02 RELATED SECTIONS**

- A. Section 40 05 97 – Piping and Equipment Identification Systems
- B. Section 07 90 00 – Joint Fillers, Sealants, and Caulking

**1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS**

- A. Without limiting the generality of these specifications, the Work shall conform to the applicable requirements of the following documents:
  - 1. SSPC – The Society for Protective Coatings Standards
    - a. SSPC-Vis 1 – Pictorial Surface Preparation Standards for Painting Steel Structures
    - b. SSPC-SP2 – Hand Tool Cleaning
    - c. SSPC-SP3 – Power Tool Cleaning

- d. SSPC-SP5/NACE 1 – White Metal Blast Cleaning
  - e. SSPC-SP6/NACE 3 – Commercial Blast Cleaning
  - f. SSPC-SP7/NACE 4 – Brush-off Blast Cleaning
  - g. SSPC-SP10/NACE 2 – Near-White Metal Blast
  - h. SSPC-SP11 – Power Tool Cleaning to Bare Metal
  - i. SSPC-SP13/NACE6 – Surface Preparation of Concrete
- 2. ICRI – International Concrete Repair Institute
  - 3. NACE – National Association of Corrosion Engineers
  - 4. NAFP – The National Association of Pipe Fabricators
  - 5. ASTM D1737 – Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
  - 6. ASTM B117 – Method of Salt Spray (Fog) Testing
  - 7. ASTM D4060 – Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser
  - 8. ASTM D3359 – Method for Measuring Adhesion by Tape Test

#### **1.04 SUBMITTALS**

- A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, submit the following:
  - 1. Manufacturer's literature and Material Safety Data Sheets for each product.
  - 2. Painting schedule identifying surface preparation and paint systems proposed. Cross reference with Tables 1 and 2. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the Award of Contract, so approved schedule may be used to identify colors and specify shop paint systems for fabricated items. Manufacturer shall substitute paint system with equal performance where required for VOC compliance.
  - 3. Contractor shall submit Q.C. Inspection plan describing all tests and inspections task to be performed. Include copy of daily log showing environmental conditions measurements and frequency. Copy of completed log shall be provided at completion of work.

### **1.05 SYSTEM DESCRIPTION**

- A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping, miscellaneous metals, equipment, buildings, exterior fiberglass, exposed electrical conduit and appurtenances.
- B. Perform Work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.
- C. Paint surfaces which are customarily painted, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.
- D. Submerged ferrous metal, piping, and internal pump surfaces within potable water facilities or potable water distribution systems shall be painted with NSF 61/600 approved coatings.
- E. Piping and equipment shall receive color coding and identification. Equipment shall be the same color as the piping system.

### **1.06 QUALITY ASSURANCE**

- A. Painting operations shall be accomplished by skilled craftsman and licensed by the state/commonwealth to perform painting work.
- B. Provide a letter indicating that the painting applicator has five years of experience, and 5 references which show previously successful application of the specified or comparable painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.
- C. Contractor shall coordinate Q.C Inspections.
- D. Notify Owner and Engineer at completion of surface preparation, priming application and final cure to allow inspection by Owner and Engineer or their Third-Party Inspector.

### **1.07 STORAGE AND DELIVERY**

- A. Bring materials to the job site in the original sealed and labeled containers.
- B. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

- C. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

## **PART 2 – MATERIALS**

### **2.01 GENERAL INFORMATION**

- A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.
- B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the Work identifying products used and verifying that surfaces were properly prepared, products were properly applied, and the paint systems were proper for the exposure and service.
- C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.
- D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.
- E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.
- F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

### **2.02 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:

- 1. Tnemec Company Inc.

2. PPG
3. CARBOLINE
4. Sherwin-Williams
5. International Paints (Akzo Nobel)

## **PART 3 – EXECUTION**

### **3.01 SHOP PAINTING**

- A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.
- B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.
- C. Coordinate shop painting and field coating to ensure item is delivered and field coating occurs within recoat window of shop painted system requirements.

### **3.02 SURFACE PREPARATION**

- A. General
  1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.
  2. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.
  3. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.
  4. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where

manufacturer recommends additional surface preparation, in addition to requirements of specification.

5. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touchup coats are in addition to the specified applied systems, and not considered a field coat.
6. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.
7. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

#### B. Metal Surface Preparation

1. Prepare all welds to a minimum NACE weld preparation level "C" per NACE Standard SP0178. Provide additional weld preparation where required by the coating manufacturer. Contractor shall provide NACE SP0178 weld mold visual aids on site for evaluation of all weld preparation.
2. Conform to current The Society for Protective Coatings Standards (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.
3. Perform blast cleaning operations for metal when following conditions exist:
  - a. Moisture is not present on the surface.
  - b. Relative humidity is below 80%.
  - c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.
  - d. Painting or drying of paint is not being performed in the area.
  - e. Equipment is in good operating condition.
  - f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.
4. Abrasive blast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP5, White Metal Blast.



5. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or in severe service. Provide a 3.0 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
6. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-corrosive environment or weathering exposure. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
7. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system. Galvanized metal shall be prepared in accordance with SSPC SP-16. Abrasive blast clean to increase mechanical adhesion in accordance with ASTM D6386, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting when required by coating manufacturer. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
8. Abrasive blast clean internal and external ductile iron pipe surfaces prior to coating in accordance with NAPF 500-03-04, Surface Preparations Standard for Abrasive Blast Cleaning of Ductile Iron Pipe. Abrasive blast clean internal and external cast ductile iron and cast-iron fitting surfaces in accordance with NAPF-03-05.
9. Prime cleaned metals immediately after cleaning to prevent rusting.
10. Clean rusted metals down to bright metal by abrasive blasting and immediately field primed.

#### C. Concrete Surface Preparation

1. Cure concrete a minimum of 28 days at 75° F before surface preparation, and painting begins. Allow more time at lower temperatures if specified by paint manufacturer.
2. Test concrete for pH and salts using test methods recommended by the paint manufacturer. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer. Do not begin surface preparation, or painting until acceptable to manufacturer.
3. Moisture content of concrete and masonry surfaces shall conform to manufacturer's recommended limits, and as listed in SSPC-SP13/NACE 6 Section 6 Acceptance Criteria Table 1. Floor surfaces to be coated shall be tested in accordance with ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride or as required by the coating manufacturer. Moisture vapor transmission shall not

exceed three pounds per 1,000 square feet in a 24-hour period or less if specified by Coating Manufacturer. Vertical and horizontal overhead surfaces shall be tested in accordance with ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes (relative humidity shall not exceed 80% or as required by the coating manufacturer) or with ASTM D4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Test Method (test results shall be no moisture present). Engineer or Coating Manufacturer Representative shall specify all test locations. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer.

4. Prepare concrete surfaces to receive coatings in accordance with NACE 6/SSPC-13 – Joint Surface Preparation Standards and ICRI Technical Guidelines. Remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities using abrasive blasting, shot blasting, water jetting or mechanical abrading. Use dry, oil-free air for blasting operations. Surface texture after blasting shall achieve profile as required by manufacturer or where not defined by manufacturer, profile shall be a minimum ICRI-CSP 5 surface profile. Remove residual abrasives, dust, and loose particles by vacuuming or other approved method.
5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric or waterborne epoxy cementitious filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.
6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.
7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.
8. To ease coating around outside corners, provide ¾-inch chamfered edges on all new concrete outside corners and grind existing concrete outside corners to a minimum radius of ¾-inch.
9. Unless recommended otherwise by the coating manufacturer, provide ¼" deep by ¼" wide tool cut terminations at 1-inch maximum from all coating edges for anchorage. Provide terminations around all equipment, piping, openings, gates, top and bottom of walls, stop locations of each day's work and overlap onto previously completed work. Transition coating 3-inches onto interior lining of piping except where coating compatibility concerns are noted by coating manufacturer.

10. Apply epoxy or polymeric filler compatible with painting system to all inside corners of areas to be coated with a margin trowel to form a continuous 45-degree cant cove across corners with a minimum dimension of 1.5-inch. Roughen or prepare cured filler as recommended by coating manufacturer for proper coating adhesion.
11. All equipment grouting shall be installed and cured prior to starting coating work. Coating shall be applied over grout up to the edges of all equipment, gates and uninterrupted piping unless specifically noted otherwise.

#### D. Wood

1. Clean wood surfaces free of all foreign matter, with cracks and nail holes and other defects properly filled and smoothed. Remove sap and resin by scraping and wipe clean with rags dampened with mineral spirits.
2. Saturate end grain, cut wood, knots, and pitch pockets with an appropriate sealer before priming.
3. Prime and backprime wood trim before setting in place.
4. After prime coat has dried, fill nailholes, cracks, open joints, and other small holes with approved spackling putty. Lightly sand wood trim prior to applying second coat of paint.

#### E. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.
2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

#### F. Masonry

1. Cure for a minimum of 30 days prior to paint application.
2. Clean masonry surfaces free from all dust, dirt, oil, grease, loose mortar, chalky deposits, efflorescence, and other foreign materials.
3. Test masonry for moisture content. Use test method recommended by paint manufacturer. Do not begin painting until moisture content is acceptable to manufacturer.

#### G. Gypsum Drywall

1. Sand joint compound with sandpaper to provide a smooth flat surface. Avoid sanding of adjacent drywall paper.
2. Remove dust, dirt, and other contaminants.

#### H. Previously-Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.
2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.
3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.
4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.
5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

#### 3.03 APPLICATION OF PAINT

- A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.
- B. Apply paint without runs, sags, thin spots, or unacceptable marks.
- C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.
- D. Special attention shall be given to nuts, bolts, edges, angles, flanges, welds, etc., where insufficient film thicknesses are likely. Stripe paint outside corners and edges in accordance with SSPC PA Guide 11. Stripe painting shall be in addition to coats specified.
- E. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.
- F. Allow paint to dry a minimum of twenty-four hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.
- G. Suspend painting when any of the following conditions exist:
  1. Rainy or excessively damp weather.

2. Relative humidity exceeds 85%.
  3. General air temperature cannot be maintained at 50°F or above through the drying period, except on approval by the Engineer and paint manufacturer.
  4. Relative humidity will exceed 85% or air temperature will drop below 40°F within 18 hours after application of paint.
  5. Surface temperature of item is within 5 degrees of dewpoint.
  6. Dew or moisture condensation are anticipated.
  7. Surface temperature exceeds the manufacturer's recommendations.
- H. Where application of coating across concrete control joints or expansion joints has the potential to crack, turn coating into joints and caulk joints with a sealant compatible with coating rated for the intended service per Section 07 90 00 – Joint Fillers, Sealants, Caulking.

### **3.04 INSPECTION**

- A. Each field coat of paint will be inspected and approved by the Engineer or the Engineer's authorized representative before succeeding coat is applied. Tint successive coats so that no two coats for a given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.
- B. Use magnetic dry film thickness gauges and wet fiber thickness gauges for quality control. Furnish magnetic dry film thickness gauge for use by the Engineer.
- C. Coatings shall pass a holiday detector test.
- D. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.
- E. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.

1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, 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 specified coating thickness.
  2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Razor Model M1 non-destructive type holiday detector, K-D Bird Dog, 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-Flow, shall be added to the water prior to wetting the detector sponge.
- F. Paint manufacturer's NACE certified representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

### **3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES**

- A. Use covers, masking tape, other method when protection is necessary, or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lapmarks and without additional cost to the Owner.
- B. Take all necessary precautions to contain dispersion of abrasive blasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the abrasive blasting debris and paint. Suspend painting operations when abrasive blasting debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

### **3.06 PIPING AND EQUIPMENT IDENTIFICATION**

- A. Piping and equipment identification shall be in accordance with Section 40 05 97 – Piping and Equipment Identification Systems.

### **3.07 SCHEDULE OF COLORS**

- A. Match colors indicated. Piping and equipment colors are indicated in Section 40 05 97 – Piping and Equipment Identification Systems. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Engineer. No variation shall be made in colors without the Engineer's approval. Color names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

### **3.08 WORK IN CONFINED SPACES**

- A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forceddraft fans and temporary ducts to the outside, or direct air supply to individual workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosionproof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state/commonwealth, and local regulations at all times.

### **3.09 OSHA SAFETY COLORS**

- A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not to exceed 2 feet wide by 3 feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.
- B. Paint hazardous areas and objects in accordance with OSHA regulations.

### **3.10 VOC REGULATIONS**

- A. Provide paint systems in accordance with local, state, and federal regulations. Where paint systems shown in schedule do not comply, substitute equal products with VOC limits which comply with local, state, and federal regulations.

**Table 1: Painting Schedule**

Surface	Application	Painting System and No. of Coats	Product Reference (Table 2)	Total Min. Dry Film Thickness (Mils)
<b>Concrete and Masonry</b>				
Interior masonry and concrete walls, columns, beams, and ceilings	All new structures	1 coat sealer 2 coats acrylic epoxy	101 116	75-85 sq.ft./gal. 4-6/coat
Interior masonry and concrete walls, columns, beams, and ceilings in chemical rooms		1 coat sealer 2 coats epoxy polyamide	117 102	60-80 sq.ft./gal. 4-6/coat
Exterior masonry cavity walls on cavity face of inner wythe	All new structures	Dampproofing	See Section 07 11 00	
Exterior below grade if interior is dry	Accessible areas (e.g. pipe galleries, pump rooms, basements, etc.)	Waterproofing	See Section 07 13 50	
Submerged or occasional contact with potable or raw water	Water retaining side of new wall surfaces where opposite side of wall is interior and dry and where indicated "epoxy waterproofing" on drawing	2 coats NSF 61/600 approved epoxy polyamide Provide filler as required and recommended by manufacturer	105	4-6/coat
Submerged wastewater	Water retaining side of new wall surfaces where opposite side of wall is interior and dry and where indicated "epoxy waterproofing" on drawing	2 coats high solids epoxy Provide filler as required and recommended by manufacturer	119	6-10/coat
Containment Liner <sup>1</sup>	Interior and exterior secondary containment floors, tank supports and walls	2 coats high solids epoxy coating	119	6-10/coat
<b>Metals</b>				
Interior and exterior nonsubmerged (gloss)	All new blowers, pumps, motors and mechanical equipment, piping, etc.	1 coat epoxy polyamide primer 1 coat epoxy polyamide 1 coat aliphatic polyurethane	104 102 115	4-6 4-6 3-5
Interior insulated		1 coat acrylic latex	103	4
Submerged or occasional contact with potable or raw water	All metal piping, mechanical equipment, etc.	2 coats NSF 61/600 approved epoxy polyamide	105	4-6/coat
Submerged Wastewater		2 coats high solids epoxy	119	8-10/coat
Steel doors, windows and door frames, steel stairs, monorails, structural steel, misc. metals (steel), galvanized lintels,		1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4
Aluminum surfaces in contact with concrete		2 coats coal tar	107	26
Shop Primed Structural Steel	Pre-Engineered Buildings	1 tie coat 1 coat epoxy 1 coat epoxy	113 114 120	2-3 3-4 3-4
<b>Other</b>				
Interior: Gypsum Wallboard	All new structures	2 coats acrylic latex matte or satin	103	2-3/coat



Surface	Application	Painting System and No. of Coats	Product Reference (Table 2)	Total Min. Dry Film Thickness (Mils)
Interior: Tar-dipped piping where color is required		1 coats epoxy resin sealer	112	2-3/coat
		1 coats epoxy polyamide	102	5-8/coat
PVC Piping		1 coat epoxy polyamide	102	5-8
		1 coat aliphatic polyurethane	115	3-4

1 Painting manufacturer shall verify compatibility of containment liner and chemical to be contained. Where incompatible substitute a compatible coating system.

Ref.	System	Purpose	Product			
			Tnemec Series	PPG	CARBOLINE	Sherwin-Williams
101	Acrylic filler	Primer-sealer	130-6601	BLOXFIL 400BF	Sanitile 100	Pro-Industrial Heavy Duty Block Filler
102	Epoxy polyamide	Finish coat semi-gloss or gloss	N69	AMERLOCK 600 (SEMI-GLOSS)	Carboguard 890	Macropoxy 646
103	Acrylic latex	Sealer	1028/1029	PITT TECH PLUS	Carbocrylic 3359DTM	DTM Acrylic Primer/Finish
104	Epoxy Polyamide – metal	Primer	66	AMERCOAT 600	Carboguard 893SG	Macropoxy 646
105	Epoxy polyamide	Primer/Finish	L140	AMERLOCK 2 VOC	Carboguard 61/891VOC	Macropoxy 646 PW
106	Coal tar epoxy	Finish high-coat build	46H-413	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
107	Coal tar	Sealer	46-465	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
108	Alkyd-medium oil	Finish coat	2H	HP INDUSTRIAL ALKYD 4308	Carbocoat 8215	Industrial Enamel
109	Alkyd-long oil	Finish coat	1029	HP INDUSTRIAL ALKYD 4308	Carbocoat 8215	Industrial Enamel
110	Epoxy polyamide	Primer	66-1211	AMERCOAT 600	Carboguard 893SG	Macropoxy 646
112	Epoxy polyamide	Sealer	66-1211	AMERLOCK SEALER	Carboguard 893SG	Macropoxy 920 Pre-Prime
113	Urethane	Barrier coat	530	AMERLOCK SEALER	Rustbond	-
114	Polyamine Epoxy	Intermediate coat	27	AMERLOCK 600	Carboguard 893SG	-
115	Aliphatic Polyurethane	Finish coat	1094 or 1095	PITTHANE ULTRA SERIES	Carbothane 134HG	Acrolon 218HS
116	Acrylic epoxy	Finish coat	113 or 114	AQUAPON WB EP	Sanitile 255	Pro-Industrial Water-Based Catalyzed Epoxy
117	Epoxy block filler	Sealer	1254	AMERLOCK 400BF	Sanitile 500	Kem Cati-Coat HS Epoxy Filler
118	Catalyzed epoxy	Finish coat	84	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
119	High solids epoxy	Finish coat	104	AMERLOCK 240	Carboguard 890	Dura-Plate 235
120	Epoxy	Top coat	N69	AMERLOCK 240	Carboguard 890	-

**Table 2: Product Listing**

**END OF SECTION**

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1

**SECTION 26 05 61**  
**MEDIUM VOLTAGE ELECTRIC MOTORS**

**PART 1 – GENERAL**

**1.01 THE REQUIREMENT**

- A. The Contractor shall furnish all labor, materials, tools and equipment necessary for furnishing, installing, connecting, testing and placing into satisfactory operation all medium voltage electric motors as shown on the Drawings and specified herein. All medium voltage motors required for this Contract shall comply with this Section unless otherwise noted.
- B. Reference Section 09 90 00 – Painting and the applicable Sections of Divisions 40 through 46.
- C. Medium voltage motors are defined as motors rated 2.3 thru 15kV.

**1.02 SUBMITTALS**

- A. In accordance with the procedures and requirements set forth in the General Conditions and Division 01 – General Requirements, the Contractor shall obtain from the equipment manufacturer and submit the following:
  - 1. Shop Drawings.
  - 2. Preliminary Operation and Maintenance Manuals.
  - 3. Final Operation and Maintenance Manuals.
  - 4. Spare Parts List.
  - 5. Reports of Certified Shop Tests.
- B. Each submittal shall be identified by the applicable Equipment Identification Number and Specification Section.
- C. Shop Drawings
  - 1. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
  - 2. Partial, incomplete or illegible submissions will be returned to the Contractor without review for resubmittal.

3. Shop drawings shall include, but not be limited to:
  - a. Equipment specifications and data sheets identifying all materials used and methods of fabrication.
  - b. Motor data shall also include the following:
  - c. Full load power rating (HP) and service factor
  - d. Full load speed (rpm)
  - e. Rated voltage and rated frequency
  - f. Enclosure
  - g. Mounting position
  - h. Type of bearings, lubrication and design thrust
  - i. Temperature rise of stator windings (°C) at continuous 1.0 service factor
  - j. Maximum ambient temperature (°C) if >40°C
  - k. Altitude above sea level (ft) if >3300 ft
  - l. Design inertia of the load (at motor speed)
  - m. Direction of rotation (CW or CCW) as viewed from NDE of the motor
  - n. Design torque at locked rotor, minimum and BDT in % of the motor full load torque
  - o. Locked rotor and full load amps
  - p. Guaranteed efficiency at full, 3/4 and 1/2 load
  - q. Power factor at full, 3/4 and 1/2 load
  - r. Motor sound power levels
  - s. Vibration in velocity measured at bearing housings
  - t. Rotor inertia
  - u. X/R, T<sup>d</sup>, T<sub>a</sub>
  - v. Speed range and load profile when driven by a variable frequency drive
  - w. Number of allowed starts

- x. Number of days of startup included
- y. Number of days of training
- z. Comments and exceptions to specifications (if any)
- aa. Example equipment nameplate data sheet.
- bb. Connection wiring diagrams.
- cc. List of recommended lubricants.
- dd. Motor Test Data Sheets shall be submitted
- ee. An outline drawing or an outline data sheet showing complete motor dimensions. Drawings or sheets shall bear complete identifying data including frame size, speed, horsepower ratings and application for each particular unit.
- ff. Description of proposed shop and field testing methods, procedures and apparatus with calibration dates shall be submitted. Testing methods and procedures shall be submitted at least 45 days in advance prior to confirmation of witness testing dates and actual testing.
- gg. Qualifications of proposed testing, firm to perform acceptance testing shall be submitted. Submit records of firm's experience at least 45 days prior to actual testing. Five recent references with phone numbers shall be submitted.
- hh. Data for all motor accessories, heaters, detectors, etc., shall be submitted.

#### D. Operations and Maintenance Manuals

1. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 01 - General Requirements.
2. Two copies of a preliminary O&M manual shall be included in the shop drawing submittal. Without inclusion of these manuals, the submittal will be considered incomplete and will be returned without review.

#### E. Lubricants

1. The manufacturer shall submit a list with a minimum of four manufacturer's standard lubricants which may be used interchangeably for each type of lubricant required.

2. The Contractor shall utilize this list in preparing his comprehensive lubrication survey as specified in Division 01 - General Requirements.

F. Certificates of Compliance

1. Certified copies of motor characteristic curves and all other data necessary for establishing control and protective equipment settings shall be submitted.
2. Results of unwitnessed shop tests shall be certified. Routine tests in conjunction with complete initial tests shall be submitted and accompanied by a certificate of authenticity sworn to before a notary public by an officer of the manufacturing company. Results shall be included for each test.

Upon receipt of the certified test reports, witness shop tests shall be scheduled and the Engineer shall be notified of the witness test date.

3. Results of the witness tests shall be submitted with copies of certified initial tests, accompanied by a certificate of authenticity sworn to before a notary public by an officer of the manufacturing company.

Upon approval of the witness shop tests, release for shipment to site shall proceed and the Engineer shall be notified of the arrival date.

G. Reports

1. Certified shop tests, witnessed shop tests and field test reports shall be submitted.
2. Manufacturer's site visit and acceptance testing reports shall be submitted.

**1.03 REFERENCES**

- A. Equipment shall comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. National Electrical Code (NEC)
  2. NEMA MG1 – Motors and Generators
  3. UL 547 – Thermal Protectors for Electric Motors
  4. UL 674 – Electric Motors and Generators for Use in Hazardous Locations
  5. UL 1004 – Electric Motors
  6. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings
  7. ABMA 11 – Load Ratings and Fatigue Life for Roller Bearings

8. IEEE 85 – Sound Tests
  9. IEEE 112 – Test Procedure for Polyphase Induction Motors and Generators
  10. ANSI C5 – General Requirements for Synchronous Machines
  11. NETA. ATS – International Electrical Testing Association Acceptance Testing Specifications
- B. Where conflict arises between the local codes and the requirements of the National Electrical Code, the National Fire Code, ASTM, etc., the more stringent requirements shall prevail.

#### **1.04 DESIGN REQUIREMENTS**

- A. Motors shall be designed, built and tested in accordance with the latest applicable editions of ANSI/IEEE, NEMA, NFPA and UL. The classifications, ratings, performance and testing of all motors shall be in accordance with the latest edition of NEMA Publication No. MG 1.
- B. Motors shall be of sufficient capacity to operate the driven equipment under all conditions of operation imposed by the driven equipment without loading the motors beyond their rated nameplate's current and power.
- C. The rating of the motors offered shall in no case be less than the horsepower shown on the Contract Drawings or stated herein. Both the rating and the characteristics of the motor shall be suitable for the successful operation of the driven equipment, under load conditions, within its nameplate's values of service factor and ambient temperatures.
- D. All motors shall be continuous time rated suitable for operation in a 40 degrees C ambient temperature.
- E. Motors specified shall meet the requirements of an energy efficient motor as defined by NEMA MG1 energy efficiency requirements. Motors with horsepower or RPMs not listed by NEMA shall conform to standards of construction and materials comparable to those for listed NEMA motors.
- F. Motors operated from variable frequency drives shall comply with NEMA MG 1 performance standards for inverter duty motors.

### **PART 2 – PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be



designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

- B. Electric motors shall be Premium Efficiency motors manufactured by ABB/Baldor/Reliance Electric Company, Siemens, Nidec Motors, General Electric Company or equal.

## **2.02 MATERIALS AND CONSTRUCTION**

### **A. General**

1. The motor types specified under this Section shall include three phase, 60 Hertz, alternating current, squirrel cage, medium voltage induction motors, horizontal or vertical shaft, as specified in the mechanical equipment Sections.
2. Motors shall be designed to meet the application requirements and to have a minimum locked rotor torque of 60% and a minimum breakdown torque of 200% at full voltage. At the specified starting conditions, the motors shall have a minimum of 10% torque margin throughout the driven equipment load curve.
3. Motor rated horsepower shall be sized with a minimum 5% margin on the maximum brake-horsepower for any normal operating condition.
4. Motors for use with variable frequency drives (VFD) shall be inverter duty and shall meet an 80°C temperature rise at 1.0 service factor at maximum rated speed with the VFD waveform. The motor shall be designed to meet the 80°C maximum temperature rise throughout the speed range.

### **B. Stator Core**

1. The stator core shall consist of low loss electrical steel laminations insulated on both sides with separate air vent spacers. The core shall be secured by fingerplates on each end and held in compression by welded cross members or through bolts.
2. The stator core shall be supported by a rigid frame structure. This frame shall transmit to the foundation all static and dynamic forces associated with normal operation and all expected fault conditions.
3. The stator lamination steel shall be 24-gauge with M-19 grade (or better) material which will minimize hysteresis and eddy current losses to yield a maximum core loss of 2.08 watts/lb at 1.5 Tesla. The lamination steel shall also be a C5 core plate capable of burnout temperatures (during rewinding) of 400°C. The core shall be designed to operate with a maximum tooth density of 90,000 lines per square inch at rated voltage.

### **C. Stator Windings**

1. All motors shall be adequately braced to permit across-line full voltage starting. The stator windings and motor leads shall have Class F or H insulation with copper conductors. Class F insulation shall be provided for non-inverter duty motors and Class H insulation shall be provided for inverter duty motors. In either case, temperature rise shall be limited to that for Class B insulation.
2. Motors shall be form wound with mica tape insulation. Slot liners shall be installed prior to coil insertion. The end coil bracing shall be in place prior to the VPI process. The completely wound stator shall be vacuum pressure impregnated to provide a rigid, sealed insulation system capable of passing an immersion test per NEMA MG 1 Part 20.18.
3. Windings shall be epoxy coated. The windings shall be thoroughly treated with approved insulating compound suitable for protection against moisture, salt air and slightly acid or alkaline conditions. The insulation system for enclosed motors shall be upgraded by additional dips and bakes to increase moisture resistance.
4. Motors shall have an inverter grade insulation system designed and built in accordance with NEMA MG1 Part 31.
5. The stator windings and end turn connections shall be fully brazed to withstand full voltage starting regardless of the starting method indicated. The bracing system shall essentially eliminate coil vibration under high current conditions of starting as well as during normal operation. If a tied system is used, it shall be such that no tie depends on the integrity of any other tie within the system.
6. Stator windings shall be connected externally in the motor junction box to accommodate a differential protection scheme as specified herein and indicated on the Drawings.

#### D. Bearings

1. The motors shall have spherical roller thrust bearings at the non-drive end (top). All anti-friction thrust bearings shall be designed for an L10 life of 100,000 hours (including pump design thrust and rotor weight). For applications with higher thrust loads (which cannot meet the L10 life) plate-type thrust bearings and oil lubricated sleeve guide bearings shall be used. The oil sump shall be designed to maintain a maximum 40°C temperature rise. Motors shall be designed for the necessary upthrust.
2. Motors shall be provided with non-reverse ratchets (or similar devices) rated at 100% of motor full load torque. In lieu of such device to prevent reverse rotation, the motor shall be designed and built so that it is capable of safely running in the reverse direction without damage at a speed twenty (20) percent higher than the reverse runaway speed under the maximum turbining head specified, as calculated by the pump manufacturer. The maximum head shall be predicated on

the failure of the pump discharge check valve to operate coupled with simultaneous power failure of the motor.

3. When required by motor speed and bearing size, provision shall be made for forced lubrication. The oil supply shall be supplied with motor. In addition, oil rings and an adequate oil reservoir in the bearing housings shall be provided to permit orderly shutdown of the motor in the event of failure of the forced feed lubrication system.

#### E. Enclosures

1. **Frame and Construction:** The motor frame shall be welded from thick steel members to provide adequate strength and rigidity to meet the vibration levels specified herein. The external side panels of the motor enclosure shall be fabricated from plate steel with a minimum thickness of 1/4". Enclosures manufactured with synthetic materials such as plastic or fiberglass are not acceptable. The bearing bracket shall be secured to the frame with a rabbet fit. There shall be pilot holes for dowel pins in the motor feet. The motor feet shall be tapped for vertical jacking bolts with SAE fine threads (16/inch).
2. Motor enclosures shall conform to the NEMA classifications specified in the Division 43 – Process Gas and Liquid handling, Purification, and Storage Equipment. Motors shall have a steel or cast-iron frame, cast iron end brackets and steel conduit box.
  - a. Vertical motors of the open type shall be provided with drip hoods of approved shape and construction. When the drip hood is too heavy to be easily removed, provision shall be made for access for testing.
  - b. Open motors shall be provided with corrosion resistant screens over the air openings in accordance with NEMA requirements for guarded machines. All enclosures shall be provided with stainless steel corrosion resistant screens over all openings and reusable washable inlet air filters and differential pressure switches.
3. The internal cooling air of all motors shall circulate from both ends of the motor towards the center of the rotor and stator lamination stacks, then through vents in the rotor and stator laminations (symmetrical cooling) to the exhaust openings or heat exchanger. Under no circumstances shall uni-directional (asymmetrical) cooling airflow be utilized due to the uneven heat distribution caused particularly in the rotor and bearings.
4. All motors shall include corrosion resistant bolts.
5. Drain(s) shall be provided in the lowest location(s), as necessary, to eliminate the accumulation of liquids.

6. There shall be a metal arrow on each end of the motor indicating direction of rotation. The arrows shall be stainless steel and fasten to the motor frame with stainless steel drive pins.
7. There shall be four air gap inspection ports on each end of the motor. Fans and air baffles shall be designed to accommodate air gap measurement.
8. Motors shall be capable of being lifted in one piece and fully assembled when shipped.
9. Motor conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Motor conduit box shall be in accordance with the following:
  - a. The main terminal box shall be made of welded sheet steel, sized for stress cones and have a minimum size of ANSI type II.
  - b. The box shall be sized for all components specified such as lightning arresters, surge capacitors, motor differential current transformers, etc. The box shall be completely rotatable 360-degrees in 90-degree increments.
  - c. A separate cast aluminum motor mounted terminal box or boxes shall be provided for RTDs, space heaters, bearing relays and any other specified accessories wired to ring tongue/screw type terminal blocks. The box shall be completely rotatable 360-degrees in 90-degree increments.
  - d. Conduit box shall be gasketed and shall include rubber-like gaskets between the frame and the conduit box and between the conduit box and its cover.
  - e. Conduit boxes or openings in motor housings shall be provided with conduit hub type fittings to permit threaded conduit connections.
  - f. Terminal leads shall be flexible and shall be of sufficient length to extend for a distance of not less than ten inches beyond the face of the terminal box. Terminal leads shall be fitted with solderless lugs suitable for attachment to lugs installed on external wiring. Leads shall be sealed with a non-wicking, non-hygroscopic insulating material or an insulating wrap-cap as manufactured by Ideal Industries.
  - g. Provisions for terminal box size, length of leads, size of conduit openings and type of terminal lugs shall be complied with irrespective of any other standards or practice.
  - h. A motor frame grounding stud shall be provided inside the conduit box. A drilled and tapped hole shall be included.

#### F. Balancing and Vibration

1. Rotors shall be dynamically balanced with a half key to grade G1 per ISO 1940 to insure low vibration levels. The vibration levels shall be measured on the bearing housing in the X, Y and Z direction at rated speed with the fully assembled machine mounted on a rigid foundation per NEMA MG 1 Part 7.6.2. The vibration spectrum shall be recorded and include frequencies up to 5 times operating speed. The maximum allowable no-load vibration (filtered) shall be 0.08 in/sec.

G. Sound Level

1. The average sound pressure level ( $L_{pm}$ ) of motors shall not exceed 85 dBA at 3 feet measured according to IEEE 85 in a free field at no-load. If it is not possible to meet 85 dBA the motor vendor shall state the minimum sound level possible.

## 2.03 ACCESSORIES

A. General

1. Motor accessories shall be provided in accordance with the requirements specified herein.
2. Each motor shall be provided with space heaters.
3. Six 100 Ohm stator RTDs (2 per phase)
4. Two 100 Ohm bearing RTDs (1 per bearing - upper/lower, inboard/outboard)
5. Vibration
6. Auxiliary terminal boxes for each of the accessories
7. Non-drive end bearing insulation.
8. Each motor shall be provided with bar type differential CT's, surge capacitors (3) and lightning arrestors (3).

B. Space Heaters

1. Space heaters for condensation prevention shall be rated 120-volt. Wattage shall be suitable for the particular frame size and type in accordance with the manufacturer's recommendation.
2. Space heater wire leads shall be brought out to an auxiliary conduit box on the motor. Box construction shall match the main power conduit box.

C. Winding Thermal Protection

1. Winding thermal protection shall be in accordance with the following:

- a. Resistance temperature detectors shall be 100-ohm precision type with calibrated resistance-temperature characteristics. Detectors, two per phase, shall be positioned to detect highest winding temperature and located between coil sides in stator slots. Detector leads shall be wired to a separate NEMA 4X terminal box.

D. Bearing Temperature and Vibration Protection

- 1. Bearing temperature detectors RTD type similar to the winding detectors specified above shall be provided on the thrust bearing for vertical motors.
- 2. Each bearing shall be provided with two proximity transducer probes, Bentley Nevada 3300 Series or equal.

E. Surge Protection

- 1. Surge arresters for the station type with porcelain tops shall be provided in the main terminal box. The arresters shall be of the metal-oxide type rated at the maximum continuous operating voltage (MCOV) line-to-ground shown in the table below. Removable bus links shall be provided for motor testing. These links shall be treated to resist corrosion, designed to maintain a positive contact and have low contact resistance.

Motor Voltage	Surge Arrester MCOV	Capacitor Rating
2300V	2700V	0.5 microfarad
4160V	4500V	0.5 microfarad
13200V	14400V	0.125 microfarad

- 2. A three-pole capacitor unit equipped with built in discharge resistors and using a non-polychlorinated biphenyl (PCB) insulating medium shall be provided in the main terminal box. Removable bus links shall be provided for motor testing. These links shall be treated to resist corrosion, designed to maintain a positive contact and have low contact resistance.

- F. All six stator winding leads shall be wired to the motor junction box for connection externally to the motor. Stator winding leads shall be provided with two-hole pad connectors. Motor junction box shall be provided with three bar type differential current transformers. Stator winding leads shall be connected to bar type differential current transformers. Stator winding connections shall be made in the factory and shall comply with IEEE Std 141-1993.

## **2.04 SPARE PARTS**

- A. The Contractor shall furnish and deliver to the Engineer, at that part of the site and at such time as the Engineer may direct, spare parts for the electric motors in accordance with Division 01 - General Requirements.
- B. The spare parts shall be listed in an index and packed in containers suitable for long term storage, bearing labels clearly designating the manufacturer's part number with complete information for use and reordering.
- C. Spare parts shall be furnished in accordance with the manufacturer's recommendations for the motor size and type. Spare parts shall include at a minimum the following:
  - 1. One complete set of upper and lower bearing liner halves for the drive end (DE) and non-drive end (NDE) bearings for each type and size of motor. Spare bearings shall be furnished for all motor types. When sleeve bearing motors are provided, spare oil rings shall be furnished for those motors.
  - 2. One set of bearing temperature detectors shall be provided (per each set of three, or less) of each type of motor.
  - 3. One complete set of oil ring(s), front and rear inboard and outboard seals.
  - 4. One set of special tools which may be needed.

## **PART 3 – EXECUTION**

### **3.01 MANUFACTURER'S FIELD SERVICES**

- A. A qualified manufacturer's service representative shall assist in the installation of the motors, check the motor installation before it is placed into operation, assist in the performance of field tests, observe and assist initial operations and train the plant operations and maintenance staff in the care, operation and maintenance of the motors.
- B. The Contractor shall provide equipment start-up services and training in accordance with the Division 01 - General Requirements.
- C. The Contractor shall provide a field report from the manufacturer's representative for each visit to the site. The report shall include complete information on time, schedule, tasks performed, persons contacted, problems corrected, tests results, training, instruction and all other pertinent information.
- D. The service representative shall sign in with the Engineer on each day they are at the site.

### **3.02 DELIVERY, STORAGE AND HANDLING**

- A. Electric motors shall be delivered, stored and handled in accordance with the Division 01 - General Requirements, the motor manufacturer's instructions and the following:
  - 1. Motors shall be inspected for shipping damage when received.
  - 2. All sleeve or oil lubricated bearings motors shall be identified and the bearing reservoirs filled to normal level.
  - 3. Motors shall be handled using motor base lifting lugs. Avoid pounding or bumping of motor which may damage motor. A hoist and spreader bar arrangement shall be used to avoid damage.
  - 4. Motors shall be stored indoors in clean, dry, heated areas.
  - 5. Motor space heaters shall be energized to prevent moisture condensation throughout the storage and construction period.
  - 6. Motors shall not be stored in areas subject to continuous vibration. A small quantity of grease shall be injected into each bearing on a monthly basis. Purged grease shall be inspected for water or rust.

### **3.03 INSTALLATION**

- A. Motors shall be installed in accordance with manufacturer's instructions and recommendations.
- B. Each motor shall be carefully and properly aligned with the driven equipment.
- C. Equipment shall be secured to mounting surface with anchor bolts. Anchor bolts shall be provided meeting manufacturer's recommendations and of sufficient size and number to secure equipment.

### **3.04 PAINTING**

- A. External Surfaces
  - 1. All severe duty motors shall have all external surfaces pretreated, primed and painted. External surfaces shall be pretreated so the surface is clean and free of contaminants. After pretreatment, the surface shall be primed with an oxide primer and then spray painted with a minimum of .003 inch thick epoxy polyamide and semi-gloss coating that is chemical, solvent, salt water, and acid resistant.
  - 2. All other motors shall have external surfaces pretreated, primed and painted in accordance with the manufacturer's standard treatment.

- B. Internal Surfaces



1. All severe duty motors shall have all internal surfaces pretreated, primed and painted. Internal surfaces shall be pretreated so the surface is clean and free of contaminants. After pretreatment, the surface shall be primed with an oxide primer and then painted with an epoxy paint. Machined joints and threaded parts shall be coated with rust inhibiting compound.
  2. All other motors shall have internal surfaces pretreated and primed in accordance with the manufacturer's standard treatment.
- C. All machined bolts and screws and other hardware shall be of the hex head type and shall be zinc plated. Stainless steel hardware shall be used on severe duty motors.

### **3.05 SHOP TESTING**

- A. Shop testing shall be performed on each motor at the manufacturer's plant prior to shipment. Shop test shall be in accordance with the latest revisions of NEMA MG 1 and shall demonstrate that the equipment tested conforms to the requirements specified.
- B. The Contractor shall submit certified shop test reports as specified herein.
- C. Shop Tests shall be witnessed by the Engineer where required by equipment Sections. At least 10 days' notice shall be given to the Engineer prior to test dates.
- D. Shop tests shall consist of the following:
  1. Visual inspection of the motor
  2. Insulation resistance measurement
  3. Measurement of winding resistance
  4. Direction of rotation with proper phase sequence
  5. Check air gap
  6. Vibration at no load with recording of bearing vibration signatures
  7. No-load readings of current and input power at rated Volts and Hz.
  8. High potential test according to MG 1-20.48
  9. Functional test all accessories for proper operation
  10. Determination of locked rotor torque and current
  11. Determination of no load speed, voltage, current and losses at rated frequency.
  12. Determination of percent slip

13. Determination of speed vs. torque curve
14. Determination of speed vs. current curve
15. Determination of open and short circuit saturation curves
16. Motor heat run test (recordings until temperatures stabilize to determine full load temperature rise)
17. Determination of full-load current
18. Determination of efficiency at 125%, 100%, 75% and 50% of full load
19. Determination of power factor at 125%, 100%, 75% and 50% of full load
20. Determination of breakdown torque (calculated)
21. Winding resistance test
22. High potential test
23. Sound pressure level measurement at no load
24. Polarization index test
25. Vibration Test
26. Bearing Inspection

### **3.06 FIELD TESTS**

- A. After installation, each motor shall be field tested for operation and conformance to the specifications. The Contractor shall perform field tests in accordance with the General Conditions, Division 01 – General Requirements and Section 46 00 00 – Equipment General Provisions. Field Testing shall include preliminary field tests, final acceptance inspection and final acceptance tests. The field tests shall be witnessed by the Engineer and certified by the Contractor.
- B. Preliminary motor field testing shall be performed by the manufacturer's technical representative, prior to energizing equipment. Equipment shall not be energized without the permission of the Engineer. The testing shall be in accordance with the recommendations of the manufacturer's representative and shall include at a minimum the following:
  1. Motors shall be checked to determine that they have been properly installed, lubricated and connected.
  2. Electrical and grounding connections.

3. Shaft alignment, proper mounting and lubrication.
  4. Ventilating air passageways shall be inspected for blockage.
- C. Acceptance inspection shall be performed on each motor after the completion of the preliminary field tests. Acceptance inspection shall be performed by the testing firm. Inspection shall include the following:
1. Electrical and grounding connections.
  2. Shaft alignment, proper mounting and lubrication.
  3. Ventilating air passageways shall be inspected for blockage.
  4. Check for any overheating.
  5. Check for excessive noise.
  6. Check for correct rotation.
  7. Protective detectors operation shall be checked.
  8. Any excessive vibration shall be checked.
  9. Space heater operation shall be checked.
- D. Final acceptance electrical testing shall be performed on each motor. Testing shall include the following:
1. Insulation resistance tests.
  2. Surge comparison.
  3. Vibration tests shall be performed.
  4. Bearing insulation resistant tests on insulated bearings.
  5. Running current and voltage shall be measured and evaluated relative to load conditions and nameplate full-load amperes.
  6. High-potential tests.
  7. Motors shall be operated with driven equipment for a minimum of 48 continuous hours and rechecked for overheating and vibration.
  8. Polarization Index shall be tested

- E. All test data and values for each motor shall be in accordance with the manufacturer's recommendations and NETA, ATS Acceptance Testing Specification.
- F. The Contractor shall submit an acceptance testing report upon completion of inspection and testing. The report shall be in accordance with NETA, ATS Acceptance Testing Specification. Final Acceptance test data shall be recorded on a "Motor Test Record" sheet as referenced in the NETA ATS document and submitted with the report.

**END OF SECTION**

**SECTION 40 05 57**  
**VALVE OPERATORS AND ELECTRIC VALVE ACTUATORS**

**PART 1 – GENERAL**

**1.01 THE REQUIREMENT**

- A. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions and Section 40 05 00 – Basic Mechanical Requirements.
- B. Reference Section 40 06 20 – Process Pipe, Valve, and Gate Schedules for additional information on valves and operators/actuators.
- C. The electric valve actuators shall meet the signal requirements described in Section 40 61 23 – Signal Coordination, Section 40 61 93 – Process Control System Input/Output List, and Section 40 61 96 – Process Control Descriptions.
- D. Valve operators and electric valve actuators shall be designed to unseat, open or close, and seat the valve under the most adverse operating condition to which the valves will be subjected.
- E. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer. There shall be no mounting restrictions on the electric valve actuator.
- F. The valve operators and electric actuators shall be the full and undivided responsibility of the valve manufacturer in order to ensure complete coordination of the components and to provide unit responsibility.

**1.02 SUBMITTALS**

- A. The following items shall be submitted in accordance with, or in addition to the submittal requirements specified in Section 01 33 00 – Submittal Procedures and Section 46 00 00 – Equipment General Provisions:
  - 1. Shop Drawings
  - 2. O&M Manuals
  - 3. Certification that the force required to operate all valves is as specified herein.

**1.03 WARRANTY AND GUARANTEE**

- A. Warranty and Guarantee shall be as specified in Section 46 00 00 – Equipment General Provisions with the exception that the warranty period shall be for two (2) years.

## **PART 2 – PRODUCTS**

### **2.01 GENERAL**

- A. Electric actuators shall be provided where specified in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.
- B. Manual operators shall be provided on all valves which do not receive electric actuators. Manual operator type shall be as specified herein and as shown on the Drawings.
- C. Quarter turn valves 8” and greater in size shall have geared operators. Gate valves 14” and greater in size shall have geared operators.
- D. Operators/actuators shall be furnished with conservatively sized extension bonnets, extension stems, or torque tubes, and all required appurtenances required for a complete installation. Operators furnished with extension bonnets shall include stainless steel extension stems, or stainless steel torque tubes.

### **2.02 MANUAL OPERATORS**

- A. Unless otherwise specified or shown on the Drawings, manual operator type shall be as follows:
  - 1. Buried valves shall be equipped with nut operators, extended stems, and valve boxes. Where the depth of the operating nut is more than 4 feet below finish grade, a valve operator extension shall be provided to bring the operating nut to within 18-24 inches of the surface.
  - 2. Exposed valves up to 6-inch shall be lever operated (except gate valves).
  - 3. Exposed valves 8-inches and larger shall be handwheel operated.
  - 4. Exposed gate valves shall be handwheel operated.
  - 5. Valves with centerline of operator located more than 6-feet above the floor or platform from which it is to be operated shall have a chainwheel operator unless otherwise indicated on the Drawings.
- B. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.
- C. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.

- D. Valve operators shall be designed so that the force required to operate the handwheel, lever, or chain (including breakaway torque requirements) does not exceed 80 pounds applied at the extremity of handwheel or chainwheel operator. Design pressures for sizing of valve operators shall be the piping test pressure for the piping in which the valve is to be installed as shown in the Piping Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.
- E. Handwheels for valves operators shall not be less than 12 inches in diameter. The maximum diameter of any handwheel shall not exceed 24”.
- F. Nut operators shall have standard 2-inch square AWWA operating nuts designed in accordance with AWWA C504-94.
- G. Geared manual operators shall be of the worm gear, traveling nut or scotch yolk type except manual operators for butterfly valves 18-inch in diameter or larger which shall be worm gear, unless otherwise indicated in the individual valve specification. Gear operators shall be of the worm gear or bevel gear type. Gear box designs incorporating end of travel stops in the housing shall be equipped with AWWA input stops. Each gearbox shall require a minimum of 10 turns for 90 degree rotation or full valve stem travel and shall be equipped with a mechanical valve position indicator.
- H. Manual operators on below grade (and vault installed) valves shall be permanently lubricated and watertight under an external water pressure of 10 psi.

### **2.03 ELECTRIC VALVE ACTUATORS**

- A. Electric Actuators shall be open/close service or modulating service as specified in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules.
  - 1. Open/Close (non-modulating) valve actuators shall be IQ series as manufactured by Rotork, or SA series as manufactured by AUMA.
  - 2. Modulating valve actuators shall be Type IQM as manufactured by Rotork, or Type SAR as manufactured by AUMA.
- B. Performance Requirements
  - 1. The actuators shall be designed for indoor and outdoor service and shall be capable of mounting in any position.
  - 2. Torque capacity of the actuators shall be sufficient to operate the valves with the maximum pressure differential, as indicated in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, with a safety factor of 1.5. Actuators in modulating service will be selected such that the required dynamic valve torque is no more than 60% of the electric actuator’s maximum rated breakaway of torque.

3. Operating time for full limits of travel shall be not more than 2 seconds per inch diameter of the valve, +/- 50 percent through 20 inches; +/- 30 percent for valves 24 inches and larger. Operating time shall not be less than 60 seconds for all modulating valves.
  4. Actuators shall be capable of operating in ambient temperatures ranging from 0 degrees F – 160 degrees F.
  5. For open/close (non-modulating) actuators, the gearing, motor and contactor shall be capable of 60 starts per hour without overheating.
  6. For modulating actuators, the gearing, motor and contactor shall be capable of 1200 starts per hour without overheating.
- C. The actuators shall include, in one integral housing, individual compartments for the motor, gearing, wiring terminals, and control circuits. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The inner seal shall protect the motor and all other internal electrical elements of the actuator from entrance of moisture and dust when the terminal cover is removed. Double cartridge shaft seals shall be provided on the hand wheel and output shafts for weatherproof protection. All external fasteners shall be stainless steel. Compartments shall be provided with moisture and dust-proof rigid cast covers meeting NEMA 6, certified to submergence in 6 ft of water for 30 minutes. Actuators located in classified areas shall be suitable for use in Class 1, Division 1, Group D environments.
- D. The actuators shall be provided with externally operable and lockable 480VAC circuit breakers integral to the control housing
- E. All gearing shall be hardened alloy steel or bronze and shall be rated at twice the output torque of the operator and shall be designed to withstand the stall torque of the motor without failure. Output drive gearing shall consist of a worm shaft and worm gear pinion operating in an oil bath. The worm gear pinion shall be alloy bronze. Worm gear drive shall be self-locking to prevent creeping of the valve disc in an intermediate position. Heavy-duty grease shall protect gearing and sealed ball bearings of the main shaft for five years without changing. Motor reduction gearing shall be spur or planetary gearing and shall allow for field repair and change in gear ratio. For quarter turn applications, overtravel of the operator shall be prevented by internal mechanical stops cast into the actuator.
- F. A mechanical dial position indicator shall be furnished to continuously indicate the position of the valve at and between the fully open and fully closed positions. The indicator shall be driven by gearing driven off of the main worm gear pinion and shall operate when the actuator is in either the electrical mode or manual mode.
- G. A handwheel shall be permanently attached for manual operation. A gear assembly shall be provided between the handwheel and the worm shaft if required to reduce the force necessary to operate the handwheel to less than 40 pounds. A positive declutch



mechanism shall engage the handwheel when required. When the actuator is set in the declutched position for handwheel operation, it shall return automatically to electric operation when actuator motor is energized. The handwheel shall not rotate during electric operation nor shall a fused motor prevent handwheel operation.

- H. The drive motor shall be specifically designed for actuator service and shall be characterized by high starting torque and low inertia. Motors shall be 460 volts, three phase, 60 Hz AC reversible squirrel cage induction type motors and shall be specifically designed for modulating service where indicated on the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules. Motors shall be totally enclosed, non-ventilated, with NEMA Class F insulation minimum (Class H for modulating actuators) and a maximum continuous temperature rating of 120 degree C (rise plus ambient). A space heater shall be provided in the motor compartment. The electric motor shall have a time rating of at least 15 minutes at 104°F (40°C) or twice the valve stroking time, whichever is longer, at an average load of at least 33% of maximum valve torque. Motor bearings shall be permanently lubricated by premium lubricant. The motor shall have plug and socket electrical connection to facilitate easy removal and replacement. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence of the three-phase power supply connected to the actuator. The motor shall include single phase protection. A suitable thermal protection device shall be incorporated in the motor or motor starter circuits, connected to a tripping device. Fast acting fuses shall be provided to protect solid state components. The motor shall be capable of starting against the rated load in either the open or close direction when voltage to the motor terminals is plus or minus ten (10) percent of nameplate rating.
  - 1. Open/Close actuators shall be furnished with electro-mechanical reversing starters.
  - 2. Modulating actuators shall be furnished with solid state reversing starters utilizing thyristors.
- I. Leads from the motor shall be brought to the control circuit (limit switch) compartment without external piping or conduit box. An adequately sized space heater shall be installed in the control circuit compartment to aid in the prevention of damage resulting in from condensation. The following items shall be located in the control circuit compartment.
  - 1. Torque limit switches shall be provided to de-energize the motor control circuit in the event of a stall when attempting to unseat a jammed valve and when torque is exceeded during valve travel. Each actuator shall have an open direction torque switch and a close direction torque switch. The torque switches shall be mechanically operated and able to be set in torque units. Torque switches shall be calibrated prior to the actuator's assembly to the valve.

2. Travel limit switches shall be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and close directions. The limit switch drive shall be of the counter gear type and “in step” with the actuator output drive at all times in either the electrical or manual mode of operation. A minimum of six (6) contacts, three (3) normally open and three (3) normally closed, shall be supplied at each end of valve travel. Four (4) additional contacts shall be provided to report end of travel or any desired position between ends of travel.
- J. Modulating actuators shall have a position feedback potentiometer mounted directly to the valve actuator gearing inside the gearing compartment. The potentiometer shall provide a 4-20 mA signal corresponding to valve position. Modulating valve actuators shall be designed to respond to either a 4-20mADC analog signal or a digital pulse signal as specified herein or as required to coordinate with the requirements of Division 40.
1. Modulating valve actuators designed to respond to a 4-20mADC signal shall be provided with a valve positioner which shall position the valve proportional to an externally generated 4-20mADC signal. The valve positioning control circuitry shall position the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer. The positioner shall be field adjustable to fail to the “open,” “closed,” or “last” position on loss of 4-20 mADC command signal.
  2. Modulating valve actuators designed to respond to “pulse” open/close signals shall operate the valve during the time the open or close pulse signal is high. Modulating actuators designed to respond to “pulse” open/close signals shall have the latching circuitry described above for open/close actuators disabled.
- K. The electrical terminals shall be housed in a double sealed terminal compartment isolated from the rest of the actuator components. The actuators shall be designed to operate from a single 480VAC, 3-phase source. The actuators shall be furnished with fuses inside of the terminal compartment. A quantity of two – ¾ inch NPT conduit entries shall be furnished.
- L. Actuators shall contain wiring and terminals for the following control functions. All dry contacts shall be rated for 5A at 250VAC.
1. Open, Close, and Stop commands from external dry contacts (utilizing internal 24VDC power supply) and/or from an external signal of 12V to 120V. The inputs for the open, close, stop signals shall be field selectable to be respond to either maintained or momentary remote signals. In momentary mode, the actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact signal unless a stop signal is received.

2. Emergency override input from a normally closed or normally open contact. The actuator shall either open or close (field selectable) upon receiving the emergency override input.
3. Remote Local-Off-Remote selector switch, Open/Close pushbuttons, and Open/Closed pilot lights for a remote manual control station (see below). The remote Local-Off-Remote selector switch and Open/Close pushbuttons shall be a dry contact input to the actuator control circuitry. The Open/Closed pilot lights shall be powered from the valve actuator control power.
4. Four (4) unpowered contacts shall be provided which can be selected to indicate valve "Opened" and "Closed" position, "Remote" status of the actuator, and fail status of the actuator. The fail status contacts shall activate upon motor overtemperature and actuator overtorque as a minimum.
5. Terminals for 4-20mADC position command and 4-20mADC position feedback as described above for modulating actuators.

#### M. Local Controls

1. Actuators shall be furnished with a Local-Off-Remote selector switch; Open, Close, and Stop pushbuttons for local control; a red lamp indicating closed and a green lamp indicating open. L-O-R switch shall be padlockable in any of the three positions.
  - a. When the LOR is in the "Local" position, open/close control shall be by the open and close pushbuttons on the actuator. The stop push button shall stop the actuator travel.
  - b. When the LOR is in the "Off" position, the actuator shall not operate.
  - c. When the LOR is in the "Remote" position, the actuator shall be controlled by remote inputs from the PLC or from the remote manual controls station.
2. The local controls shall be arranged so that the direction of travel can be reversed without the necessity of stopping the actuator.

#### N. Remote Manual Control Station

1. Where indicated in the Valve Schedule in Section 40 06 20 – Process Pipe, Valve, and Gate Schedules, manual actuator controls shall be furnished in a separate NEMA 4X stainless steel enclosure (NEMA 7 if located in a classified area). Manual control station controls shall include Hand–Off-Auto Selector switch; Open, Stop, and Close pushbuttons; a red lamp indicating closed and a green lamp indicating open.

- a. When the HOA is in the “Hand” position, open/close control shall be by the open and close pushbuttons on the remote manual control station. The stop push button shall stop actuator travel.
- b. When the HOA is in the “Off” position, the actuator shall not operate.
- c. When the HOA is in the “Auto” position, the actuator shall be controlled by remote inputs to the valve actuator from the PL

#### **2.04 ELECTRIC OPERATORS FOR PVC/CPVC VALVES**

- A. Automatic electric operators shall be provided for PVC/CPVC valves where specified and/or as shown on the Drawings. Operators shall operate on 120 volt AC, single phase, 60 hertz power and be equipped with solid state electronic internal controls. Motors shall be brushless, capacitor-run, reversing type, suitable for high duty cycle applications and shall be specifically designed for open/close service. Motors shall be provided with integral thermal overload protection with auto-reset. Operator gears and shafts shall be constructed of heat treated high-alloy steel. Operator output shaft shall be electro-less nickel plated. Operator gear trains shall be permanently lubricated. The gear train shall withstand operator stall torque. Operator enclosures shall be NEMA 4. Operators shall be provided with internally wired, thermostatically controlled enclosure heaters to maintain an enclosure temperature of at least 40 degrees F. Operators shall be provided with positive visual position indication markings permanently affixed to the operator body and final output shaft. Operator drive output shall be provided with a declutchable manual override. A manual lever shall be provided for manual valve positioning. Operators shall be failsafe, utilizing a mechanical spring with a clutch mechanism to uncouple the motor during spring return operation, allowing the spring to relax and either open or close the valve. Selection of either fail-opened or fail-closed shall be made by selection of field wiring terminals.
- B. Independently adjustable cam-operated position limit switches shall be provided with dry contacts for remote fully opened and fully closed valve position indication. Operators shall respond to external dry contact open/close controls. The actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact open or close signal unless a stop signal is received. The all actuator control circuitry, including latching circuitry, shall be internal to the valve actuator. Valve control circuits and components mounted in a separate enclosure external to the valve actuator assembly will not be permitted. Connections for external remote controls shall be powered from an internal 24VDC or 120VAC power supply. Limit switches shall be rated for 15 amps at 120 VAC. Valve remote status shall also be provided as specified in Section 40 61 96 – Process Control Descriptions. The Contractor shall coordinate operator controls with the functional requirements specified in Section 40 61 96 – Process Control Descriptions.

## 2.05 PNEUMATIC CYLINDER OPERATORS FOR OPEN-CLOSE TYPE VALVES

- A. Pneumatic cylinder operators for open-close type operation shall be as manufactured by Rotork Control, Inc., or equal.
- B. This specification relates to the design, construction and fabrication of pneumatic cylinder operators for quarter turn valves such as plug and butterfly valves. Actuators shall be designed to operate from the compressed service air system when a minimum pressure of 100 psi and a maximum pressure of 125 psi is applied to the cylinder. The valve sizing pressure shall be based on 60 psi. The operator shall be of the double acting single cylinder actuator type, unless otherwise specified herein or required for proper operation of the valve. Double acting actuator end travel torque shall be at least 1.5 times the mid-travel torque.
- C. The valve actuators shall be designed to operate in indoor and outdoor installations. The center body shall be of a fully enclosed design to preclude the possibility of injury to personnel during operation. The center body shall be capable of being lubricated by oil or grease.
- D. The actuator shall be fitted with a visual position indicator easily understood and readable.
- E. All actuators shall have a minimum safety factor on pressurized components of at least 4 to 1. The maximum safe working pressure shall be clearly indicated on the actuator.
- F. Each actuator shall have external, easily adjustable position stops. These stops shall be fully sealed to prevent leakage of oil from the center body. All materials of the actuator shall be suitable for normal operation over a temperature range of -10°F to 200°F.
- G. All components in rubbing contact with seals shall be electroless nickel plated. This is to ensure prolonged seal life and the maintain efficiency. Dynamic seals between the center body and the environment shall be of the double seal type to ensure integrity of the inner seal throughout the working life. An additional seal washer shall be provided on the torque plug to prevent ingress of particulate matter to the inner sealing surface.
- H. The center body cover shall be easily removable to allow for inspection of the center body without disassembling the entire unit or removing the unit from the valve.
- I. Cylinder construction shall be of the external tie rod type. Tie rods shall be designed to stretch within their elastic limit in the event of over pressurization of the cylinder.
- J. The center body shall be a one-piece ductile iron casting designed to maintain correct bearing alignment. A removable cover shall be provided to totally enclose the center body. This cover shall incorporate a weather tight vent. Sealing shall be provided to facilitate oil fill of the center body.

- K. Piston rods shall be turned, ground, and polished bar. Piston rods shall be electroless nickel plated over the entire surface. The yoke pin shall be of high-grade steel capable of withstanding the high stresses inherent in this design.
- L. Cylinders shall be constructed of carbon steel to a finish of 16 micro-inch RMS, or better. Cylinders are to be electroless nickel plated on all surfaces.
- M. The yoke shall be constructed of high yield ductile iron and all surfaces shall be corrosion protected after machining. Piston rod bushings shall be of bronze or similar corrosion resistant material. Flanges shall be constructed of ductile iron. The actuator shall be designed so that it can be mounted in any position. Actuators shall be supplied with the center bodies pregreased at the factory.
- N. Manual handwheel overrides shall be provided and shall be designed to give the maximum torque output from the operator. Manual overrides shall be capable of being declutched.
- O. Full open and full closed limit switches shall be provided, each rated at 8 A minimum. Limit switches shall be wired to a terminal board for remote output.

**PART 3 – EXECUTION**

**3.01 MANUFACTURER’S FIELD SERVICES**

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 46 00 00 – Equipment General Provisions and shall include the following site visits for electric actuators:

<b>Service</b>	<b>Number of Trips</b>	<b>Number of Days/Trip</b>
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

**3.02 INSTALLATION**

- A. All valve actuators shall be installed in accordance with the manufacturer's published recommendations and the applicable Specification Sections for valves and motor controls.
- B. Valve actuators shall be factory coated in accordance with the manufacturer’s standard paint system.

### **3.03 SHOP TESTING**

- A. Shop testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and with the following additional requirements:
1. Conduct a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.
  2. Submit written certification that:
    - a. Shop tests for the electrical system and all controls were successfully conducted;
    - b. Electrical system and all controls provide the functions specified and required for proper operation of the valve operator system.
  3. Each actuator shall be performance tested and individual test certificates shall be supplied free of charge. The test equipment shall simulate each typical valve load and the following parameters should be recorded:
    - a. Current at maximum torque setting
    - b. Torque at maximum torque setting
    - c. Flash Test Voltage
    - d. Actuator Output Speed or Operating Time
    - e. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.
    - f. Verification of actuator torque rating with valve.

### **3.04 FIELD TESTS**

- A. Field testing shall be in accordance with Section 46 00 00 – Equipment General Provisions and with the following additional requirements:
1. Valve actuators shall be field-tested together with the associated valves.
  2. Test all valves at the operating pressures at which the particular line will be used.
  3. Test all valves for control operation as directed.
  4. Field testing shall include optimization of opening and closing times of the valves. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as

determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

**B. Preliminary Field Tests**

1. General: Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components.
2. Scope: Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly.
3. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation, as specified or otherwise directed.

**C. Final Field Tests**

1. Final field tests shall be conducted in accordance with the latest revision of AWWA C500.
2. Final field tests shall be conducted simultaneously with the start-up and field testing of the pumps.
3. Final field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.
4. Certification of Equipment Compliance: After the final field tests are completed and passed, submit affidavit according to Section 46 00 00 – Equipment and General Provisions.

**END OF SECTION**



**SECTION 40 05 64**  
**BUTTERFLY VALVES**

**PART 1 – GENERAL**

**1.01 THE REQUIREMENT**

- A. Reference Section 40 05 00 – Basic Mechanical Requirements.

**PART 2 – PRODUCTS**

**2.01 BUTTERFLY VALVES (WATER SERVICE)**

- A. Butterfly valves (water service) shall be of the rubber-seated, tight-closing type conforming to the latest revision of AWWA C504. The manufacturer shall have a minimum of 5 years of experience in manufacturing butterfly valves of the sizes required in accordance with AWWA C504. All butterfly valves shall be the product of one manufacturer. Butterfly valves shall be as manufactured by Pratt, Mueller Co., DeZurik, GA Industries, or equal. Each valve shall be performance and leak tested as specified in AWWA C504 revised as follows: In addition to the testing requirements of AWWA C504, each butterfly valve shall be thoroughly cleaned and opened and closed at least three (3) times prior to testing. Certified copies of the test results shall be submitted to the Engineer for approval prior to shipment of the valve.
- B. Butterfly valves shall be Class 150B, unless otherwise indicated in the valve schedules, and of the short body design with mechanical joint or flanged ends, as shown on the Drawings.
- C. Valve bodies shall be epoxy coated cast iron conforming to ASTM A-126, Grade B, ASTM A-48, Class 40 or Ductile Iron ASTM A536, Grade 65-45-12. Where required to meet design operating conditions, valve bodies shall be manufactured of higher strength materials. Valve bodies shall have integral hubs for housing shaft bearings and seals.
- D. Butterfly valves shall be of the concentric or eccentric shaft types. Valve discs shall be constructed of epoxy coated ductile iron, ASTM A536, Grade 65-45-12. Discs shall provide a full 360 degree seating surface with no external ribs transverse to flow, and shall comply with the latest revision of AWWA C504. The valve manufacturer shall furnish Shop Drawings which include end clearance dimensions when the disc is in the fully open position.
- E. The resilient valve seat shall be synthetic rubber designed to seat against a pressure differential of 150 psi on either side of the valve, unless otherwise indicated. The resilient seat shall be mechanically attached to the valve disc or valve body. Any required seat attachment hardware shall be stainless steel. The resilient seat shall be capable of being

adjusted or replaced in the field without moving the valve disc along the shaft axis or removing the valve from the line. The mating seat surface shall be stainless steel or monel.

1. The seats shall be factory tested as per AWWA C504 at a test pressure of 150 psig, unless otherwise indicated, and post adjusted for differential pressures indicated herein.
- F. Valve shafts shall be one-piece or two-piece units of stainless steel construction suitably sized to transmit the torques required to operate the valves under the conditions listed in the valve schedule with appropriate safety factor. Shafts shall be securely attached to valve disc by means of conservatively sized corrosion-resistant taper pins, threaded at one end and secured with lockwashers and nuts (i.e.: mechanically attached). Provide O-ring seal on taper pin if required to prevent leakage. Shaft key shall be constructed of corrosion-resistant material.
- G. Shaft bearings shall be contained in the integral hubs of the valve body and shall be the permanently self-lubricated, corrosion resistant, sleeve type of teflon or heavy-duty bronze. The valve assembly shall be furnished with a factory set two-way thrust bearing designed to center the valve disc in the valve seat at all times. End cover bolts shall be of stainless steel construction.
- H. The shaft seal shall be either the bronze cartridge type with at least two O-rings, monolithic V-Type, U-Cup Type, or pull down packing type. If monolithic V-Type, U-Cup Type, or pull down packings are utilized, it shall be self-adjusting, self-compensating type. Packing shall be as manufactured by Chevron, or equal. Butterfly valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator. For buried valves with pull down packing the packing gland cover assembly shall be heavy duty, soil and water resistant. Stuffing boxes for pull down packing shall have a depth sufficient to accept at least four rings of self-compensating type packing specifically selected for the operating pressures to be encountered. Stuffing box bolts, studs and nuts shall be stainless steel.
- I. The "O" ring type shaft seal shall be contained in a removable bronze cartridge. The bronze cartridge shall be manufactured from ASTM B505 copper alloy UNS #C93200 and shall meet the requirements of AWWA C504 for bronze, Grade E. The "O" ring material shall be nitrile, BUNA-N rubber, as intended for use with potable water or wastewater and per ASTM D-2000 with a hardness of 70 Shore A Durometer.
- J. Manual operators for butterfly valves 18-inches in diameter or larger shall be the worm gear type conforming to AWWA C504. Manual operators for butterfly valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators. Operators shall be equipped with adjustable AWWA limit stops, shall be sized according to Table IV for Class 150B, and shall require a minimum of 15 turns for 90 degrees or full stem valve travel. The capacity of the manual operator shall be adequate

to drive the valve under the differential pressure of 150 psi and maximum anticipated flow, unless otherwise indicated in the appropriate valve schedule.

- K. The manufacturer shall certify that the butterfly valves are capable of operating in continuous duty service under these pressures and flow conditions.
- L. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.
- M. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

## **2.02 BUTTERFLY VALVES (LOW PRESSURE AIR SERVICE)**

- A. Isolation valves and throttling valves for low pressure (less than 25 psig) air service shall be resilient-seated butterfly valves as manufactured by Centerline (Crane), Bray, DeZurik or Engineer approved equal. All valve components shall be suitable for continuous operation at temperatures up to 300°F with a 25 psig minimum working pressure. Materials of construction shall be as specified below. Valves shall otherwise be as described above in Paragraph 2.01 - Butterfly Valves (Water Service).
  - 1. Valve bodies – Ductile Iron
  - 2. Valve discs – Ductile Iron
  - 3. Valve shafts – Stainless Steel
- B. Valves less than 30 inches shall be flanged or have a wafer or lug style body and be compatible with ASME B16.1 flanges. The Contractor shall coordinate flange connections upstream and downstream of wafer valves. Valves 30 inches or larger shall have flanged end connections conforming to ASME B16.1, 125-pound rating.
- C. Manually operated isolation valves shall be provided with a handwheel or chainwheel, as required and/or as shown on the drawings, operator and shall provide for tight shut-off. A mechanical dial indicator shall be provided on the operator to continuously indicate valve positions. Where specified and/or as shown on the drawings, the Contractor shall provide motor actuators meeting the requirements of Section 40 05 57 – Valve Operators and Electric Valve Actuators. Motor actuators for throttling valves shall provide for modulating operation. Cycle time from full open to full closed shall be approximately 60 seconds. 4-20 ma position feedback signals shall be provided for each actuator. Contractor shall wire 4-20 ma position signals to the PLC.

## **2.03 BUTTERFLY VALVES (RECTANGULAR)**

- A. Rectangular butterfly valves shall be bubble tight with flow in either direction. Rectangular butterfly valves shall be manufactured by Pratt, Hydro Gate, or equal. The Valve body shall be fabricated carbon steel, designed for wall mounting. Valve manufacturer shall provide a double flanged wall thimble to be cast in place. The valve disc shall be fabricated of carbon steel with Type 304 stainless steel seating edge. Disc shall be streamlined in shape to prevent turbulence in fully open position and to minimize pressure drop across valve. The valve seat, contained in the body of the valve, shall be a synthetic rubber compound with a durometer of 50.
- B. Seat adjustment shall not be less than 1/8 inch. Valve seat shall be fully field adjustable and replaceable without dismantling operator, disc, or shaft and without the use of special tools. Valve shaft shall be 304 stainless steel securely locked to disc by stainless steel taper pins.
- C. Each valve assembly shall be furnished with a 2-way thrust bearing assembly designed to hold the disc centered in the seat at all times. Thrust bearing shall be secured by locking device and easily accessible for field adjustment from operator end of valve.
- D. Valve operators shall conform to AWWA-C504 and shall be designed to hold the valve in any intermediate position between fully closed and fully open without creeping or fluttering. Manual operators shall be of the travelling nut, self-locking type and shall be equipped with mechanical stop-limiting devices to prevent over travel of the disc. Operators shall be fully enclosed and designed to produce the specified torque with a maximum pull of 80 lb. on the handwheel.
- E. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.
- F. The manufacturer shall certify that the rectangular butterfly valves are capable of operating in continuous duty service under the required pressures and flow conditions. Each valve shall be hydrostatically tested and tested for bubble-tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.

## **PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 40 61 23**  
**SIGNAL COORDINATION REQUIREMENTS**

**PART 1 – GENERAL**

**1.01 THE REQUIREMENT**

- A. The Contractor shall conform to the signal coordination requirements specified herein.
- B. The Contractor shall be responsible for coordinating signal types and transmission requirements between the various parties providing equipment under this Contract. This shall include, but not be limited to, distribution of appropriate shop drawings among the equipment suppliers, the electrical subcontractor, the HVAC subcontractor, and the instrumentation subcontractor.
- C. Analog signals shall be signals for transmitting process variables, etc. from instruments and to and from panels, equipment PLCs and Control System PLCs.
- D. Discrete signals shall consist of contact closures or powered signals for transmitting status/alarm information and control commands between starters, panels, equipment PLCs, the Control System, etc.

**1.02 ANALOG SIGNAL TRANSMISSION**

- A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be individually isolated, linear 4-20 milliamperes and shall operate at 24 VDC.
- B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.
- C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.
- D. Analog signal isolation and/or conversion shall be provided where necessary to interface with instrumentation, equipment controls, panels, and appurtenances.
- E. Non-standard transmission systems such as pulse duration, pulse rate, and voltage regulated shall not be permitted except where specifically noted in the Contract Documents. Where transmitters with nonstandard outputs do occur, their outputs shall be converted to an isolated, linear, 4-20 milliamperes signal.
- F. The Contractor shall provide 24 V power supplies for analog signals and instruments where applicable and as required inside panels, controls, etc.

- G. Where two-wire instruments transmit directly to the Control and Information System, the instrumentation subcontractor shall provide power supplies at the PLC-equipped control panels for those instruments.
- H. Where four-wire instruments with on-board loop power supplies transmit directly to the Control and Information System, the instrumentation subcontractor shall provide necessary signal isolators or shall otherwise isolate the input from the Control and Information System loop power supply. Similar provisions shall be made when a third element such as a recorder, indicator, or single loop controller with integral loop power supply is included in the loop.

### **1.03 DISCRETE INPUTS**

***THE USE OF 24 VDC FOR DISCRETE INPUTS AND OUTPUTS IS PREFERRED. SOME CLIENTS OR SITUATIONS WITH EXISTING EQUIPMENT MAY REQUIRE 120 VAC I/O AND/OR RELAY OUTPUTS, OR COMBINATIONS OF ALL OF THE ABOVE. CHOOSE THE APPROPRIATE SIGNAL TYPES BELOW AND COORDINATE ALL MATCHING REQUIREMENTS WITH THE ELECTRICAL DESIGN.***

- A. All discrete inputs to equipment and Control and Information System PLCs, from field devices, starters, panels, etc., shall be unpowered (dry) contacts in the field device or equipment, powered from the PLCs, unless specified otherwise.
- B. Sensing power (wetting voltage) supplied by the PLC shall be 24 VDC.

### **1.04 DISCRETE OUTPUTS**

- A. All discrete outputs from local control panels and Control and Information System PLCs to field devices, starters, panels, etc., shall be 24 VDC powered (sourced) from PLCs.
- B. PLC powered discrete outputs shall energize 24 VDC pilot relay coils in the field devices, starters, panels, etc. which in turn open or close contacts in the associated control circuit. The 24 VDC relay coil, contacts, and associated control circuitry shall be furnished integral with the field device, starter, panel, etc. by the supplier and contractor furnishing the field device, starter, or panel.
- C. Where required or specified herein, discrete outputs from equipment and Control and Information System PLC's to field devices, starters, panels, motor operated valves, etc., shall be dry contact or relay outputs.
- D. Outputs to solenoid valves shall be 120 VAC, powered from the PLC or control panel unless specified or shown otherwise.

### **1.05 OTHER DISCRETE SIGNALS**

- A. Discrete signals between starters, panels, etc. where no 24 VDC power supply is available may be 120 VAC, as long as such contacts are clearly identified in the starter,

panel, etc. as being powered from a different power supply than other starter/panel components.

- B. Where applicable, warning signs shall be affixed inside the starter, panel, etc. stating that the panel is energized from multiple sources.
- C. Output contacts in the starter, panel, etc., that are powered from other locations shall be provided with special tags and/or color-coding. Disconnecting terminal strips shall be provided for such contacts.
- D. The above requirements shall apply to all starters and panels, regardless of supplier.

**PART 2 – PRODUCTS (NOT USED)**

**PART 3 – EXECUTION (NOT USED)**

**END OF SECTION**

**SECTION 40 67 63**  
**UNINTERRUPTIBLE POWER SYSTEMS**

**PART 1 – GENERAL**

**1.01 THE REQUIREMENT**

- A. The Contractor shall furnish, test, install and place in satisfactory operation all uninterruptible power systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.
- B. One UPS shall be provided for each operator workstation and its peripherals (i.e. printer, network equipment, radio, etc.) provided under this Contract.
- C. One UPS shall be provided for each programmable logic controller (PLC) panel or remote telemetry unit (RTU) and its appurtenant equipment provided under this Contract. However, courtesy receptacles in PLC and RTU cabinets shall not be powered by the UPS.
- D. UPS units shall be mounted in or near enclosures containing digital hardware, unless otherwise specified or shown on the Drawings, as follows:
  - 1. UPS units for operator's consoles shall be mounted within the consoles.
  - 2. UPS units for control panels containing PLCs shall be mounted either within the cabinet or in an adjacent cabinet of suitable environmental rating.
  - 3. UPS units for RTUs shall be mounted within the RTU cabinet.
- E. Where the UPS is mounted within a dedicated enclosure, that enclosure shall be properly sized for heat dissipation and all other applicable requirements as specified in Section 40 67 00 – Control System Equipment Panels and Racks and its subordinate Sections.

**1.02 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 40 61 13 – Process Control System General Provisions
- B. Section 40 62 00 – Computer System Hardware and Ancillaries
- C. Section 40 63 43 – Programmable Logic Controllers
- D. Section 40 62 16 – Operator Workstation Computers



### **1.03 SUBMITTALS**

- A. Sizing calculations, in Watts (W) or Volt-Amps (VA), for all UPS units.
- B. Heat dissipation calculations for all enclosures that contain a UPS unit.
- C. Run time calculation.

## **PART 2 – EQUIPMENT**

### **2.01 UNINTERRUPTIBLE POWER SYSTEMS**

- A. Each UPS shall consist of a freestanding UPS module and battery modules as required to meet backup run time requirements.
- B. UPS units shall be true on-line type. Each UPS shall be sized to match the maximum power requirements of the associated digital equipment, control panel power supplies and accessories. Under normal operation, the AC power shall be converted to DC. The DC power from the battery charger shall supply an inverter and maintain the battery module at full charge. The AC output from the inverter shall be fed to the associated digital equipment power supply unit and/or other equipment power supplies as appropriate. Upon loss of the AC supply, the inverter shall continue to supply normal power to the device, drawing DC from the batteries.
- C. An automatic bypass switch shall be provided with UPS units of greater than 2 kVA capacity. The transfer switch shall be of the solid state, make-before-break type and shall automatically transfer load from the inverter to the AC line in the event of an inverter malfunction. The total transfer time shall be 5 milliseconds or less. The transfer switch shall be provided with a manual override.
- D. A manually operated maintenance bypass switch shall be provided for each UPS installation, other than for computers, to allow the hardware to be powered while the UPS is removed for maintenance. The bypass switch shall be the make-before-break type to ensure continuous power to the load.
- E. Loss of AC power shall be monitored on the line side of the UPS and reported via normally closed (fail safe) unpowered contacts to the associated PLC/RTU.
- F. Each UPS shall meet the following requirements:
  - 1. Input voltage shall be 117 VAC, single phase, 60 Hz.
  - 2. Voltage regulation shall be +/-5 percent for line and load changes.
  - 3. The output frequency shall be phase-locked to the input AC line on AC operation and shall be 60 hertz +/-0.5 percent when on battery operation.

4. The batteries shall be of the sealed, lead acid or lead calcium gelled electrolyte type, or VRLA absorbed glass mat (AGM) type. The battery modules shall have a minimum full load backup time of 30 minutes for PLC-based control panels, and 45 minutes for remote telemetry units.
  5. The UPS capacity shall be sized for 150% of the connected load.
  6. A status monitoring and control panel shall be provided and shall include the following:
    - a. Status indicating lights for both normal and abnormal conditions.
    - b. Individual alarm contacts that shall close upon:
      - 1) Loss of the AC line
      - 2) Low battery level
      - 3) Fault condition.
    - c. Contacts shall be wired to the closest discrete input subsystem.
    - d. Circuit breaker for the AC input.
  7. Sound absorbing enclosure.
  8. EMI/RF noise filtering.
  9. Surge protection shall be provided on the AC input circuit, which shall have a UL TVSS clamping voltage rating of 400 V with a <5 ns response time.
- G. UPS systems shall be the 9PX series by Eaton, Smart-UPS On-line series by APC/Schneider-Electric, or equal.

## **PART 3 – EXECUTION**

### **3.01 REQUIREMENTS**

- A. Where the UPS is mounted within the PLC or RTU cabinet, it shall not interfere with access to other equipment or wiring within the panel (i.e., it shall not be necessary to move or remove the UPS to remove or service other panel-mounted equipment). For floor-mounted PLC cabinets with bottom wiring access (including those cabinets with legs), the UPS shall be placed on a dedicated shelf within the cabinet.
- B. Refer to Section 40 61 13 – Process Control System General Provisions for additional requirements.

**END OF SECTION**

**SECTION 46 00 00**  
**EQUIPMENT GENERAL PROVISIONS**

**PART 1 – GENERAL**

**1.01 THE REQUIREMENT**

- A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all accessories as specified, as shown on the Drawings, and as required for a complete and operable system.
- B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.
- C. The Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces related mechanical, structural, electrical, instrumentation, and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as shown and specified.
- D. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.
- E. The requirements of this section shall apply to equipment furnished under Divisions 40, 41, 43, and 46.
- F. Comply with reference specifications, codes and standards as specifically modified, complimented, and supplemented herein.

**1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01 42 00 – References along with those identified herein this and other individual specification sections.
- B. American Institute for Steel Construction (AISC)
- C. American National Standards Institute/American Bearing Manufacturers Association (ANSI/ABMA):
  - 1. ANSI/ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings
  - 2. ANSI/ABMA 11 – Load Ratings and Fatigue Life for Ball Bearings

- D. Acoustical Society of America (ASA) / American National Standard Institute (ANSI) S2.75, Shaft Alignment Methodology:
  - 1. Part 1: General Principles, Methods, Practices, and Tolerances
  - 2. Part 2: Vocabulary
  - 3. Part 3: Alignment of Vertically Oriented Rotating Machinery
  - 4. Guidelines and recommendations included in ASA/ANSI S2.75 shall establish and be interpreted as the minimum requirements for acceptance for leveling, grouting and alignment related work.
- E. American National Standards Institute / American Society of Mechanical Engineers (ANSI/ASME) Standard B29.1, Heavy Duty Offset Sidebar Transmission Roller Chains and Sprocket Teeth.
- F. American Welding Society (AWS):
  - 1. D1.1 "Structural Welding Code - Steel"
  - 2. D1.2 "Structural Welding Code - Aluminum" of the American Welding Society
- G. Electrical Apparatus Service Association, Inc. (EASA) Mechanical Reference Handbook (latest revision).
- H. Standard, ISO 1940 – Mechanical Vibration – Balance quality requirements for rotors balance quality grade for rotors in a constant rigid state.
- I. In the event of conflict between individual specifications and reference specifications, codes and standards, the more restrictive criteria shall govern.

### **1.03 ACTION/INFORMATIONAL SUBMITTALS**

- A. Product Data:
  - 1. Comply with Section 01 33 00 – Submittals Procedures
  - 2. Fabrication information
- B. Provide submittals identified in individual equipment specification sections in addition to the submittals identified herein.
- C. Shop Drawings shall include the following information in addition to the requirements of Section 01 33 00 – Submittal Procedures and shall include the following additional information:
  - 1. Equipment name, identification number and specification number.

2. Performance characteristics and descriptive data, including but not limited to capacity, power, speed, torque, and efficiency.
3. Detailed equipment dimensional drawings and setting plans including but not limited to:
  - a. General cutaway sections
  - b. Materials of construction
  - c. Dimension of shaft projections
  - d. Shaft and keyway dimensions
  - e. Shaft diameter
  - f. Shaft connection details
  - g. Dimension between bearings
  - h. General dimensions of equipment
  - i. Anchor bolt locations
  - j. Forces
  - k. Assembly views
  - l. Weights: Provide weight of entire equipment assembly, including motor and base weight of individual major subassemblies. Indicate the weight of each component, and total static and dynamic loads imparted by the equipment to the supporting structure.
  - m. Rotating assembly technical information and illustration.
  - n. Drawings shall identify each component by tag number to which the catalog data and detail sheets pertain.
  - o. Drawings showing the location and type of all equipment, system components, supports, hangers, foundations and the required clearances to operate and maintain equipment, valves and system components in a code compliant, safe and ergonomic manner. Drawings shall show clearances reserved for walking access around all sides, for opening access doors fully, for visual inspection for condition monitoring, and for the performance of maintenance tasks including but not limited to changing filters, replacing belts, maintaining lubrication levels, predictive maintenance and performing diagnostic functions.

4. Drive and motor data as required by Division 26 – Electrical. Complete motor data shall include but not be limited to size, make, type and characteristics along with wiring diagrams. Where equipment and motor speeds are to be regulated by variable speed drives, the CONTRACTOR shall coordinate, furnish and exchange all necessary requirements with the respective equipment manufacturers to ensure compatibility and shall submit equipment, shafting, coupling, motor and variable speed drive shop drawings.
5. Bearings:
  - a. Information on bearings including but not limited to: type, size, materials of construction.
  - b. Bearing life calculations including but not limited to: basic dynamic load rating, static load rating, rating life, ABMA L10 reliability (expressed in hours of bearing life) and bearing system life.
6. Gear box design and performance criteria and AGMA service factor, including but not limited to the following:
  - a. Thermal horsepower rating
  - b. Bearing type
  - c. Actual gear ratio
  - d. Forced lubrication system: Provide description of equipment, system and instrumentation including but not limited to flow meter, pressure switches, etc.
  - e. Gear tooth finish quality
7. Piping schematics.
8. Equipment protective device details and connection diagrams.
9. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.
10. A list of spare parts and special tools to be provided.
11. Information on equipment appurtenances including couplings, shaft guards, v-belt drive systems, etc.
12. Any additional information required to demonstrate conformance with the equipment specifications.

13. Results of critical speed analyses, structural, lateral, and torsional dynamic analyses as required herein and in the individual specification sections.
14. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.
15. Shipment, delivery, handling, and storage instructions.
16. Installation instructions
17. Manufacturers literature and brochures
18. Materials of construction and associated specifications (such as AISI, ASTM, SAE, etc.), including grade and type.
19. Anchor design in accordance with Section 05 04 23 – Metal Fastening.
20. Intermediate shafting design, including but not limited to general arrangement drawings, engineering data, materials of construction, recommended angular offsets (for cardan universal jointed shafts), and shaft critical speed analyses (including 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> critical speed analysis).
21. Coatings: Coating system data and description of coating system, surface preparation and shop painting, including certification that the shop paint is compatible with the finish paint.
22. Pre-commissioning lubrication oil flushing plan developed by a machinery lubrication specialist, specifically for each piece of lubricated equipment. Plan shall identify, describe procedure and demonstrate data-based approach to demonstrating achievement of lubricant cleanliness via flushing. Level of lubricant cleanliness shall be as required by equipment manufacturer's written recommendations.
23. Equipment installation lists.
24. Equipment specific requirements for levelness, plumbness, flatness, coplanarity and coplanar surface deviation.

#### **1.04 CLOSEOUT SUBMITTALS**

- A. Submit warranty documentation in compliance with:
  1. Section 01 33 00 – Submittal Procedures
  2. Section 01 61 00 – Product Requirements and Options



- B. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01 33 00 – Submittal Procedures and Section 01 78 23 Operation and Maintenance Data.

#### **1.05 MAINTENANCE MATERIALS SUBMITTALS**

- A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with:
  - 1. Section 01 33 00 – Submittal Procedures
  - 2. Section 01 78 23 – Operation and Maintenance Data
- B. Comply with Section 01 78 43 – Spare Parts and Extra Materials:
  - 1. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section.
  - 2. Submit complete list of spare parts, extra stock materials, maintenance supplies and special tools required for maintenance for one year with unit prices and source of supply. Indicate number/quantity specified and furnished, manufacturer, part number, description,
- C. Comply with Section 01 79 00 – Instructions to Owner’s Personnel.
- D. Lubrication Information:
  - 1. Comply with Specification Section 01 78 23 – Operation and Maintenance Data.
  - 2. Complete lubrication instructions and lubricant schedule, including manufacturer’s recommended lubricant. All lubricants shall be food grade, NSF 61 approved. Schedule shall include frequency of lubricant application, type of lubricant, and instructions regarding lubricant application

#### **1.06 QUALITY ASSURANCE SUBMITTALS**

- A. Factory testing plan.
- B. Factory Test Results shall be submitted and approved prior to shipment of equipment.
- C. Field testing plan.
- D. Comply with Section 01 75 00 – Check Out and Start Up Procedures.
- E. Alignment Report:
  - 1. Alignment reports shall contain numerical values to express offset and angular alignment and all other parameters documented in ANSI/ASA S2.75.

2. Alignment reports shall be submitted immediately after each of the following activities have been completed:
  - a. Preliminary Alignment
  - b. Final Alignment (at both ambient and operating temperatures)
  - c. Re-check of alignment
- F. Preliminary field test data
- G. System field quality control testing
- H. Final field test data
- I. Certified test reports

#### **1.07 GENERAL INFORMATION AND DESCRIPTION**

- A. All parts of the equipment furnished shall be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new and shall conform to all applicable Sections of these Specifications.
- B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.
- C. Equipment and appurtenances shall be designed in conformity with specifications, codes and reference standards.
- D. All bearings and moving parts shall be protected by bushings or other Engineer approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.
- E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.
- F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.
- G. All machinery and equipment shall be safeguarded in accordance with the specifications, codes, and reference standards.

- H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.
- I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.
- J. All manufactured items provided under this Section shall be of current manufacture and shall be the products of manufacturers specializing in the manufacture of such products.
- K. Code Compliance, safety and ergonomics for operating and maintenance personnel accessing equipment shall be considered during shop drawing development, fabrication, and installation. Items to considering include but are not limited to clearances reserved for walking access around all sides, for opening access doors fully, for visual inspection for condition monitoring, and for the performance of maintenance tasks including but not limited to changing filters, replacing belts, maintaining lubrication levels, predictive maintenance and performing diagnostic functions.

#### **1.08 EQUIPMENT WARRANTIES**

- A. Warranty requirements shall be as specified in Section 01 61 00 – Product Requirements and Options and Section 01 75 00 – Checkout and Startup Procedures. Warranty requirements are supplementary to the individual equipment specifications.

#### **1.09 DEFINITIONS**

- A. Comply with specification Section 01 42 00 – References.
- B. Refer to the specified reference specifications, codes and standards for definitions applicable to this specification. Additional definitions are included hereafter.
- C. Chockplate: A solid steel (or alloy steel) plate with a machined top surface that is grouted to a concrete foundation to support and maintain alignment of a machinery structural steel base plate.
- D. Equipment Train: Two or more rotating equipment machinery elements consisting of at least one driver and one driven element joined together by a coupling.
- E. Mounting plate: A device used to attach equipment to concrete foundations; includes base plates, soleplates, and chockplates. A mounting plate is a base-support mechanism for the attached machinery and all individual pieces of machinery are expected to be removable from the mounting plate as a single assembly.
- F. Operating Temperature (Thermal) Alignment: A procedure to determine the actual change in relative shaft positions within a machinery train from the ambient (not running) condition and the normal operating temperature (running) condition by taking measurements from start-up to normal operating temperature while the machine(s) is

(are) operating, or after the shafts have been stopped but the machines are still near operating temperature.

- G. Preliminary alignment: The aligning of two adjacent machinery shafts to ensure that final alignment can be achieved without being bolt bound. This is accomplished before grouting (for horizontal machines) and the measurement of piping strain on the machinery.
- H. Soleplate: A solid steel (or alloy steel) plate with a machined top surface that is grouted to a concrete foundation to support and maintain alignment of machinery.

## **PART 2 – PRODUCTS**

### **2.01 GENERAL**

- A. All like components within a piece of equipment shall be provided by the same manufacturer.
- B. Base plates:
  - 1. Top surface of mounting plates shall be machined in locations where equipment supports/feet will contact the plate.
  - 2. Equipment contact points shall be flat and parallel within ASA/ANSI 2.75 tolerances or 0.002-inches per foot, whichever is more stringent, and within related tolerances.
  - 3. There shall be no paint where equipment supports or feet contact mounting plate.
  - 4. Mounting plate shall be sufficiently rigid to avoid bending or flexing when equipment is installed.

### **2.02 ANCHORS AND SUPPORTS**

- A. Comply with the following Specification Sections:
  - 1. Specification Section 05 05 23 – Metal Fastening.
  - 2. Comply with individual equipment specifications.
- B. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and templates shall be used by the Contractor when required in the detailed equipment Specifications.
- C. Anchor bolts and fasteners:

1. Anchor bolts shall be designed and provided by the Contractor in accordance with Section 05 05 23 – Metal Fastening, and with the individual equipment Specifications.
  2. All anchor bolts shall have at least the minimum diameter as required by Specification Section 05 05 23 – Metal Fasteners.
  3. All anchor bolts, guard bolts, washers, clips, clamps, fasteners, and leveling plate pads, nuts, shims, and jack bolts of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.
  4. Undercutting of anchors or fasteners shall not be permitted.
- D. Pipe sleeves as a means for adjusting anchor bolts shall be provided where indicated in the contract documents or required by the equipment manufacturer.
- E. The Contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 4" high, unless otherwise shown on the Drawings, and shall be doweled.

### **2.03 DEFAULT MATERIALS**

- A. Equipment shall be constructed out of the materials specified in respective individual pumping specification sections. Material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended.

### **2.04 STRUCTURAL STEEL**

- A. Structural steel used for fabricating equipment shall conform to the requirements of Section 05 12 00 – Structural Steel.
- B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

### **2.05 DISSIMILAR METALS**

- A. All dissimilar metals shall be isolated in accordance with Section 05 10 00 – Metal Materials and to the satisfaction of the Engineer.

### **2.06 GALVANIZING**

- A. Where required by the equipment specifications, galvanizing shall be performed in accordance with Section 05 05 13 – Galvanizing.

## **2.07 STANDARDIZATION OF GREASE FITTINGS**

- A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be “Zerk” type.

## **2.08 ELECTRICAL REQUIREMENTS**

- A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit, and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the Division 26 specifications and the latest National Electric Code. Motor starters and controls shall be furnished and installed under Division 26 and Division 40 unless otherwise specified in the individual equipment specifications.
- B. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.
- C. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 26 unless otherwise specified in the equipment specification. Wherever variable speed drives (VSDs) are specified the same requirements as for VFDs shall apply.
- D. Motor starters and controls shall be furnished and installed under Division 26 and Division 40 unless otherwise specified in the individual equipment specifications.

## **2.09 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS**

- A. Accessories, spare parts, and special tools shall be provided in accordance with Section 01 78 43 – Spare Parts and Extra Materials.

## **2.10 EQUIPMENT IDENTIFICATION**

- A. All mechanical equipment shall be provided with a substantial stainless-steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with:
  - 1. The manufacturer's name
  - 2. Year of manufacture
  - 3. Serial number
  - 4. Principal rating data such as (for example):
    - a. Capacity

- b. Pressure
  - c. Horsepower
  - d. Speed
- B. Each piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless-steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1 (RWP-1)". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.
- C. Nameplates shall not be painted over.

## **PART 3 – EXECUTION**

### **3.01 SHOP TESTING**

- A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.
- B. No equipment shall be shipped to the project site until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.
- C. A certified copy of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.
- D. If required by the individual equipment Specifications, arrangements shall be made for the Owner/Engineer to witness performance tests in the manufacturer's shop. The Engineer shall be notified ten working days before shop testing commences. Expenses are to be paid by Contractor.
- E. Shop testing of electric motors shall conform to:
  - 1. Section 26 05 60 – Low-Voltage Electric Motors
  - 2. Section 26 05 61 – Medium Voltage Electric Motors
  - 3. Section 26 05 00 – Basic Electrical Requirements

### **3.02 SHIPMENT, DELIVERY, HANDLING AND STORAGE**

- A. Shipment, delivery, and handling of equipment and materials shall be in accordance with Section 01 65 00 – Product Delivery Requirements.

- B. Storage of equipment and materials shall be in accordance with Section 01 66 00 – Product Storage and Protection Requirements.
- C. Shipping plans shall include consideration for protecting bearings and/or other rotating equipment from chatter damage.
- D. Any equipment shipped to site that needs further attention shall have a WARNING tag affixed to it with indication of the action that should be taken in preparation for startup. Examples are: Final Lubrication, Mechanical Seal not in final position, etc.

### **3.03 MANUFACTURER’S FIELD SERVICES**

- A. Manufacturer’s field services shall be in accordance with Section 01 75 00 – Checkout and Startup Procedures.
- B. The Contractor shall arrange for a qualified factory trained Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.
- C. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections. Additional site visits may be required as described below and in the equipment specifications.
- D. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of their inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.
- E. The manufacturer's Technical Representative shall provide the following services.
  - 1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer’s requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.



2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.
  3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. If equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.
  4. Training: Training shall be provided in accordance with Section 01 79 00 – Instruction of Owner Personnel.
  5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site thirty (30) days after the startup date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that their equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.
- F. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.
- G. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.

- H. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day the Technical Representative is at the project.

### **3.04 INSTALLATION**

- A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished to the Engineer's field representative one week prior to installation.
- B. The Owner's field representative (e.g., the Engineer or similar) shall witness all activities involved with equipment installation.
- C. The Contractor shall have on hand personnel, construction equipment, and machinery of capacity to facilitate the work and to handle all emergencies encountered in work of this character. To minimize field erection problems, mechanical units shall be factory assembled insofar as practical.
- D. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.
- E. All equipment sections and loose items shall be match-marked prior to shipping.
- F. The Contractor shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.
- G. Leveling and Grouting:
  - 1. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/- 1/16 inch except as otherwise specified, required or indicated on the drawings.
  - 2. Base plate Surface Preparation – Prior to setting equipment and grouting, inspect and clean equipment mounting base plates, pads, feet, and frames to remove all grease, rust, paint, and dirt.
  - 3. Wedges (i.e., tapered shims) shall not be used for leveling, aligning, or supporting equipment.
  - 4. General Equipment Leveling:
    - a. Non-rotating Equipment: Set level to +/- 1/16 inch per 10-foot length (0.005 inch per foot) unless manufacturer's requirements are more stringent.

- b. Rotating Equipment: Install, set to the most stringent of the following requirements for levelness, plumbness, flatness, coplanarity and coplanar surface deviation:
    - 1) ASA-ANSI S2.75, Shaft Alignment Methodology. Comply with tolerance ranges scheduled at the end of this specification section.
    - 2) Individual equipment specifications
    - 3) Manufacturer's pre-printed written requirements.
    - 4) When the equipment manufacturer's pre-printed tolerances are more stringent than those stated in ASA/ANSI 2.75 or more stringent than the individual pump specification, the cost of field machining sole plates or precision grouting sole plates shall be covered by the [Contractor] [by the allowance stated in the bid table] [by the unit cost stated in the bid table].
  - c. Shims or leveling nuts shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment base plate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one-inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.
  - d. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with epoxy base plate grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (e.g., such as shim leveling pumps, or chemical grout).
5. Grouting
- a. Comply with Section 03 60 00 – Grout.
  - b. Grout Materials:
    - 1) Rotating Equipment: Grout for rotating equipment shall be epoxy base plate grout. Cementitious grouts shall not be accepted for rotating equipment.
    - 2) Non-rotating Equipment: Grout shall be as per the non-rotating equipment manufacturer's pre-printed written installation instructions and shall be subject to the Engineer's approval.
  - c. Fill pipe sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.

- d. Concrete Surface Preparation: Roughen concrete equipment pad surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale.
    - 1) When grouting with cementitious grouts is approved, the contact area of the concrete equipment pad shall be saturated with water at least 4 hours prior to grouting, removing excess water ponds.
  - e. Application:
    - 1) Place grout after the equipment base has been set and its initial alignment and level have been approved.
    - 2) Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions.
    - 3) Grout mixture shall be flowable. Dry packing of grout shall not be permitted.
    - 4) Eliminate all air or water pockets beneath the base using a drag chain or rope.
    - 5) Grout voids detectable by tapping the top of the base plate with a hammer shall be grounds for removal and reinstallation of the work.
  - f. Finishing: Point the edges of the grout to form a smooth 45-degree slope.
  - g. After cementitious grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.
  - h. Level Verification. After grout has cured, and immediately prior to final drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.
6. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.

### **3.05 ALIGNMENT**

- A. For equipment that requires field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the equipment and motor prior to making piping connections or anchoring the equipment base. Alignment shall be as specified herein.
- B. Rotating Equipment Shaft Alignment: Assembled equipment shafts shall be set to comply with the most stringent of the following tolerance requirements for shaft runout

and shaft-to-shaft alignment tolerances expressed in angle at flex plane, in offset and angularity and/or in offset per tolerance plane separation:

1. ASA-ANSI S2.75, Shaft Alignment Methodology. Comply with tolerance ranges scheduled at the end of this specification section.
  2. Individual equipment specifications
  3. Manufacturer's pre-printed written requirements.
- C. Use the machined surfaces on which the equipment sets for the base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.
- D. Sprocket and Sheave Alignment:
1. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI Standard B29.1-1975.
  2. Drive and driven sheaves shall lie in the same plane. The sum of parallel and angular sheave misalignment measured across the span length of the belt and angular misalignment perpendicular to the belt span length shall each not exceed  $\frac{1}{2}$  degree or the belt manufacturer's recommendation whichever is more stringent.
- E. Belt tensioning: Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.
- F. Thermal/Mechanical Growth: Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.
- G. Rotating Shaft Alignment
1. Measurement devices/fixtures will be set up on the driver and driven machine, or machine shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.
  2. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.
  3. Final alignments shall be performed utilizing laser alignment tools unless otherwise approved by the Engineer.
  4. Cardan Universal Jointed Intermediate Shafting:

- a. Align cardan universal joints in accordance with manufacturer's written offset recommendations.
  - b. Offsets shall be field verified.
  - c. Contractor shall have unit responsibility for all components of extended shaft driven equipment, including but not limited to the coordination of shaft design with equipment, variable frequency drive and control strategies.
5. Alignment Steps: Each of the following alignment steps are required in all instances, including but not limited to, all vertically and horizontally mounted drivers:
- a. Preliminary alignment is when uncoupled. Preliminary Alignment (at ambient temperature):
    - 1) Perform prior to grouting and piping connections.
    - 2) Check shaft straightness (runout).
    - 3) Correct for soft foot.
  - b. Final alignment method is when coupled. Final Alignment (at ambient temperature):
    - 1) Perform after grouting and piping connections have been completed.
    - 2) Check for pipe strain.
    - 3) Alignment shall be within tolerances.
  - c. Final alignment method is when coupled. Final Alignment (at operating temperature after 1-hour of continuous operation):
    - 1) Check for pipe strain.
    - 2) Alignment shall be within tolerances (coupled).
  - d. Re-check alignment (at operating temperature):
    - 1) After a minimum of 24-hours of run time
    - 2) Alignment shall be within tolerances (coupled)
6. Additional Alignment Steps for Vertical Mixers:
- a. Level gearbox.

- b. Verify vertical plumbness of shaft (while shaft is not turning).
- c. Grout.
- d. Check shaft runout.
- e. Install impeller blades.

### **3.06 FIELD TESTING**

- A. Field testing shall be in accordance with Section 01 75 00 – Checkout and Startup Procedures.
- B. All equipment shall be set, aligned, and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer's representative.
- C. Preliminary Field Tests, Yellow Tag.
  - 1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall:
    - a. Verify that the equipment is free from defects.
    - b. Check for alignment as specified herein.
    - c. Check for direction of rotation.
    - d. Check motor for no load current draw.
  - 2. Contractor shall flush all bearings, gear housings, etc., in accordance with the pre-commissioning lubrication oil flushing plan and manufacturer's pre-printed written recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.
  - 3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or the Engineer's assigned representative and attached to the equipment. The tag shall not be removed.
  - 4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.
- D. Final Field Tests, Blue Tag

1. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, ducting, electrical and controls, and other ancillary facilities.
  2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or the Engineer's assigned representative and the Owner or the Owner's assigned representative.
  3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Operating field tests shall consist of the following:
    - a. Check equipment for excessive vibration and noise.
    - b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded. The rated motor nameplate horsepower shall not be exceeded when a torque transducer is provided.
    - c. Recheck alignment where applicable, after unit has run under load for a minimum of 24 hours.
- E. Additional field testing recommended by the manufacturer shall be performed at no cost to Owner.
- F. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments, and replacements at no additional cost to the Owner.
- G. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed, and no further construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.
- H. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
- I. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc., shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Owner unless otherwise specified in the individual equipment specifications.
- J. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.



- K. Field testing of electric motors shall be in accordance with Section 26 05 60 – Low-Voltage Electric Motors; Section 26 05 61 – Medium Voltage Electric Motors, and Section 26 05 00, Basic Electrical Requirements.

### **3.07 VIBRATION TESTING**

- A. Vibration testing shall be in accordance with Section 01 75 00 – Checkout and Startup Procedures.

### **3.08 FAILURE OF EQUIPMENT TO PERFORM**

- A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.
- B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding their having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.
- C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.
- D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.
- E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.
- F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

### **3.09 PAINTING**

- A. The equipment and motor shall be painted. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable paragraphs of Section 09 90 00 – Painting.
- B. All shop coatings shall be compatible with proposed field coatings.
- C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer.

- D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

### **3.10 WELDING**

- A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

**END OF SECTION**

**Schedule 46 00 00 – 01 – Applicable Tolerance Range**

<b>Equipment Horsepower</b>	<b>ANSI/ASA S2.75 Quality Grade Tolerance Range</b>
<= 25 HP	Minimal
> 25 HP < 100 HP	Standard
>= 100 HP	Precision

Scheduled ANSI/ASA S2.75 Quality grade tolerance range categories relate to ANSI/ASA S2.75 quantified tolerances for: levelness, plumbness, flatness, coplanarity, coplanar surface deviation, shaft runout, shaft-to-shaft alignment, flex plane offset, angularity, and offset per tolerance plane separation.

## Felix C. Davis – Request for Proposals for Blower Pre-Selection

To All Proposers:

Manufactures submitting proposals for the above named Request For Proposal (RFP) shall take note of the following changes, additions, deletions, clarifications, etc., in the RFP, which shall become a part of and have precedence over anything contrarily shown or described in the RFP, and as such shall be taken into consideration and be included in the Manufacture's Proposal.

Refer to the attached sheets.

The return receipt requested with this communication will be deemed evidence that the proposer has received this Addendum and has followed the instructions outlined herein. Please sign, date, clearly print company name, and email to [tdarms@hazenandsawyer.com](mailto:tdarms@hazenandsawyer.com) immediately upon receipt. Manufacturer shall also indicate receipt, where appropriate, on the Proposal Form.

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Company Name

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Acknowledgement of Receipt

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Date

HAZEN AND SAWYER, P.C.  
735 Johnnie Dodds Blvd.  
Suite 102  
Mt. Pleasant, SC 29464  
Tel. (843) 744-6467

## Modifications to Bid Documents

### Interpretations and Addenda

Changes to original language is highlighted in bold below:

“All questions regarding the RFP are to be submitted to the Engineer, **Tim Darms with Hazen and Sawyer**, via email at [tdarms@hazenandsawyer.com](mailto:tdarms@hazenandsawyer.com). Interpretations or clarifications considered necessary by the Engineer in response to such questions will be issued by addenda and emailed to all Suppliers. Questions received less than 10 days prior to the date for opening of proposals will not be answered.”

### Questions

**Question 1: Please provide the email address for the Engineer to which question regarding this RFP are to be sent.**

Response: All questions regarding the RFP are to be submitted to the Engineer, Tim Darms with Hazen and Sawyer, via email at [tdarms@hazenandsawyer.com](mailto:tdarms@hazenandsawyer.com).

**Question 2: Please provide the following specifications for review:**

- **01 33 00 – Submittal Procedures**
- **09 90 00 – Painting**
- **26 05 61 – Medium Voltage Electric Motors**
- **40 05 57 – Valve Operators and Electric Valve Actuators**
- **40 05 64 – Butterfly Valves**
- **40 06 20 – Process Pipe, Valve, and Gate Schedules**
- **40 61 23 – Signal Coordination Requirements**
- **40 67 63 – Uninterruptible Power Systems**
- **46 00 00 – Equipment General Provisions**

Response: The full specification package has not yet been prepared. A draft of the above requested specifications has been attached to Addendum No. 1. Specification 40 06 20 – Process Pipe, Valve and Gate Schedules has been omitted due to detailed design of this project not having begun.

**Question 3: Please clarify the blower delivery dates which the proposal price needs to remain valid through.**

Response: The prices presented in the proposals shall be valid for a blower delivery from October 2025 through April 2026.

**Question 4: Is the blower manufacturer required to provide a master control panel to manage the blowers?**

Response: A master control panel (MCP) needs to be included in the base price if the blower manufacturer requires that the MCP be provided by the manufacturer. If the blower manufacturer allows the MCP and programming to be furnished separately from a third party, the manufacturer shall omit the MCP from their base bid. The blower manufacturer may propose to furnish an MCP as an option and include it in their proposal as a separate additive alternative unless it is required that the manufacturer provide it, in which case it shall be part of the base bid.

**Question 5: Within the Ex. Blower Room, is it permissible to utilize footprint behind the overhead door? Is this permissible for the actual footprint of the blower package? Is this permissible to use for maintenance purposes only (e.g. space required for doors to swing open for maintenance)?**

Response: The proposed blowers shall allow for ample room for removal of the existing blowers and installation of the new blowers. Removal of existing blowers and installation of new blowers will need to be staged to maintain aeration capacity through the entirety of construction. The proposed blowers shall allow for sufficient clearance meeting the manufacturer's recommendations for maintenance and access. The location of the proposed blowers in the room shall not interfere with the ability to install or remove (existing and new) blowers or major blower components through the existing overhead door.

**Question 6: Please provide the RFP in Word format.**

Response: The RFP document has been added to RFP via addendum.

**Question 7: Provide information on any inlet pipe configuration which the blowers must conform to and any external intake filter/silencer requirements.**

Response: Inlet pipe configuration will be determined upon selection of blower manufacturer and technology. The blower manufacturer shall include in their proposal blower filters/silencers in accordance with the specifications 43 11 11 2.21 or 43 11 13 2.22. If a manufacturer does not have an integrated inlet air filter for the proposed blower then a separate external inlet filter shall be provided in the manufacturer's submittal and base price.

## **Attachments**

Attachment No. 1: Felix WWTP Aeration Upgrades Blower RFP.docx

Attachment No. 2: 01 33 00 – Submittal Procedures

Attachment No. 3: 09 90 00 – Painting

Attachment No. 4: 26 05 61 – Medium Voltage Electric Motors

Attachment No. 5: 40 05 57 – Valve Operators and Electric Valve Actuators

Attachment No. 6: 40 05 64 – Butterfly Valves

Attachment No. 7: 40 61 23 – Signal Coordination Requirements

Attachment No. 8: 40 67 63 – Uninterruptible Power Systems

Attachment No. 9: 46 00 00 – Equipment General Provisions