APPENDIX A

REQUEST FOR MULTISTAGE BLOWER PRICE PROPOSAL

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Brownsville Public Utilities Board

Robindale Wastewater Treatment Plant

Robindale Wastewater Treatment Plant Multistage Blower Procurement

Contract B010-21

October 2020

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PROJECT TITLE PAGE

Robindale Wastewater Treatment Plant
Multistage Blower Procurement

Contract B010-21

October 2020

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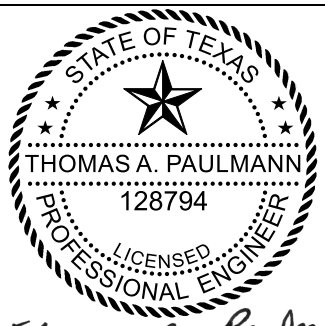

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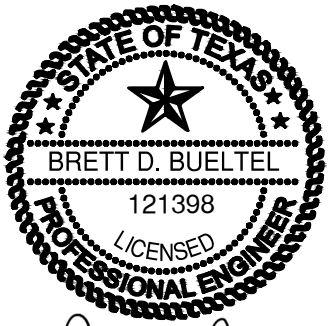

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Division 26
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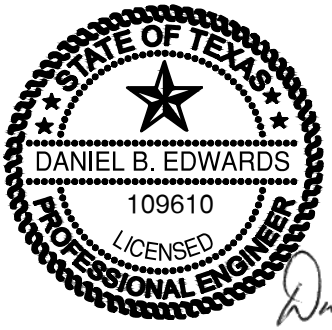

Dan B Edwards
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BROWNSVILLE
PUBLIC UTILITIES BOARD

LEGAL NOTICE

AND

INVITATION TO BID
B010-21

Sealed bids will be received by the PUBLIC UTILITIES BOARD of the City of Brownsville, Texas ("BPUB"), at the BPUB Purchasing Department office; 1155 FM 511, Olmito, TX 78575 **until 5:00 PM, November 24, 2020** for the project described in the Contract Documents and Specifications entitled:

Robindale Wastewater Treatment Plant (RWWTP) Multistage Blower Procurement

Bids received after this time will not be considered.

Bids will be publicly opened and read aloud on November 25, 2020 at 10:00 AM. Bidders can call (956) 214-6020 to listen to the bid opening or can request a bid tabulation by emailing dsolitaire@brownsville-pub.com.

Detailed specifications may be obtained at Brownsville Public Utilities Board website: https://www.brownsville-pub.com/rfp_status/open/.

Each bid, in duplicate, shall be enclosed in a sealed envelope and shall be plainly marked on the outside of the envelope: **"B010-21 Robindale WWTP Multistage Blower Procurement, November 24, 2020, 5:00 PM".** This envelope shall be addressed to Diane Solitaire; Brownsville Public Utilities Board; Purchasing Department; 1155 FM 511, Olmito, TX 78575.

Successful BIDDER is required to execute a contract and furnish a Material Supply Bond in the full amount of the contract. If the successful bidder fails to execute the contract and to furnish satisfactory Material Supply bond within 10 days from the date on which he is notified that his bid has been accepted, the amount of his check or bid bond shall be forfeited to the Brownsville PUB as mutually agreed to liquidated damages, and not as a penalty. **No bid will be considered if the Material Supply Bond is not provided as required.**

The BPUB will not be responsible in the event that the U.S. Postal Service or any other courier system fails to deliver the sealed bids to the Brownsville Public Utilities Board, Purchasing Office by the given deadline above. **No bids will be accepted via facsimile or electronically**.

The BPUB specifically reserves the right to reject any or all bids, to waive irregularities or informalities in any or all bids and to accept any bid which is deemed to be in the best interest of the Board.

BY:
Diane Solitaire
Purchasing Department
(956) 983-6366
(956) 983-6367-Fax

INSTRUCTIONS TO BIDDERS
Acknowledgment Form
B010-21
Robindale WWTP Multistage Blower Procurement
Please submit this page upon receipt

For any clarifications, please contact Diane Solitaire at the Brownsville Public Utilities Board, Purchasing Department at (956) 983-6366 or via e-mail: dsolitaire@brownsville-pub.com

Please fax, mail or e-mail this page upon receipt of the bid package or legal notice. If you only received the legal notice and you want the bid package mailed, please provide a method of shipment with account number in the space designated below.

Check one:

( ) Yes, I will be able to send a bid; obtained bid package from website.

( ) Yes, I will be able to send a bid; please email the bid package.
Email: _____

( ) Yes, I will be able to send a bid; please mail the bid package using the carrier & account number listed below:
Carrier: _____
Account: _____

( ) No, I will not be able to send a bid for the following reason:

_____

_____

If you are unable to send your bid, kindly indicate your reason for "No bid" above and return this form **via email: dsolitaire@brownsville-pub.com.** This will ensure you remain active on our Contractor list.

Date _____

Company:_____

Name:_____

Address:_____

City: _____State:_____ Zip Code: _____

Phone: _____Fax: _____

Email: _____

IF SPECIFICATIONS ARE DOWNLOADED FROM WEBSITE PLEASE EMAIL/FAX THIS PAGE TO NUMBER LISTED ABOVE

Special Instructions

Contract Information

- **Interpretation**

Questions concerning terms, conditions, and technical specifications should be directed no later than seven (7) days prior to bid opening to:

Diane Solitaire, Materials Warehouse Manager
(956) 983-6366

- **Tentative Time Line**

1. November 2, 2020 through November 24, 2020 - Vendors work on bid.
2. November 24, 2020 at 5:00 PM – **Vendor must submit bid, in duplicate, sealed in an envelope to:**

Diane Solitaire, Purchasing
1155 FM 511
Olmito, TX 78575

B010-21 Robindale WWTP Multistage Blower Procurement
Due: November 24, 2020 at 5:00 PM

The above noted information must be included on bid envelope and on any carrier's envelope/package. The Brownsville Public Utilities Board will not be held responsible for missing, lost or late mail. Brownsville Public Utilities Board will not accept facsimile or electronic transmission of sealed bids.

1. November 10, 2020 – Pre-Bid Conference Call, 10:00 AM
2. November 25, 2020 – Open bids at 10:00 AM
3. November 25, 2020 – December 20, 2020 - Evaluate bids
4. December 18, 2020 – Provide Final Recommendations
5. January 11, 2021 – Send to Utilities Board for approval

- **Or Equal**

Where a brand name or manufacturer's reference is indicated as "or equal", its use in this request is descriptive – not restrictive – it is intended to indicate type and quality desired. Brands of like nature and quality will be considered. If bidding on other than referenced specifications please provide complete descriptive information of said article.

- **Pricing**

Bid unit price on quantity specified, extend and show total. In case of errors in extension, unit prices shall govern. Price shall remain firm until all materials have been received.

All fields (UNIT PRICE, TOTAL PRICE, & EST DELIVERY IN DAY) in the Bid Schedule must be filled. The data must be complete to identify the bidding brand.

Failure to submit any of the above information with the sealed bid will disqualify bid.

- **Vendor Representative**

The successful vendor agrees to send a personal representative with binding authority for the company to the Brownsville Public Utilities Board upon request to make adjustments and/or assist with coordination of all transactions as needed.

- **Quality of Products**

All items must be new, in first class condition, including containers suitable for shipment and storage. No substitutions in standard grades or lesser quality will be accepted.

- **Determining Factors for Award**

1. Compliance with requirements of the technical specifications
2. Bidders net price on bid items
3. Stock availability
4. Reputation of brand name offered
5. Reputation and location of the bidder
6. Delivery
7. BPUB financial and legal responsibility evaluations of any identified teaming arrangements involving significant joint ventures, subcontractors and suppliers.
8. Safety record will be considered when determining the responsibility of the bidder

- **Contract with Vendor/Entity Indebted to BPUB**

It is a policy of the BPUB to refuse to enter into a contract or other transaction with an individual, sole proprietorship, joint venture, Limited Liability Company or other entity indebted to BPUB.

- **Vendor ACH (Direct Deposit) Services**

The BPUB has implemented a payment service for vendors/contractors by depositing the contract payment directly to the contractor's/vendor's bank account. Successful vendor(s)/contractors will be required to receive payments directly through Automated Clearing House (ACH) in lieu of a paper check. **Return the Direct Deposit Authorization Form with the bid response. The awarded vendor must agree to receive payments via ACH (Direct Deposit).**

- **Tax Identification Number (TIN)**

In accordance with IRS Publication 1220, a W9 form, or a W8 form in cases of a foreign vendor, will be required of all vendors doing business with the Brownsville PUB. If a W9 or W8 form is not made available to Brownsville PUB, the first payment will be subject to income tax withholding at a rate of 28% or 30% depending on the U.S. status and the source of income as per

IRS Publication 1220. **The W9 or W8 form must be included with bid response.** Attached are sample forms.

- **Taxes**

The Brownsville Public Utilities Board is exempt from Federal Excise Tax, State Tax and local Taxes. Do not include tax in the bid. If it is determined that tax was included in the bid it will not be included in the tabulation or any awards. Tax exemption certificates will be furnished upon request.

- **Signing of Bid**

Failure to manually sign bid will disqualify it. Person signing bid should show title or authority to bind their firm to a contract.

- **EEOC Guidelines**

During the performance of this contract, the contractor agrees not to discriminate against any employee or applicant for employment because of race, national origin, age, religion, gender, sexual preference, marital or veteran status, or physically challenging condition.

- **Living Wage Statement**

On April 16, 2007, the BPUB Board of Directors approved a local "living wage" policy that requires all Contractors and Subcontractors performing 100% Non-Federally funded Work for the BPUB to pay a minimum wage rate of $8.00/hour. The BPUB requires that all Contractors and Subcontractors comply with this policy.

- **Contract and Purchase Order**

The Robindale WWTP Multistage Blower Procurement shall be delivered to FOB Brownsville Public Utilities Board, Robindale Wastewater Treatment Plant, 3208 Robindale Road, Brownsville, Texas 78521. A contract for the equipment will be placed into effect by means of a purchase order issued by Brownsville Public Utilities Board after tabulation and final approval by the Board.

- **Brownsville Public Utilities Board Rights**

1. If only one or no bid is received by "submission date", the BPUB has the right to reject, re-bid, accept and/or extend the bid by up to an additional two (2) weeks from original submission date.
2. The right to reject any/or all bids and to make award as it may appear to be advantageous to the Brownsville Public Utilities Board.
3. The right to hold bid for 90 days from submission date without action, and to waive all informalities in any bid.
4. The right to extend the total bid beyond the original 90-day period prior to an award,

if agreed upon in writing by all parties (BPUB and vendor/contractor) and if bidder/vendor holds original bid prices firm.

5. The right to terminate for cause or convenience all or any part of the unfinished portion of the Project resulting from this solicitation within thirty (30) calendar days written notice; for cause: upon default by the vendor/contractor, for delay or non-performance by the vendor/contractor; or if it is deemed in the best interest of the BPUB for BPUB's convenience.
6. The right to increase quantities. In bid, stipulate whether an increase or decrease in quantities will affect bid price.

- **Corrections**

Any interpretation, correction, or change to the invitation to bid will be made by ADDENDUM. Changes or corrections will be issued by the Brownsville PUB Purchasing Department. **Addenda will be emailed or faxed to all who have returned the Bid Acknowledgement form**. Addenda will be issued as expeditiously as possible. It is the responsibility of the vendors to determine whether all addenda have been received. It will be the responsibility of all respondents to contact the Brownsville PUB prior to submitting a response to the invitation to bid to ascertain if any addenda have been issued, and to obtain any all addenda, execute them, and return addenda with the response to the invitation to bid. Addenda may also be posted on BPUB's webpage.

- **Insurance Requirements**

A. Vendor agrees to maintain Worker's Compensation and Employers' Liability Insurance to cover all of its own personnel engaged in performing services for BPUB under this Contract in at least the following minimum amounts:

Workmen's Compensation – Texas Statutory
Employers' Liability -- $100,000.00

B. Vendor also agrees to maintain Commercial General Liability, Comprehensive Business Automobile Liability, and Excess Umbrella Liability Insurance covering claims against Vendor for damages resulting from bodily injury, death or property damages from accidents arising in the course of work performed under this Contract in not less than the following amounts:

Commercial General Liability
Personal injury and property damage -
$1,000,000.00 combined single limit each occurrence and
$1,000,000.00 aggregate

Comprehensive Business Automobile Liability for all vehicles:
Bodily injury and property damage -
$500,000.00 combined single limit each occurrence

Excess Umbrella Liability:

$1,000,000.00

C. Vendor shall add the BPUB and the City of Brownsville, together with their respective commissioners, board members and employees, as additional insureds on all required insurance policies, except worker's compensation and employers' liability. The Commercial General Liability Policy and Umbrella Liability Policy shall be of an "occurrence" type policy. Insurance must be underwritten by companies acceptable to BPUB and authorized to do business in the State of Texas. Insurance Certificate(s) shall provide for advance notice to BPUB of any policy amendment or cancellation.

D. Vendor shall furnish BPUB with an Insurance Certificate on the date this Contract is executed and accepted by the BPUB, which confirms that all required insurance policies are in full force and effect. Certificates showing that Bidder has and continues to protect itself and BPUB by means of such insurance shall be provided to the BPUB upon request at any time during Contract period.

EQUIPMENT CONTRACT

AGREEMENT made _____ , 20___, between the Brownsville Public Utilities Board, Brownsville, Texas (hereinafter called the "Purchaser") and _____ _____ (hereinafter called the "Seller"), a Corporation organized and existing under the laws of the State of _____.

WHEREAS, the Purchaser desires to purchase and the Seller desires to sell the equipment described herein for the project designated:

Robindale WWTP Multistage Blower Procurement

NOW THEREFORE, in consideration of the mutual undertakings herein contained, the parties hereto agree as follows:

SECTION 1 - ACCEPTANCE OF BID

(a) The Purchaser accepts the Bid which is attached hereto and by this reference made a part hereof, and the parties hereto agree that the Seller shall sell and deliver to the Purchaser and the Purchaser shall purchase and receive from the Seller the equipment (hereinafter called the "Equipment") described in the Bid upon the terms and conditions herein stated.

(b) The prices set forth in the Bid include the cost of delivery of the equipment to: Brownsville Public Utilities, Robindale Wastewater Treatment Plant, 3208 Robindale Road, Brownsville, TX 78521.

(c) The prices set forth in the Bid do not include any sums which are or may be payable by the Seller on account of taxes imposed by any taxing authority upon the sale, purchase or use of the Equipment.

SECTION 2 - DELIVERY

The equipment shall be delivered to Brownsville PUB, Robindale Wastewater Treatment Plant located in the City of Brownsville, Texas. The time for delivery, as specified in vendor's response, shall be extended for the period of any reasonable delay due exclusively to causes beyond the control and without the fault of the Seller, including, but not limited to, acts of God, fires, strikes, and floods.

SECTION 3 – PAYMENT

Upon the shipment of any Equipment hereunder, the Seller shall submit to the Purchaser a detailed statement of the Equipment shipped. The Purchaser shall, upon receipt of the Equipment, pay the Seller ninety-five percent (95%) of the contract price of the Equipment. When the Equipment has been installed, placed in satisfactory operation, tested and accepted by the Purchaser, the Purchaser shall make final payments thereof to the Seller; provided, however, such final payment shall be made not later than one-hundred eighty (180) days after delivery of the Equipment, unless such acceptance by the Purchaser shall be withheld because of the fault of the Seller.

SECTION 4 - DEFECTIVE MATERIAL AND WORKMANSHIP

(a) All Equipment furnished hereunder shall be subject to the inspection, tests, and approval of the Purchaser and the Seller shall furnish all information required concerning the nature of source of any Equipment and provide adequate facilities for testing and inspecting the Equipment at the plant of the Seller. Trip to plant, if needed, will be at BPUB's expense.

(b) The Equipment furnished hereunder shall become the property of the Purchaser upon delivery, provided, however, that the Purchaser, within two years after installation acceptance or within the period for which the Equipment is guaranteed, whichever is longer, may reject any Equipment which does not comply with the Specifications attached hereto and made a part hereof or with the guarantees, if any, of the Seller and the manufacturer. Upon any such rejection, the Seller shall repair or replace such defective Equipment within a reasonable time after notice in writing from the Purchaser and in the event of failure by the Seller so to do, the Purchaser may make such replacement and the cost and expense thereof shall be paid by and recoverable from the Seller.

SECTION 5 - MISCELLANEOUS

(a) All manufacturers' guarantees of Equipment, if any, shall be transferred and assigned to the Purchaser upon delivery of any Equipment and before final payment is made for such Equipment. Such guarantees shall be in addition to those required of the Seller by other provisions of this Contract.

(b) **THE SELLER SHALL HOLD HARMLESS AND INDEMNIFY THE PURCHASER FROM ANY AND ALL CLAIMS, SUITS, AND PROCEEDINGS FOR INFRINGEMENT OF ANY PATENT OR PATENTS COVERING EQUIPMENT PURCHASED HEREUNDER.**

(c) Each and all of the covenants and agreements herein contained shall extend to and be binding upon the successors and assigns of the parties hereto provided, however, that the Seller shall not assign this contract or any part hereof without approval in writing of the Purchaser, and further that the Seller shall not enter into any contract with any person, firm or corporation for the performance of the Seller's obligations hereunder, or any part thereof, without the approval in writing of the Purchaser.

(d) The Seller agrees to pay liquidated damages, not as a penalty, the amount of $500.00 per day if equipment is not delivered within the delivery time specified by vendor on the Bid Schedule section of this contract.

(e) Seller agrees to furnish a Material Supply Bond in the amount of the bid.

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IN WITNESS WHEREOF, the parties hereto have caused this contract to be signed in their respective corporate names by their presidents and their corporate seals to be hereunto affixed and attested by their secretaries, all as of the day and year first above written.

PUBLIC UTILITIES BOARD OF THE CITY OF BROWNSVILLE	(Insert Vendor's Name)
By:_____	By:_____
Name: John S. Bruciak	Name:_____
Title: General Manager & CEO	Title:_____
Attest:_____ Secretary	Attest:_____ Secretary
Date:_____	Date:_____

BID SCHEDULE

B010-21

EQUIPMENT LUMP SUM – Multistage Centrifugal Blowers including Reduced Voltage Solid State Starters and Onsite Installation Assistance, Field Testing, Startup, Commissioning and Training.

The TOTAL SINGLE PRIME **BASE BID AMOUNT** is:

_____
(Words)

_____ Dollars.
(…Continued Words)

and _____ Cents.
(Words)

($ _____).
(Numbers)

Bidder Name: _____

ADDITIONAL INFORMATION:

a. The Owner is exempt from sales tax on materials. The prices quoted shall exclude such sales and use tax.
b. The prices of Equipment set forth herein shall include the cost of delivery to BPUB Robindale Wastewater Treatment Plant located in the City of Brownsville, Texas 78521. Such delivery shall be made within 250 days after the receipt of the purchase order of the Purchaser.
c. This Bid is made pursuant to the provisions of the Legal Notice and Instructions to Bidders, and the Bidder agrees to the terms and conditions thereof.
d. The Bidder warrants the accuracy of all statements contained in the Bidder's Qualifications, if any shall be submitted, and agrees that the BPUB shall rely upon such accuracy as a condition of the Contract in the event that this Bid is accepted.
e. The Bidder warrants that this Bid is made in good faith and without collusion or connection with any other person or persons bidding for the same work.
f. The Bidder agrees that, in the event this Bid is accepted, it will execute a Contract in the form attached hereto.
g. The Bidder warrants that the Equipment will conform to the performance data and guarantees, which are attached hereto and by this reference made a part hereof.
h. If, in submitting this Bid, the Bidder has made any change in the form of Bid or Contract furnished by the BPUB, the Bidder understands that the BPUB may evaluate the effect of

such change as they see fit or they may exclude the Bid from consideration in determining the award of the Contract.

i. This bid is void unless an equipment contract based on this bid is entered into effect by the BPUB and the Bidder within ninety (90) days after the date hereof (unless a mutually agreeable date is confirmed).

j. Bidder agrees to furnish a Materials Supply Bond in the amount of the bid.

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(Insert Vendor's Name)

By:_____
Signature (Must be signed to be considered)

Name:_____

Title:_____

Address:_____

Address:_____

Date:_____

Bidder's contact person for additional information on this Bid:

Name:_____

Email:_____

Telephone:_____

Address: _____

MATERIALS BOND

KNOW ALL MEN BY THESE PRESENT:

THAT _____
(Name of Bidder)

_____

(Address of Bidder)

_____
(Corporation, Partnership or Individual)

hereinafter called Principal, and

_____

(Name of Surety)

_____

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto the BROWNSVILLE PUBLIC UTILITIES BOARD of the City of Brownsville, Texas, hereinafter called OWNER, in liquidated damages, not as a penalty, the sum of _____Dollars ($_____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract with the OWNER, dated the ___ day of _____, 20___, a copy of which is hereto attached and made a part hereof, for supplying **Robindale WWTP Multistage Blower Procurement** for the Robindale Wastewater Treatment Plant .

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term thereof, and any extensions thereof which may be granted by the OWNER, with or without notice to the Surety and during the one year guaranty period, and if he shall satisfy all claims and demands incurred under such contract, and shall fully indemnify and save harmless the OWNER from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all outlay and expense which the OWNER may incur in making good any default, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said surety, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to MATERIALS to be performed there under or the SPECIFICATIONS accompanying the same shall in any way affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the MATERIALS or to the SPECIFICATIONS.

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

This bond is subject to and governed by Section 2253.02 of the Texas Government Code (Vernon's Texas Codes Annotated) and Article 7.19-1 of Vernon's Texas Insurance Code and all amendments thereto.

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

ATTEST: _____
(Principal)

_____ By:_____
(Principal) Secretary (Signature) (SEAL)

(SEAL)

_____ _____
(Witness as to Principal) (Address)

_____
(Address)

ATTEST: _____
(Surety)

_____ By:_____
(Surety) Secretary (Attorney in Fact)

(SEAL)

REQUIRED FORMS

FORM CHECKLIST

The following documents to be submitted as a part of the Bid/RFP/RFQ document

NAME	FORM DESCRIPTION	SUBMITTED WITH BID	
		YES	NO
Legal Notice	Acknowledgement Form	☐	☐
	Debarment Certificate	☐	☐
	Ethic Statement	☐	☐
	Conflict of Interest Questionnaire	☐	☐
	W9 or W8 Form	☐	☐
	Direct Deposit Form	☐	☐
	Residence Certification	☐	☐
Special Instructions (if applicable)	Bid Schedule/Cost sheet completed and signed	☐	☐
	Cashier Check or Bid Bond of 5% of Total Amount of Bid	☐	☐
	OSHA 300 Log	☐	☐
	Contractor Pre-Bid Disclosure completed, signed and notarized	☐	☐
	Sub-Contractor Pre-Bid Disclosure completed, signed, and notarized	☐	☐
		☐	☐
References	Complete title of form for each reference provided	☐	☐
Addenda			

CERTIFICATION REGARDING
DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS
(**THIS FORM MUST BE COMPLETED IN ITS ENTIRETY AND SUBMITTED WITH BID RESPONSE**)

Name of Entity: _____

The prospective participant certifies to the best of their knowledge and belief that they and their principals:

a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency:
b) Have not within a three year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, Local) with commission of any of the offenses enumerated in paragraph (1) (b) of this certification; and
d) Have not within a three-year period preceding this application/bid had one or more public transactions (Federal, State, Local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this bid or termination of the award. In addition, under 18 USC Section 1001, a false statement may result in a fine up to a $10,000.00 or imprisonment for up to five (5) years, or both.

_____
Name and Title of Authorized Representative (Typed)

_____ _____
Signature of Authorized Representative Date

☐ I am unable to certify to the above statements. My explanation is attached.

ETHICS STATEMENT

(THIS FORM MUST BE COMPLETED IN ITS ENTIRETY AND SUBMITTED WITH BID RESPONSE)

The undersigned bidder, by signing and executing this bid, certifies and represents to the Brownsville Public Utilities Board that bidder has not offered, conferred or agreed to confer any pecuniary benefit, as defined by (1.07 (a) (6) of the Texas Penal Code, or any other thing of value as consideration for the receipt of information or any special treatment of advantage relating to this bid; the bidder also certifies and represents that the bidder has not offered, conferred or agreed to confer any pecuniary benefit or other thing of value as consideration for the recipient's decision, opinion, recommendation, vote or other exercise of discretion concerning this bid, the bidder certifies and represents that bidder has neither coerced nor attempted to influence the exercise of discretion by any officer, trustee, agent or employee of the Brownsville Public Utilities Board concerning this bid on the basis of any consideration not authorized by law; the bidder also certifies and represents that bidder has not received any information not available to other bidders so as to give the undersigned a preferential advantage with respect to this bid; the bidder further certifies and represents that bidder has not violated any state, federal, or local law, regulation or ordinance relating to bribery, improper influence, collusion or the like and that bidder will not in the future offer, confer, or agree to confer any pecuniary benefit or other thing of value of any officer, trustee, agent or employee of the Brownsville Public Utilities Board in return for the person having exercised their person's official discretion, power or duty with respect to this bid; the bidder certifies and represents that it has not now and will not in the future offer, confer, or agree to confer a pecuniary benefit or other thing of value to any officer, trustee, agent, or employee of the Brownsville Public Utilities Board in connection with information regarding this bid, the submission of this bid, the award of this bid or the performance, delivery or sale pursuant to this bid.

THE VENDOR SHALL DEFEND, INDEMNIFY, AND HOLD HARMLESS THE CITY OF BROWNSVILLE AND THE BROWNSVILLE PUBLIC UTILITIES BOARD, ALL OF THEIR OFFICERS, AGENTS AND EMPLOYEES FROM AND AGAINST ALL CLAIMS, ACTIONS, SUITS, DEMANDS, PROCEEDING, COSTS, DAMAGES, AND LIABILITIES, ARISING OUT OF, CONNECTED WITH, OR RESULTING FROM ANY ACTS OR OMISSIONS OF CONTRACTOR OR ANY AGENT, EMPLOYEE, SUBCONTRACTOR, OR SUPPLIER OF CONTRACTOR IN THE EXECUTION OR PERFORMANCE OF THIS BID.

I have read all of the specifications and general bid requirements and do hereby certify that all items submitted meet specifications.

COMPANY: _____

AGENT NAME: _____

AGENT SIGNATURE:_____

ADDRESS:_____

CITY: _____

STATE: _____ ZIP CODE: _____

TELEPHONE: _____ TELEFAX: _____

FEDERAL ID#: _____AND/OR SOCIAL SECURITY #: _____

DEVIATIONS FROM SPECIFICATIONS IF ANY:

NOTE: QUESTIONS AND CONCERNS FROM PROSPECTIVE CONTRACTORS SHOULD BE RAISED WITH OWNER AND ITS CONSULTANT (IF APPLICABLE) AND RESOLVED IF POSSIBLE, PRIOR TO THE BID SUBMITTAL DATE. ANY LISTED DEVIATIONS IN A FINALLY SUBMITTED BID MAY ALLOW THE OWNER TO REJECT A BID AS NON-RESPONSIVE.

THIS FORM MUST BE COMPLETED IN ITS ENTIRETY & SUBMITTED WITH BID RESPONSE

CONFLICT OF INTEREST QUESTIONNAIRE — FORM CIQ

For vendor doing business with local governmental entity

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).

By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. *See* Section 176.006(a-1), Local Government Code.

A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.

OFFICE USE ONLY

Date Received

1 **Name of vendor who has a business relationship with local governmental entity.**

2 ☐ **Check this box if you are filing an update to a previously filed questionnaire.** (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)

3 **Name of local government officer about whom the information is being disclosed.**

_____
Name of Officer

4 **Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.**

A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?

☐ Yes ☐ No

B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?

☐ Yes ☐ No

5 **Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.**

6 ☐ Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).

7

_____ _____
Signature of vendor doing business with the governmental entity Date

Form provided by Texas Ethics Commission www.ethics.state.tx.us Revised 11/30/2015

CONFLICT OF INTEREST QUESTIONNAIRE
For vendor doing business with local governmental entity

A complete copy of Chapter 176 of the Local Government Code may be found at http://www.statutes.legis.state.tx.us/Docs/LG/htm/LG.176.htm. For easy reference, below are some of the sections cited on this form.

Local Government Code § 176.001(1-a): "Business relationship" means a connection between two or more parties based on commercial activity of one of the parties. The term does not include a connection based on:

(A) a transaction that is subject to rate or fee regulation by a federal, state, or local governmental entity or an agency of a federal, state, or local governmental entity;

(B) a transaction conducted at a price and subject to terms available to the public; or

(C) a purchase or lease of goods or services from a person that is chartered by a state or federal agency and that is subject to regular examination by, and reporting to, that agency.

Local Government Code § 176.003(a)(2)(A) and (B):

(a) A local government officer shall file a conflicts disclosure statement with respect to a vendor if:

***

(2) the vendor:

(A) has an employment or other business relationship with the local government officer or a family member of the officer that results in the officer or family member receiving taxable income, other than investment income, that exceeds $2,500 during the 12-month period preceding the date that the officer becomes aware that

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor;

(B) has given to the local government officer or a family member of the officer one or more gifts that have an aggregate value of more than $100 in the 12-month period preceding the date the officer becomes aware that:

(i) a contract between the local governmental entity and vendor has been executed; or

(ii) the local governmental entity is considering entering into a contract with the vendor.

Local Government Code § 176.006(a) and (a-1)

(a) A vendor shall file a completed conflict of interest questionnaire if the vendor has a business relationship with a local governmental entity and:

(1) has an employment or other business relationship with a local government officer of that local governmental entity, or a family member of the officer, described by Section 176.003(a)(2)(A);

(2) has given a local government officer of that local governmental entity, or a family member of the officer, one or more gifts with the aggregate value specified by Section 176.003(a)(2)(B), excluding any gift described by Section 176.003(a-1); or

(3) has a family relationship with a local government officer of that local governmental entity.

(a-1) The completed conflict of interest questionnaire must be filed with the appropriate records administrator not later than the seventh business day after the later of:

(1) the date that the vendor:

(A) begins discussions or negotiations to enter into a contract with the local governmental entity; or

(B) submits to the local governmental entity an application, response to a request for proposals or bids, correspondence, or another writing related to a potential contract with the local governmental entity; or

(2) the date the vendor becomes aware:

(A) of an employment or other business relationship with a local government officer, or a family member of the officer, described by Subsection (a);

(B) that the vendor has given one or more gifts described by Subsection (a); or

(C) of a family relationship with a local government officer.

Form provided by Texas Ethics Commission www.ethics.state.tx.us Revised 11/30/2015

BROWNSVILLE PUBLIC UTILITIES BOARD

RESIDENCE CERTIFICATION

In accordance with Art. 601g, as passed by the 1985 Texas Legislature, the following will apply. The pertinent portion of the Act has been extracted and is as follows:

Section 1. (a)

(1) "Nonresident bidder" means a bidder whose principal place of business is not in this state, but excludes a contractor whose ultimate parent company or majority owner has its principal place of business in this state.

(2) "Texas resident bidder " means a bidder whose principal place of business is in this state, and includes a contractor whose ultimate parent company or majority owner has its principal place of business in this state.

Section 1. (b)

The state or governmental agency of the state may not award a contract for general construction, improvements, services, or public works projects or purchases of supplies, materials or equipment to a nonresident bidder unless the nonresident's bid is lower than the lowest bid submitted by a responsible Texas resident bidder by the same amount that a Texas resident bidder would be required to underbid a nonresident bidder to obtain a comparable contract in the state in which the nonresident's principal place of business is located.

I certify that _____(Company Name) is **a resident Texas bidder** as defined in Art. 601g.

Signature: _____

Print Name: _____

I certify that _____ (Company Name) is a **nonresident bidder** as defined in Art. 601g. and our principal place of business is:

_____

(City and State)

Signature:_____

Print Name:_____

Form **W-9**
(Rev. November 2017)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

▶ **Go to *www.irs.gov/FormW9* for instructions and the latest information.**

Give Form to the requester. Do not send to the IRS.

Print or type. See Specific Instructions on page 3.

1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank.

2 Business name/disregarded entity name, if different from above

3 Check appropriate box for federal tax classification of the person whose name is entered on line 1. Check only **one** of the following seven boxes.

☐ Individual/sole proprietor or single-member LLC ☐ C Corporation ☐ S Corporation ☐ Partnership ☐ Trust/estate

☐ Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=Partnership) ▶ _____

Note: Check the appropriate box in the line above for the tax classification of the single-member owner. Do not check LLC if the LLC is classified as a single-member LLC that is disregarded from the owner unless the owner of the LLC is another LLC that is **not** disregarded from the owner for U.S. federal tax purposes. Otherwise, a single-member LLC that is disregarded from the owner should check the appropriate box for the tax classification of its owner.

☐ Other (see instructions) ▶

4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):

Exempt payee code (if any) _____

Exemption from FATCA reporting code (if any) _____

(Applies to accounts maintained outside the U.S.)

5 Address (number, street, and apt. or suite no.) See instructions.

Requester's name and address (optional)

6 City, state, and ZIP code

7 List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN*, later.

Note: If the account is in more than one name, see the instructions for line 1. Also see *What Name and Number To Give the Requester* for guidelines on whose number to enter.

Social security number

___ - ___ - ____

or

Employer identification number

__ - _____

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.

Sign Here **Signature of U.S. person ▶** **Date ▶**

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to *www.irs.gov/FormW9*.

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following.

- Form 1099-INT (interest earned or paid)
- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See What is backup withholding, *later.*

Cat. No. 10231X Form **W-9** (Rev. 11-2017)

Form **W-8BEN-E**

(Rev. July 2017)
Department of the Treasury
Internal Revenue Service

Certificate of Status of Beneficial Owner for United States Tax Withholding and Reporting (Entities)

▶ **For use by entities. Individuals must use Form W-8BEN.** ▶ **Section references are to the Internal Revenue Code.**
▶ **Go to *www.irs.gov/FormW8BENE* for instructions and the latest information.**
▶ **Give this form to the withholding agent or payer. Do not send to the IRS.**

OMB No. 1545-1621

Do NOT use this form for: **Instead use Form:**

- U.S. entity or U.S. citizen or resident W-9
- A foreign individual . . . . . W-8BEN (Individual) or Form 8233
- A foreign individual or entity claiming that income is effectively connected with the conduct of trade or business within the U.S. (unless claiming treaty benefits) W-8ECI
- A foreign partnership, a foreign simple trust, or a foreign grantor trust (unless claiming treaty benefits) (see instructions for exceptions) . . W-8IMY
- A foreign government, international organization, foreign central bank of issue, foreign tax-exempt organization, foreign private foundation, or government of a U.S. possession claiming that income is effectively connected U.S. income or that is claiming the applicability of section(s) 115(2), 501(c), 892, 895, or 1443(b) (unless claiming treaty benefits) (see instructions for other exceptions) . . . . . W-8ECI or W-8EXP
- Any person acting as an intermediary (including a qualified intermediary acting as a qualified derivatives dealer) W-8IMY

Part I Identification of Beneficial Owner

1 Name of organization that is the beneficial owner

2 Country of incorporation or organization

3 Name of disregarded entity receiving the payment (if applicable, see instructions)

4 Chapter 3 Status (entity type) (Must check one box only):

☐ Corporation ☐ Disregarded entity ☐ Partnership
☐ Simple trust ☐ Grantor trust ☐ Complex trust ☐ Estate ☐ Government
☐ Central Bank of Issue ☐ Tax-exempt organization ☐ Private foundation ☐ International organization

If you entered disregarded entity, partnership, simple trust, or grantor trust above, is the entity a hybrid making a treaty claim? If "Yes" complete Part III. ☐ Yes ☐ No

5 Chapter 4 Status (FATCA status) (See instructions for details and complete the certification below for the entity's applicable status.)

☐ Nonparticipating FFI (including an FFI related to a Reporting IGA FFI other than a deemed-compliant FFI, participating FFI, or exempt beneficial owner).
☐ Participating FFI.
☐ Reporting Model 1 FFI.
☐ Reporting Model 2 FFI.
☐ Registered deemed-compliant FFI (other than a reporting Model 1 FFI, sponsored FFI, or nonreporting IGA FFI covered in Part XII). See instructions.
☐ Sponsored FFI. Complete Part IV.
☐ Certified deemed-compliant nonregistering local bank. Complete Part V.
☐ Certified deemed-compliant FFI with only low-value accounts. Complete Part VI.
☐ Certified deemed-compliant sponsored, closely held investment vehicle. Complete Part VII.
☐ Certified deemed-compliant limited life debt investment entity. Complete Part VIII.
☐ Certain investment entities that do not maintain financial accounts. Complete Part IX.
☐ Owner-documented FFI. Complete Part X.
☐ Restricted distributor. Complete Part XI.
☐ Nonreporting IGA FFI. Complete Part XII.
☐ Foreign government, government of a U.S. possession, or foreign central bank of issue. Complete Part XIII.
☐ International organization. Complete Part XIV.
☐ Exempt retirement plans. Complete Part XV.
☐ Entity wholly owned by exempt beneficial owners. Complete Part XVI.
☐ Territory financial institution. Complete Part XVII.
☐ Excepted nonfinancial group entity. Complete Part XVIII.
☐ Excepted nonfinancial start-up company. Complete Part XIX.
☐ Excepted nonfinancial entity in liquidation or bankruptcy. Complete Part XX.
☐ 501(c) organization. Complete Part XXI.
☐ Nonprofit organization. Complete Part XXII.
☐ Publicly traded NFFE or NFFE affiliate of a publicly traded corporation. Complete Part XXIII.
☐ Excepted territory NFFE. Complete Part XXIV.
☐ Active NFFE. Complete Part XXV.
☐ Passive NFFE. Complete Part XXVI.
☐ Excepted inter-affiliate FFI. Complete Part XXVII.
☐ Direct reporting NFFE.
☐ Sponsored direct reporting NFFE. Complete Part XXVIII.
☐ Account that is not a financial account.

6 Permanent residence address (street, apt. or suite no., or rural route). **Do not use a P.O. box or in-care-of address** (other than a registered address).

City or town, state or province. Include postal code where appropriate. | Country

7 Mailing address (if different from above)

City or town, state or province. Include postal code where appropriate. | Country

8 U.S. taxpayer identification number (TIN), if required | **9a** GIIN | **b** Foreign TIN

10 Reference number(s) (see instructions)

Note: Please complete remainder of the form including signing the form in Part XXX.

TECHNICAL SPECIFICATIONS

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Seller shall provide submittals in accordance with this Section and provisions of the Contract.

2. Seller is responsible for dimensions to be confirmed and corrected at the Site, for information pertaining solely to the fabrication processes and to techniques of construction, and for coordinating the work of all trades. Seller's signature of submittal's stamp and letter of transmittal shall be Seller's representation that Seller has met his obligations under the Contract Documents relative to that submittal.

B. Related Sections:

1. Section 01 78 23 – Operation and Maintenance Data.

1.02 REFERENCES

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 this Section and provisions of the Contract.

d. Samples.

e. Testing plans, procedures, and testing limitations.

f. Design data not sealed and signed by a design professional retained by Seller, Subcontractor, or Supplier.

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g. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, potential Hazardous Environmental Condition, and similar reports.

h. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting.

i. Lesson plans for training and instruction of Purchaser'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 (where specified elsewhere).

d. Warranty documentation.

e. Record documentation.

f. 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, where specified elsewhere.

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.

1.03 ADMINSTRATIVE REQUIREMENTS

A. Submittal Requirements:

1. Seller shall submit electronic copy of submittals for Engineer's review via Electronic Mail, 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, Seller'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.

1.04 NOT USED

1.05 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 ½, ¾, 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 Seller, 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.

1.06 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, where specified elsewhere

3. Warranty documentation

4. 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. Disposition: Dispositions and meanings are the same as specified for Informational Submittals.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section.

B. Disposition: Dispositions and meanings are the same as specified for Informational Submittals.

1.08 SELLER'S RESPONSIBILITIES

A. Seller shall review, coordinate, and verify submittals with Subcontractors, Manufacturers, and Suppliers, in accordance with this Section and provisions of the Contract prior to submitting material for Engineer's review.

B. Seller shall provide Seller's stamp of approval certifying submittal material has been reviewed and conform to the Contract Documents prior to submitting material for Engineer's review.

C. Seller shall provide written notice of deviations or variations that submittal may have with the Contract Documents.

D. Seller 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.

E. Seller 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. Seller shall be responsible for Engineer's charges to Purchaser if submittals are not approved within the three rounds of review in accordance with this Section and provisions of the Contract. Engineer's charges shall include, but not limited to, additional review effort, meetings, and conference calls with Seller, Subcontractor, or Supplier.

1.09 ENGINEER'S REVIEW

A. Engineer's review of the Seller's submittal shall not relieve Seller's responsibility under the Contract Document in accordance with this Section and provisions of the Contract. 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 Specifications.

B. Engineer's review of Seller'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 Seller'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 Seller 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. Seller

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 Seller: Electronic submittals shall be returned electronically with dispositions provided.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Requirements for operation and maintenance data, manuals, and documentation.

1. Submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at the Site.

2. Required operation and maintenance data groupings are listed in this Section. At minimum, submit operation and maintenance data for:

a. All equipment and systems

b. Valves, gates, actuators, and related accessories

c. Instrumentation and control devices

d. Electrical gear

3. For each operation and maintenance manual, submit the following:

a. Preliminary Submittal: Printed and bound copy of entire operation and maintenance manual or electronic copy, except for test data and service reports by Supplier.

b. Final Submittal: Printed and bound copy of complete operations and maintenance manual and electronic copy, including test data and service reports by Supplier.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Quantity Required and Timing of Submittals:

1. Preliminary Submittal:

a. Printed Copies: Not required.

b. Electronic Copies: One copy.

05-04-20

c. Submit to Engineer, whichever occurs first:

1) 60 days prior to Blower delivery.

d. Furnish preliminary operation and maintenance data submittal in acceptable form and content, as determined by Engineer, before associated materials and equipment will be eligible for payment.

2. Preliminary Submittal shall be reviewed by Engineer. One printed or electronic copy shall be returned to Seller with required revisions noted.

3. Final Submittal: Provide 14 days prior to Blower delivery, unless Submittal is specified as required prior to an interim Milestone.

a. Printed Copies: Three copies.

b. Electronic Copies: One copy.

B. Format of Printed Copies:

1. Binding and Cover:

a. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.

b. Provide the following information on cover of each volume:

1) Title: “OPERATING AND MAINTENANCE INSTRUCTIONS”.

2) Name or type of material or equipment covered in the manual.

3) Volume number, if more than one volume is required, listed as “Volume __ of __”, with appropriate volume-designating numbers filled in.

4) Name of Project and, if applicable, Contract name and number.

5) Name of building or structure, as applicable.

c. Provide the following information on spine of each volume:

1) Title: “OPERATING AND MAINTENANCE INSTRUCTIONS”.

2) Name or type of material or equipment covered in the manual.

3) Volume number, if more than one volume is required, listed as “Volume __ of __”, with appropriate volume-designating numbers filled in.

4) Project name and building or structure name.

2. Drawings:

a. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing.

b. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include no more than three drawing sheets per pocket.

3. Copy Quality and Document Clarity:

a. Contents shall be original-quality copies. Documents in the manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color.

b. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content.

4. Organization:

a. Provide table of contents in each volume for each chapter or section.

b. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

C. Format of Electronic Copies:

1. Each electronic copy shall include all information included in the corresponding printed copy.

2. Submit electronic copy via transferable method and format acceptable to Engineer.

3. File Format:

a. Acceptable formats include Adobe PDF, Microsoft Word, Autodesk DWF, and AutoCAD.

b. Files shall be electronically searchable.

c. Submit separate file for each separate document in the printed copy.

d. Within each file, provide bookmarks for the following:

1) Each chapter and subsection listed in the corresponding printed copy document's table of contents

2) Each figure

3) Each table

4) Each appendix

4. Also submit drawings and figures in one of the following formats: ".bmp", ".tif", ".jpg", ".gif", "dwf", or "dwg". Submit files in a separate directory on the CD.

D. General Content Requirements:

1. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.

2. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.

3. Submit written explanations of all safety considerations relating to operation and maintenance procedures.

4. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:

a. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include

pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.

b. Recommended schedule for each preventive maintenance task.

c. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.

d. Table of alternative lubricants.

e. Troubleshooting instructions.

f. List of required maintenance tools and equipment.

5. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:

a. Manufacturer's name, address, telephone number, fax number, and Internet website address.

b. Manufacturer's local service representative's or local parts supplier's name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.

c. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.

d. For each part or piece include the following information:

1) Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.

2) Part name or description.

3) Manufacturer's part number.

4) Quantity of each part used in each assembly.

5) Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.

6. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number).

7. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation.

Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.

8. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.

9. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.

10. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.

11. Submit copy of warranty bond and service contract as applicable.

12. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

1.03 SUBMITTALS

A. Action/Informational Submittals: Submit preliminary schedule (listing) of operations and maintenance data for Engineer's review. Preliminary operations and maintenance data shall be grouped as major equipment and material systems and divided into sub-systems as required for clarity, subject to Engineer's approval.

B. Closeout Submittals:

1. Operation and maintenance data: Submit the operations and maintenance data indicated in the Contract Documents, grouped into submittals as approved by Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 26 05 60
LOW-VOLTAGE ELECTRIC MOTORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Seller shall furnish all labor, materials, tools and equipment necessary for furnishing, testing and placing into satisfactory operation all low voltage electric motors as specified herein. All motors required for this Contract shall comply with this Section unless otherwise noted.

1.02 CODES AND STANDARDS

A. Motors and related accessories shall be designed, manufactured, and/or listed to the following standards as applicable:

1. Institute of Electrical and Electronics Engineers (IEEE)

    a. IEEE 112 – Standard Test Procedure for Polyphase Induction Motors and Generators

2. National Electrical Manufacturer's Association (NEMA)

    a. NEMA MG 1 – Motors and Generators

3. Underwriters Laboratories (UL)

    a. UL 547 – Standard for Safety Thermal Protectors for Motors

    b. UL 674 – Electric Motors and Generators for Use in Hazardous (Classified) Locations

    c. UL 1004-1 – Standard for Rotating Electrical Machines

    d. UL 1004-3 – Standard for Thermally Protected Motors

    e. UL 1004-8 – Standard for Inverter Duty Motors

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Seller shall obtain from the equipment manufacturer and submit the following:

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1. Shop Drawings.

2. Spare Parts List.

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. 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.

B. Partial, incomplete or illegible submittals will be returned to the Seller without review for resubmittal.

C. Individual shop drawings for electric motors shall be submitted in accordance with the procedures and requirements set forth in Section 01 33 00 – Submittals, unless submitted as a part of the shop drawings for the driven equipment.

D. Shop drawings for electric motors shall include motor data sheets, dimensioned drawings, wiring diagrams for devices such as space heaters, temperature devices, and shaft grounding rings. Shop drawings shall identify electric characteristics and design, mechanical construction, manufacturer's name, type and pertinent specifications for the use intended, along with the name of the equipment to be driven. For motors rated 50 horsepower or greater, submittal of motor data for acceptance shall include, as a minimum, the following:

1. Manufacturer's type and frame designation

2. Horsepower rating

3. Time rating (per NEMA Standards)

4. Ambient temperature rating

5. Motor winding insulation system designation

6. RPM at rated load

7. Frequency

8. Number of phases

9. Rated-load amperes

10. Voltage

11. Code letter (starting KVA per horsepower)

12. Design letter for integral horsepower induction motors (per NEMA Standards)

13. Service factor

14. Temperature rise at full load and at service factor load

15. Efficiency at 1/4, 1/2, 3/4 and full load

16. Power factor at 1/4, 1/2, 3/4 and full load

17. Motor outline, dimensions and weight

18. Motor winding insulation system description

19. Horsepower required by connected machine at specified conditions (load curves) shall be supplied for all compressors, propeller and positive displacement pumps.

20. The foregoing data shall also be verified after manufacture and shall be included with the information to be furnished in the operation and maintenance manuals specified.

E. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Seller intends to provide are acceptable and shall be submitted.

1.05 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Purchaser by the Seller.

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 specified.

B. Electric motors shall be manufactured by Baldor/Reliance Electric Company; Nidec Motors; Toshiba Industrial and Power Systems, Inc.; Siemens Energy & Automation, Inc.; General Electric Company; or TECO Westinghouse.

2.02 MATERIALS AND CONSTRUCTION

A. Motors shall be built in accordance with the latest standards of NEMA, including, but not limited to MG-1 and MG-2, IEEE, ANSI and to the requirements specified herein.

B. Type

1. Unless otherwise noted, motors specified herein shall be polyphase squirrel cage, NEMA Design B, or single phase capacitor or repulsion start induction motors. Special equipment requiring a motor drive with unusual characteristics shall be equipped with a definite purpose motor to meet the necessary requirements.

2. Unless otherwise shown or specified, all motors 1/2 horsepower or larger shall be three- phase, 60 Hertz, NEMA Design B, squirrel cage induction motors designed for operation at 480 volts or greater as specified herein.

3. Unless otherwise specified in the individual equipment specification for the driven equipment, or as required by the dynamic characteristics of the load as determined by the manufacturer of the machine to be driven, all polyphase squirrel cage motors shall be designed to withstand the starting voltage specified and shall have torque and locked rotor current characteristics as specified for NEMA Design B motors.

4. All motors 2 horsepower and smaller shall have windings encapsulated with a flexible epoxy compound, or insulated with a flexible epoxy compound, or insulated with the manufacturer's premium quality system which shall be subject to acceptance by the Engineer.

5. All motors above 250 horsepower shall have stator windings vacuum impregnated with a polyester insulation compound.

6. Unless otherwise noted, all motors smaller than 1/2 horsepower shall be standard single-phase capacitor start or repulsion start induction type designed for operation on 120 volts or 208 volts, 60 Hz alternating current. The motor shall deliver rated load without exceeding a 80 degrees C temperature rise while operating in a 40 degrees C ambient temperature. Small fan motors less than 1/4 HP may be split-phase or shaded pole type. Shaded pole motors rated more than 1/4 horsepower are not acceptable. Fractional horsepower motors shall be completely equipped with all necessary auxiliary components for starting and labeled as "Thermally Protected". Insulation shall be Class B, except that submersible motors shall have epoxy encapsulation. Unless otherwise noted, the motors shall be totally enclosed. Small fan motors may be of the open type where they are suitably protected from moisture dripping and lint accumulation. Motors shall be provided with sealed ball bearings lubricated for 10 years of normal use.

7. Vertical hollowshaft motors shall have adequate thrust bearings to carry all motor loads and any other operating equipment loads. Horizontal motors shall not be installed where subjected to external thrust loads.

C. Rating

1. Each motor shall develop ample torque for its required service through its acceleration range and throughout its rated load range. The rating of the motors offered shall in no case be less than the horsepower elsewhere specified. It should be noted that the motor sizes specified herein, are motor sizes required to operate the specific equipment which is specified. Higher rated motor sizes may be determined from the actual equipment submitted, approved, purchased, and installed. Protective devices, motor starters, disconnect switches, and other necessary equipment shall be furnished and installed for the actual motor sizes required at no additional cost.

2. Motor ratings shall be based on continuous operation. The maximum temperature rise for open and drip proof type motors shall not exceed 90 degrees C, and for totally enclosed type motors shall not exceed 80 degrees C.

D. Motor Winding Insulation

1. Insulation shall be as specified for each particular type or class of motor. The insulation system shall provide a high dielectric strength, long life covering for the windings which may be required to operate in a continually damp, corrosive, and/or chemically contaminated environment. The insulation shall be resistant to attack by moisture, acids, alkalies, abrasives, and mechanical and thermal shock. Leads shall be sealed with a non-wicking, non-hydroscopic insulation material.

2. Motor insulation resistance may be checked at any time after delivery to the job site or during the warranty period. Encapsulated motor stators may be subjected to insulation testing while completely submerged in water. Any motor not meeting the requirements specified herein will be rejected and shall be promptly replaced at no cost to the Purchaser.

3. Torque and locked rotor current characteristics for three phase motors shall be NEMA Design B. The locked rotor KVA/HP input at full voltage for 10 horsepower. motors and larger shall not exceed that permitted for Code Letter "J", except for specialized equipment requiring a motor drive with special definite characteristics.

4. Unless otherwise specified, non-inverter duty motors shall be furnished with a Class F insulation system. Unless otherwise specified, inverter duty motors shall be furnished with a Class H insulation system. In either case, temperature rise shall be limited to that for Class B insulation. Output torque and speed characteristics of each motor shall be suitable to operate the driven equipment

through the full range of acceleration and operating load conditions without exceeding the nameplate current rating, and/or temperature rise.

E. Nameplates

1. The motor manufacturer's nameplate shall be engraved, embossed, or stamped on a stainless steel sheet and fastened to the motor frame with No. 4 or larger oval head stainless steel screws or drive pins. Printed or laser-etched nameplates are not acceptable.

2. Nameplates shall include as a minimum, Items a through m as listed in Article 1.04 in addition to that required by NEMA standards. The nameplate shall be positioned so as to be readily visible for inspection as installed in the facility.

F. Design

1. Motors shall be designed to accelerate and drive the connected equipment under all normal operating conditions without exceeding nameplate ratings.

2. Motors specified for operation with variable frequency drives shall be inverter duty rated. Motors shall be considered inverter duty rated only if they meet all of the requirements for NEMA MG-1 Part 31.

3. Motors shall be designed to output 100 percent of nameplate horsepower under continuous duty service without exceeding the temperature rise specified herein when controlled by the actual drives furnished. Inverter duty motors shall be designed to operate down to 10% of full load speed without the need for a line powered cooling fan.

4. Unless otherwise specified, electric motors shall be furnished with service factors in accordance with NEMA MG-1 as follows:

Type of Motor	Service Factor
Non-inverter Duty	1.15
Inverter Duty	1.0

5. Design selection with respect to the driven machine shall be such that the requirements do not exceed 85 percent of the motors' maximum rating modified by service factor, ambient temperature, enclosure, altitude and electrical service. The electrical service conditions shall be assumed to be 10 percent undervoltage, 5 percent underfrequency, and 3 percent voltage unbalance. Altitude shall be assumed to be the project site elevation plus 10 percent. Ambient temperature shall be assumed to be 95 degrees F in exterior locations, 104 degrees F (40 degrees C) in interior locations, and 122 degrees F (50 degrees C) within housings

or enclosures; except where higher temperatures may be encountered within or on individual items of equipment. The applicable paragraphs of NEMA MG-1 shall be used in making the design selection.

6. Motors used with belt drives shall have sliding bases to provide for belt take up.

7. Terminal boxes shall be of sufficient size to accommodate the required quantity and size of conduits. Gasketed terminal boxes shall be furnished with all splash-proof and totally enclosed motors. NEMA ratings of the terminal boxes shall be suited for the application. Motors located in hazardous locations shall be furnished with terminal boxes suitable for the specific Class, Division, and Group suitable for the application. Terminal boxes shall be sized to accommodate accessory equipment such as motor differential current transformers, where required.

8. Terminal boxes for horizontal motors shall be located on the left-hand side when viewing the motor from the drive shaft end and shall be so designed that conduit entrance can be made from above, below, or either side of the terminal box.

9. Motors larger than 250hp shall be manufactured with the six stator coil leads wired to a suitably sized motor junction box for application in a differential relay scheme. Current transformers shall be provided by the motor manufacturer and installed in the factory. All ground connections and current transformer connections shall be made in the factory.

G. Construction

1. Frames, mounting means, and shafts shall meet NEMA Standards for the horsepower, RPM, and enclosure selected. Enclosures shall be selected according to the degree of mechanical protection required and shall not be of aluminum construction. All motors shall have a manufacturer's standard shop machinery finish, consisting of a rust-resisting priming coat of zinc chromate and a finish coat of alkyd machinery enamel. For additional coating requirements for blower motors, reference Section 43 11 18 – Multistage Centrifugal Blowers.

2. Motors shall have cast iron frames and a heavy gauge steel terminal box, with neoprene gaskets between the frame and the box and between the box and its cover. A grounding lug(s) shall be provided inside the terminal box.

3. Motors weighing more than 50 pounds shall be equipped with at least one lifting eye. All lifting hardware shall be corrosion resistant.

4. Motors located in hazardous locations shall be totally enclosed and suitable for the specific Class, Division, and Group suitable for the application.

5. Motors located in Class I or II, Division 1 hazardous locations shall bear a U.L.-674 label and shall be provided with a breather/drain approved for the hazardous location. The U.L. listed breather/drain shall prevent the entrance of contaminants while allowing moisture to drain out of the motor.

6. When located outdoors, or elsewhere if specified, motors shall be totally enclosed, non-ventilated (TENV) or totally enclosed, fan-cooled (TEFC) machines, unless otherwise noted. Totally enclosed motors shall be provided with two (2) 1/4 inch drain holes drilled through the bottom of the frame, which allows complete drainage of the frame. Where specified, TEFC motors controlled by a variable frequency drive shall be provided with a separately powered cooling fan motor that runs at 60HZ to ensure proper cooling of the motor at low speeds. Cooling fan motor shall be suitable for 120VAC, single phase operation. Vertically oriented motors located outdoors shall be provided with a drip cover over the fan end to prevent accumulation of precipitation.

7. Unless otherwise specified, motors rated 100 horsepower or greater located outdoors, in unheated structures, in below grade areas, or as otherwise indicated, shall be furnished with space heaters and embedded motor winding high temperature switches with leads brought out of the motor terminal box. Space heaters shall be suitable for 120VAC operation and for a maximum surface temperature of less than 200 degrees C. Spare heaters shall be of sufficient wattage to maintain the internal temperature of the motor at approximately 10 degrees C above the ambient temperature when the motor is not running.

    a. Embedded motor winding temperature switches shall operate at temperatures well below the temperature rating of the motor winding insulation system. Motor winding temperature switches are not required where other temperature monitoring devices (e.g. RTD's) are required.

8. If so specified and when located in indoor areas which are heated and weatherproof, motors shall be open drip-proof machines. Ventilation openings shall be arranged to prevent the entrance of drops of liquid or solid particles at any angle from zero to 15 degrees downward from vertical.

9. Unless otherwise specified, or required, motors rated less than 200 horsepower shall be furnished with bearings of the grease lubricated, antifriction ball type with conveniently located grease fittings and drain plugs. A means of preventing bearings from becoming over-greased shall be provided. Bearings shall have a minimum B-10 life of 20,000 hours.

10. Rotors shall be statically and dynamically balanced. Rotor windings shall be one-piece cast aluminum. Where applicable, rotors shall be constructed with integral fins.

11. Externally mounted motor shaft grounding rings shall be provided to protect motors against motor shaft and bearing currents. Grounding rings shall be provided for all motors controlled by VFDs, with the following exceptions:

    a. Motors located in hazardous areas

    b. Motors rated less than 1 horsepower

    c. Submersible motors

12. All motors shall be provided with factory-installed one-hole terminations (ring terminals) on the ends of all motor leads. Terminations shall be identified for use with cables that have stranding other than Class B and shall be the irreversible compression type.

H. Power Factor and Efficiency

1. All motors, including vertical hollowshaft motors, in the range of 1-500 horsepower, inclusive, shall be designed specifically for energy efficiency and high power factor. The motor efficiency and power factor shall meet or exceed the values listed in the table below when the motors are tested in accordance with the NEMA preferred test method IEEE 112A, Method B, Dynamometer. Each motor shall meet the minimum guaranteed efficiency value indicated in the table below. All tests shall be performed in accordance with the procedures contained in NEMA Standard MG1-12.58.

Table 12-11
FULL-LOAD EFFICIENCIES OF ENERGY EFFICIENT MOTORS
ENCLOSED MOTORS

HP	2 POLE		4 POLE		6 POLE		8 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	75.5	72	82.5	80	80	77	74	70
1.5	82.5	80	84	81.5	85.5	82.5	77	74
2	84	81.5	84	81.5	86.5	84	82.5	80
3	85.5	82.5	87.5	85.5	87.5	85.5	84	81.5
5	87.5	85.5	87.5	85.5	87.5	85.5	85.5	82.5
7.5	88.5	86.5	89.5	87.5	89.5	87.5	85.5	82.5
10	89.5	87.5	89.5	87.5	89.5	87.5	88.5	86.5
15	90.2	88.5	91	89.5	90.2	88.5	88.5	86.5
20	90.2	88.5	91	89.5	90.2	88.5	89.5	87.5
25	91	89.5	92.4	91	91.7	90.2	89.5	87.5
30	91	89.5	92.4	91	91.7	90.2	91	89.5

Table 12-11
FULL-LOAD EFFICIENCIES OF ENERGY EFFICIENT MOTORS
ENCLOSED MOTORS

HP	2 POLE		4 POLE		6 POLE		8 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
40	91.7	90.2	93	91.7	93	91.7	91	89.5
50	92.4	91	93	91.7	93	91.7	91.7	90.2
60	93	91.7	93.6	92.4	93.6	92.4	91.7	90.2
75	93	91.7	94.1	93	93.6	92.4	93	91.7
100	93.6	92.4	94.5	93.6	94.1	93	93	91.7
125	94.5	93.6	94.5	93.6	94.1	93	93.6	92.4
150	94.5	93.6	95	94.1	95	94.1	93.6	92.4
200	95	94.1	95	94.1	95	94.1	94.1	93
250	95.4	94.5	95	94.1	95	94.1	94.5	93.6
300	95.4	94.5	95.4	94.5	95	94.1		
350	95.4	94.5	95.4	94.5	95	94.1		
400	95.4	94.5	95.4	94.5				
450	95.4	94.5	95.4	94.5				
500	95.4	94.5	95.8	95				

Table 12-12
FULL-LOAD EFFICIENCIES FOR NEMA PREMIUM™ EFFICIENCY ELECTRIC MOTORS
RATED 600 VOLTS OR LESS (RANDOM WOUND)
OPEN MOTORS

HP	2 POLE		4 POLE		6 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	77	74	85.5	82.5	82.5	80
1.5	84	81.5	86.5	84	86.5	81.5
2	85.5	82.5	86.5	84	87.5	81.5
3	85.5	82.5	89.5	84	88.5	86.5
5	86.5	84	89.5	84	89.5	87.5
7.5	88.5	86.5	91	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93	91.7	91.7	90.2
20	91	89.5	93	91.7	92.4	91
25	91.7	90.2	93.6	92.4	93	91.7
30	91.7	90.2	94.1	93	93.6	92.4

Table 12-12
FULL-LOAD EFFICIENCIES FOR NEMA PREMIUM™ EFFICIENCY ELECTRIC MOTORS
RATED 600 VOLTS OR LESS (RANDOM WOUND)
OPEN MOTORS

HP	2 POLE		4 POLE		6 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
40	92.4	91	94.1	93	94.1	93
50	93	91.7	94.5	93.6	94.1	93
60	93.6	92.4	95	94.1	94.5	93.6
75	93.6	92.4	95	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95	94.1
125	94.1	93	95.4	94.5	95	94.1
150	94.1	93	95.8	95	95.4	94.5
200	95	94.1	95.8	95	95.4	94.5
250	95	94.1	95.8	95	95.4	94.5
300	95.4	94.5	95.8	95	95.4	94.5
350	95.4	94.5	95.8	95	95.4	94.5
400	95.8	95	95.8	95	95.8	95
450	95.8	95	96.2	95.4	96.2	95.4
500	95.8	95	96.2	95.4	96.2	95.4

NOTES:

(Motor data for continuous duty, NEMA Design B, 1.15 service factor, 40 degrees Celsius ambient, Class F insulation, 3 phase, 460 volt, at listed speed rating.

(TEFC efficiencies apply to both horizontal and vertical motors.

2. Motors rated 50 horsepower or greater shall be individually tested at the factory before shipment, with a copy of test results provided for the Engineer, to assure compliance with the efficiency and power factor specifications.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Motors shall be installed in accordance with the manufacturer's installation instructions.

3.02 DELIVERY, STORAGE, AND HANDLING

A. Motors shall be properly protected from weather hazards. Motors shall not be allowed to be wrapped tightly in plastic while outdoors. Motors delivered to the site which will not be

put in service for a time in excess of 30 calendar days, whether in storage or installed, shall have the shafts rotated a minimum of five (5) rotations every 30 days.

B. Motors provided with space heaters shall have temporary power applied to the heaters no later than 30 calendar days after delivery to the site until permanent power can be applied to the heaters.

C. Motors that, in the opinion of the Engineer, have not been properly protected shall be inspected by the manufacturer's representative. Any required electrical corrections for testing shall be made at the Seller's expense prior to acceptance and/or use.

D. All motors shall operate without any undue noise or vibration and shall show no signs of phase unbalance.

3.03 TESTING

A. All tests shall be performed in accordance with the requirements this section. The following tests are required:

1. Witnessed Shop Tests

a. All motors shall be shop tested and inspected in accordance with the equipment manufacturer's standard procedures. Shop tests for motors 100 horsepower and larger may be witnessed by the Engineer. The manufacturer's testing and inspection procedures shall demonstrate that the equipment tested conforms to the requirements specified, all other applicable requirements, and shall be approved by the Engineer. At least 10 days' notice shall be given the Engineer prior to tests and inspection dates.

b. In addition to the efficiency and power factor testing specified herein, each motor shall be tested to determine compliance with the applicable requirements of the IEEE, ANSI and NEMA. Tests shall be as follows:

1) Motors larger than 100 HP

a) Each motor shall be furnished with certified test results. Each motor shall be subjected to a complete test consisting of full load heat run, percent slip, running load current, locked rotor current, breakdown torque (calculated), starting torque, winding resistance, high potential, secondary current and voltage at collector rings (wound rotor), efficiencies at 100, 75 and 50 percent of full load, power factors at 100, 75 and 50 percent of full load and bearing inspection. Tests will be witnessed by the Engineer where specifically indicated.

2) Test Reports

a) All test results for motors over 100 horsepower shall be submitted to the Engineer for approval. Copies of witnessed test raw data shall be submitted to the Engineer immediately upon completion of such tests.

2. Field Tests

a. Field tests shall be performed in accordance with the requirements specified herein.

b. All electric motors furnished for this project one (1) horsepower or larger shall have the information required in the following tabulation completed. See Exhibit "A" on following page.

c. All field testing shall be witnessed by the Engineer.

(EXHIBIT A)

MOTOR TEST RECORD					
Motor Identification Remarks	**Location**	**Specified Horsepower**	**Nameplate Horsepower**	**Nameplate Amperage (FLA)**	**Measured Amperage Under Normal Operating Conditions**

END OF SECTION

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SECTION 26 09 16

ELECTRIC CONTROLS AND RELAYS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Seller shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein.

B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.

1.02 CODES AND STANDARDS

A. Products specified herein shall be in conformance with or listed to the following standards as applicable:

1. NEMA 250 – Enclosures for Electrical Equipment

2. UL 508A – Standard for Industrial Control Panels

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Seller shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings

2. Spare Parts List

B. Each submittal shall be identified by the applicable Specification Section.

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1.04 SHOP DRAWINGS

A. 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.

B. Partial, incomplete or illegible submittals will be returned to the Seller without review for resubmittal.

C. Shop drawings shall include but not be limited to:

   1. Product data sheets.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Seller intends to provide are acceptable and shall be submitted.

1.05 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Purchaser by the Seller.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered to the Purchaser at the same time as the equipment to which they pertain.

D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same part number.

PART 2 – PRODUCTS

2.01 CONTROL COMPONENTS

A. Manufacturers

1. Control components shall be manufactured by Allen-Bradley to match the manufacturer of the reduced voltage motor controllers. No substitutions are permitted.

B. Pilot Devices

1. General

a. All pilot devices shall be provided with a legend plate. Legend plates shall have a white background and black lettering and indicate the function of the respective pilot device. The text indicated in the specifications shall be used as the basis for legend plate engraving (i.e. HAND-OFF-AUTO, RUN, EMERGENCY STOP, etc.).

b. All pilot devices shall be selected and properly installed to maintain the NEMA 250 rating of the enclosure in which they are installed. All pilot devices shall be UL 508 Listed.

c. All pilot devices shall be 30.5mm in diameter, unless otherwise indicated. 22mm devices are not acceptable.

d. Pilot devices for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein.

2. Pushbuttons

a. Pushbuttons shall be non-illuminated, black in color, and have momentary style operation unless otherwise specified.

b. Pushbuttons shall have the quantity of normally closed and/or normally open contacts as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each pushbutton. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

c. Pushbuttons shall be provided with a full guard around the perimeter of the button.

3. Selector Switches

   a. Selector switches shall be non-illuminated, black in color, and have the number of maintained positions as required. Handles shall be the extended type that provide a greater surface area for operation.

   b. Selector switches shall have the quantity of normally closed and/or normally open contacts as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each selector switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

   c. Where indicated in the Specifications, provide spring return positions.

   d. Selector switches shall be provided with an indexing component that fits into the keyed portion of the cutout for the device and prevents the switch from spinning when operated.

4. Indicating Lights

   a. Indicating lights shall be LED type, with the proper voltage rating to suit the application, and push-to-test feature.

   b. Indicating light lens colors shall be as required in equipment specifications. If lens colors are not indicated, the following colors shall be used:

Color	Designation
Red	"Run", "On", “Open”
Green	"Off", “Closed”
Amber	"Alarm", "Fail"
White	“Control Power On”

5. Emergency Stop Switches

   a. Emergency stop switches shall be non-illuminated, red in color, with a minimum 35mm diameter mushroom head. Once activated, switch shall maintain its position and require a manual pull to release/reset.

   b. Emergency stop switches shall have the quantity of normally closed and/or normally open contacts as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

C. Relays and Timers

1. General

a. Relays and timers shall be furnished with an integral pilot light for positive indication of coil energization.

b. Relays and timers shall have tubular pin style terminals with matching 11-pin DIN rail mount socket. Spade or blade style terminals are not acceptable.

c. Relays and timers for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein.

2. Control and Pilot Relays

a. Relays shall have a clear or translucent housing that allows the contacts to be visually inspected without disassembly.

b. Relays shall have coil voltage as required to suit the application.

c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have 3-pole, double-throw (3PDT) contact arrangement.

3. Time Delay Relays

a. Timers delay relays shall utilize electronic timing technology. Mechanical timing devices are not acceptable.

b. Relays shall have coil voltage as required to suit the application.

c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have double-pole double-throw (DPDT) contact arrangement.

d. Time delay ranges shall be as required to suit the application. Timing range shall be adjustable from the front of the relay. On delay and off delay timer configurations shall be provided as required to suit the application.

4. Elapsed Time Meters

a. Elapsed time meters shall be non-resettable type with no less than a 4 digit display. Coil voltage shall be as required to suit the application.

D. Control Terminal Blocks

1. Control terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or subpanel. Terminals

shall be tubular screw type with pressure plate that will accommodate wire size range of #22 – #8 AWG.

2. Control terminal blocks shall be single tier with a minimum rating of 600 volts and 20A. Separate terminal strips shall be provided for each type of control used (i.e. 120VAC vs. 24VDC). Quantity of terminals shall be provided as required to suit the application. In addition, there shall be a sufficient quantity of terminals for the termination of all spare conductors.

3. Terminals shall be marked with a permanent, continuous marking strip, with each terminal numbered. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

2.02 LOCAL CONTROL STATIONS

A. Local control stations shall be furnished and installed complete with pushbuttons, selector switches, indicating lights, and other devices as required.

B. Specific devices installed in local control stations shall be provided in accordance with the requirements specified elsewhere in this Section.

C. Local control stations shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed.

Area Designation	Enclosure Type and Material
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Die Cast Zinc
Indoor Dry Non-process Area	NEMA 12, Die Cast Zinc
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

D. Provide an engraved, high pressure plastic laminate, white with black lettering nameplate on each local control station. The name and/or number of the equipment associated with each control station shall be engraved on the nameplate, followed by the words “LOCAL CONTROL STATION”.

E. For NEMA 12 enclosures, nameplates shall be attached with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the

enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or equal. The utilization of adhesives is not permitted.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Local control stations shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein.

B. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices.

C. Pilot devices shall be properly bonded to the equipment enclosure door where they are installed. If proper bonding cannot be achieved through the locknuts that affix the device in place, a green colored bonding screw shall be provided on the pilot device. The bonding screw shall be bonded to the equipment enclosure through the use of an insulated green bonding conductor.

D. Local control station covers shall be bonded to the local control station enclosure through the use of an insulated green bonding conductor.

E. Wiring to devices at each local control station shall be provided with enough slack to permit the local control station cover to be removed and pulled at least 6 inches away from the enclosure.

F. Terminal strips, relays, timers, and similar devices shall not be installed on the rear of the panel/cabinet doors. Terminal strips, relays, timers, and similar devices shall not be installed on the side walls of panel/cabinet interiors without written permission from the Engineer.

END OF SECTION

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SECTION 26 29.13.16

LOW-VOLTAGE ENCLOSED MOTOR CONTROLLERS – REDUCED VOLTAGE

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Seller shall furnish separately mounted, individual motor controllers for the blowers specified in Section 43 11 18 – Multistage Centrifugal Blowers. Individual motor controllers specified in this Section include reduced voltage solid state starters (RVSS).

B. The Seller is responsible for the successful application and operation of the motor controller and driven equipment. This includes coordinating with the motor controller manufacturer and providing all load, torque, speed, and performance requirements for the driven equipment.

C. Reference Section 26 09 16 – Electric Controls and Relays and Section 43 11 18 – Multistage Centrifugal Blowers.

1.02 CODES AND STANDARDS

A. Individual motor controllers shall be designed, manufactured, and/or listed to the following standards as applicable:

1. UL 508 – Standard for Industrial Control Panels

2. NEMA 250 – Enclosures for Electrical Equipment

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01 33 00 – Submittal Procedures, the Seller shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.

2. Spare Parts.

3. Reports of Certified Shop Tests.

4. Operation and Maintenance Manuals.

5. Manufacturer's Field Startup Report.

6. Manufacturer's Representatives Installation Certification.

B. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

A. 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.

B. Partial, incomplete, or illegible submittals will be returned to the Seller without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Equipment Manufacturer/Supplier. This letter shall include a copy of this Specification Section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. 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. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

2. Product data sheets.

3. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of individual motor controller. For RVSS starters, in free-standing enclosures, show conduit stub-up area locations on the Drawings.

4. Custom wiring diagrams for each individual motor controller. Standard wiring diagrams that are not custom created by the manufacturer for the individual motor controllers for this project are not acceptable. One wiring diagram which is typical for an equipment group (e.g. multistage centrifugal blowers) is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.

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5. Bill of material list for each individual motor controller.

6. Nameplate schedule for each individual motor controller.

7. Manufacturer’s installation instructions.

8. Time-current curves for each type and size protective device if requested by the Engineer.

9. Approximate total shipping weight of each RVSS.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Seller intends to provide are acceptable and shall be submitted.

E. Prior to completion and final acceptance of the project, furnish and install "as-built" wiring diagrams for individual motor controller. These final drawings shall be plastic laminated and securely placed inside each individual motor controller unit door and included in the O&M manuals.

1.05 OPERATION AND MAINTENANCE MANUALS

A. The Seller shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in Division 01.

1.06 SPARE PARTS

A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Purchaser by the Seller. The Seller shall furnish the following additional spare parts:

1. One (1) solid state overload relay for each type, size, and rating used.

2. One (1) motor circuit protector & motor contactor for each type, size, and rating used.

3. One (1) spare control power transformer for each type and size used.

4. Two (2) spare fuses for each size and type used.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Seller shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Purchaser.

D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 IDENTIFICATION

A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved with the equipment name and/or number with which it is associated.

B. Nameplates shall be engraved, high pressure plastic laminate, white with black lettering.

C. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

D. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

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 specified.

2.02 REDUCED VOLTAGE SOLID STATE STARTER

A. The solid-state reduced-voltage starter shall be UL Listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, an integral paralleling bypass contactor, and electronic overload relay enclosed in a single molded

housing. The starter shall meet all applicable requirements of this Section and other Sections in this Division.

B. The RVSS shall be suitable for continuous operation at 115% of its continuous ampere rating. The Seller is fully responsible for the review of the mechanical specifications to determine specified motor speed, horsepower and full load amperes. This information is available in the applicable mechanical specifications for each piece of equipment (e.g. multistage centrifugal blower).

C. The RVSS shall be suitable for the following environmental conditions:

1. Operating Temperature: 0-50 degrees C

2. Humidity: 0-95 percent non-condensing.

3. Altitude: up to 3,300 feet.

D. The RVSS shall be suitable for operation on a 480 VAC, 3-phase, 60 Hertz system.

E. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV. Units using triacs or SCR/diode combinations are not acceptable. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dv/dt effects.

F. The paralleling run bypass contactor shall energize when the motor reaches full speed and close/open under one (1) times motor current.

G. The starter shall be provided with electronic overload protection as standard and shall be based on an inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via a DIP switch setting on the device keypad. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter. The starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad. The starter shall be capable of either an electronic or mechanical reset after a fault. Units using bimetal or eutectic alloy overload relays are not acceptable.

H. The starter shall provide protection against the following conditions:

1. Improper line-side phase rotation. The starter shall stop the motor load if a line-side phase rotation other than A-B-C exists.

2. Phase loss or unbalanced conditions. The starter shall stop the motor load if a 50% current differential between any two phases is encountered.

3. Motor stall conditions.

4. Motor jam conditions.

I. The starter shall be provided with a form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. The contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate the type of fault (Overtemp, Phase Loss, Jam, Stall, Phase Reversal, and Overload).

J. The starter shall be provided with an unpowered internal “Run” contact rated for 24VDC or 120 VAC operation.

K. The following control function adjustments on the device keypad shall be provided:

1. Selectable Torque Ramp Start or Current Limit Start

2. Adjustable Kick Start Time, 0-2 seconds

3. Adjustable Kick Start torque, 0-90%

4. Adjustable Ramp Start Time; 0.5-180 seconds

5. Adjustable Initial Starting Ramp Torque; 0-100%

6. Adjustable Smooth Stop Ramp Time; 0-60 seconds.

L. Enclosed units shall include a motor circuit protector (MCP) for short-circuit protection and quick disconnect means. If required, the unit shall include a 24 VDC power supply to be used as the primary control voltage source. A 120 VAC control power transformer, fused on both the primary and secondary sides, shall be provided as an additional control power source to power such devices as motor space heaters, valves, and similar control elements as required.

M. Unless otherwise specified, the RVSS enclosure shall be dead-front, with front accessibility. The enclosure shall be designed for both bottom and top entry. The enclosure shall be designed so rear access is not required for operations, maintenance, and repair tasks. The doors shall have full length piano type or concealed hinges and shall be braced to prevent sag when fully open. Other enclosure requirements are:

1. Finish exterior of the enclosures in ANSI-61 gray enamel.

N. The RVSS shall be furnished with a NEMA 1, painted steel enclosure.

O. The complete starter assembly shall be rated per UL 508 for a minimum withstand rating of 65kAIC rms.

P. Control Devices

1. Furnish and install control devices as required. The following control devices shall be provided as specified in Section 26 09 16 – Electric Controls and Relays:

a. Pilot devices (switches, indicating lights, etc.)

b. Relays and timers

c. Control Terminal blocks

Q. The reduced voltage solid state starter shall be the SMC-Flex with integral bypass as manufactured by Allen-Bradley. No substitutions.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation of the motor controllers will be performed by a Third Party. The Seller shall assist with installation including providing the services of a Manufacturer's Representative as specified herein.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of Division 01. The following tests are required:

1. Certified Shop Tests

a. The motor controllers shall be shop tested in accordance with manufacturer's recommended test procedures. At a minimum, shop testing shall verify internal wiring, component functionality, control system functionality and general quality control. Submit certified shop test reports for review.

3.03 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Seller shall provide the services of a qualified manufacturer's factory-trained technical representative who shall adequately supervise the installation and startup of the RVSS equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the

manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Purchaser.

B. The manufacturer’s technical representative shall perform all startup and field acceptance testing as specified herein.

C. The Seller shall provide training for the Purchaser’s personnel. Training shall be conducted by the manufacturer's factory-trained representative who shall instruct Purchaser’s personnel in operation and maintenance of all equipment provided under this Section. Training shall be provided for two (2) sessions of two (2) hours each. Training shall not take place until after the motor controllers have been installed and tested. Training shall be conducted at times coordinated with the Purchaser.

D. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One (1) trip of two (2) working days during installation of the motor controllers.

2. One (1) trip of two (2) working days to perform startup and field acceptance testing of the motor controllers.

3. One (1) trip of one (1) working day to perform training as specified herein.

E. Any additional time required to achieve successful installation and operation shall be at the expense of the Seller.

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.

B. 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.

C. Operator mounting arrangements shall be as directed by the manufacturer and/or Engineer. There shall be no mounting restrictions on the electric valve actuator.

D. 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 43 11 18 – Multistage Centrifugal Blowers and in the Equipment Contract.

PART 2 – PRODUCTS

2.01 GENERAL

A. Manual operators shall be provided on all valves which do not receive electric actuators. Manual operator type shall be as specified herein.

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B. Quarter turn valves 8” and greater in size shall have geared operators.

C. 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, manual operator type shall be as follows:

1. Exposed valves up to 6-inch shall be lever operated (except gate valves).

2. Exposed valves 8-inches and larger shall be handwheel operated.

3. Valves shall have a chainwheel operator where indicated in the specifications.

B. Manual operators shall be rigidly attached to the valve body unless otherwise specified

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 test pressure indicated in Section 43 11 18 – Multistage Centrifugal Blowers, §2.02 Performance Requirements.

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 modulating service as specified in Section 43 11 18 – Multistage Centrifugal Blowers.

1. Modulating valve actuators shall be Type IQM as manufactured by Rotork, Type SAR as manufactured by AUMA, or Series 2000 Futronic as manufactured by EIM Controls.

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 Section 43 11 18 – Multistage Centrifugal Blowers, 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 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 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 4X.

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 in Section 43 11 18 – Multistage Centrifugal Blowers. 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 120 VAC 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. 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 a 4-20mADC analog 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.

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 Section 43 11 18 – Multistage Centrifugal Blowers, manual actuator controls shall be furnished in a separate NEMA 4X stainless steel enclosure. 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 PLC

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 are included under Section 43 11 18 – Multistage Centrifugal Blowers.

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 Seller 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.

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SECTION 40 05 64
BUTTERFLY VALVES

PART 1 – GENERAL (NOT USED)

PART 2 – PRODUCTS

2.01 BUTTERFLY VALVES (LOW PRESSURE AIR SERVICE)

A. Isolation valves and throttling valves for low pressure (up to 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 300ºF with a 25 psig minimum working pressure. Materials of construction shall be as specified below.

1. Valve bodies – Ductile Iron ASTM A536, Grade 65 45 12, epoxy coated.

2. Valve discs and shafts – 316 stainless steel

3. Valve seals – Viton

B. Where required to meet design operating conditions, valve bodies shall be manufactured of higher strength materials than listed above. Valve bodies shall have integral hubs for housing shaft bearings and seals.

C. Butterfly valves shall be of the concentric or eccentric shaft types. Valve discs shall provide a full 360 degree seating surface with no external ribs transverse to flow. The valve manufacturer shall furnish Shop Drawings which include end clearance dimensions when the disc is in the fully open position.

D. The resilient valve seat shall be 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 316 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 at a test pressure of 150 psig, unless otherwise indicated, and post adjusted for differential pressures indicated herein.

E. 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

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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.

F. 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.

G. 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. 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.

H. 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.

I. The manufacturer shall certify that the butterfly valves are capable of operating in continuous duty service under these pressures and flow conditions.

J. Each valve shall by 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.

K. 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.

L. 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 installing 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.

M. Manual operators for butterfly valves 18-inches in diameter or larger shall be the worm gear type conforming to AWWA C504. 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.

N. Manually operated isolation valves shall be provided with a handwheel or chainwheel operator and shall provide for tight shut-off. Manual operators shall be as specified in Section 40 05 57 – Valve Operators and Electric Valve Actuators. Refer to Section 43 11 18 – Multistage Centrifugal Blowers for listing of valves that require handwheels or chainwheels. A mechanical dial indicator shall be provided on the operator to continuously indicate valve positions.

O. Where specified, the Seller 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.

END OF SECTION

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SECTION 40 62 63
OPERATOR INTERFACE UNITS (OIU)

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Seller shall furnish, configure, and test two (2) operator interface units, with all spare parts, accessories, and appurtenances as herein specified. Seller shall provide all Goods and Services specified in this Section with the intent of the Purchaser to contract with an installing contractor for installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 63 43 – Programmable Logic Controllers

PART 2 – PRODUCTS

2.01 OPERATOR INTERFACE UNIT

A. An Operator Interface Unit (OIU) shall be provided to view and change PLC monitoring and control parameters and to display alarm messages using a graphical user interface. The OIU shall provide the following features as a minimum.

1. Minimum of 9 inch diagonal display
2. 18-bit color TFT LCD 640 x 480 VGA display
3. Backlit analog resistive touch screen interface w/ 1 million press actuation rating
4. Backlight w/ min. 50,000 hr life to half brightness
5. Minimum of 512 MB internal storage
6. Minimum of 512 MB RAM application memory
7. Minimum of 80 MB nonvolatile user memory
8. Windows CE Operating System
9. Battery-backed real-time clock
10. Secure Digital (SD) card slot w/ min. 2 GB card
11. One USB 2.0 high-speed Type A host port; one USB 1.0 high-speed Type B device port

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12. One 10/100Base-T Auto MDI/MDI-X Ethernet port

13. Windows-based configuration software complete with download cable

14. Operating Voltage: 120 VAC or 24 VDC (internal or via independent power supply)

15. Enclosure Rating: NEMA 12/4X to match the associated PLC cabinet rating

16. Environment: 0-55°C, 5-95% relative humidity, non-condensing

B. The operator interface unit shall be Allen-Bradley PanelView Plus 7 Standard 700.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. The OIU shall be configured to display all PLC I/O, setpoints, and parameters. All equipment failures shall be alarmed. PLC I/O values and operator-entered setpoints shall be displayed with associated units and service descriptions. Menus shall be provided to navigate between screens of different equipment items. Displays shall be arranged in a hierarchical structure with displays for specific equipment items grouped together. Additional functionality shall be as specified elsewhere in this Division.

B. All necessary configuration and programming software shall be provided on optical media and turned over to the Purchaser.

C. Unless otherwise indicated, each OIU shall be mounted between 48 and 60 inches above the floor or work platform.

END OF SECTION

SECTION 40 63 43
PROGRAMMABLE LOGIC CONTROLLERS (PLC)

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Seller shall furnish, configure, and test all programmable logic controllers (PLC), with all spare parts, accessories, and appurtenances as herein specified. Seller shall provide all goods and services specified in this Section with the intent of the Purchaser contracting with an installing contractor for installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 62 63 – Operator Interface Units

B. Section 40 66 00 – Network and Communication Equipment

C. Section 40 67 63 – Uninterruptible Power Systems

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. The following specific spare parts items shall be provided:

1. One of each type and size of module for PLC equipment furnished under this Contract.

2. One of each type and size of PLC and equipment power supply furnished under this Contract.

PART 2 – PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLERS - GENERAL

A. The Seller shall furnish programmable controllers (PLCs) as specified herein. PLCs shall be provided complete with backplane, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, and appurtenances to provide all features and functions as described herein. No substitutions will be permitted.

B. All components of the PLC system shall be of the same manufacturer; who shall have fully tested units similar to those being furnished in an industrial environment with associated electrical noise. The PLC system shall have been tested to meet the requirements of NEMA Standard ICS 2-230 (Arc Test) and IEEE C37.90.1 (SWC). The

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processing unit shall perform the operations functionally described herein based on the program stored in memory and the status of the inputs and outputs.

C. Programmable controllers shall be designed to operate in an industrial environment. The PLC shall operate in an ambient temperature range of 0°-60°C and a relative humidity of 5-95 percent, non-condensing. The PLC shall operate on supply voltages of 90-132 VAC at 47-63 Hz or 24 VDC if provided with a battery backup system. An integral fuse shall be provided on the power supply for short circuit protection and shall be front panel accessible. Integral overcurrent and undervoltage protection shall be provided on the power supply.

D. Where applicable, the minimum PLC backplane size shall be 7 slots, not including power supply slots.

E. Only a single type of processor shall be supplied for all PLCs of a designated type. Memory and processor shall be adequate for all control functions specified. PLCs shall be Allen-Bradley CompactLogix.

2.02 PROCESSORS

A. PLC processors shall be provided with substantial user program, data and logic memory to allow for future expansion of the overall system. The total memory used on each processor shall be less than 60% of available memory at project completion.

2.03 COMMUNICATIONS

A. PLC communications shall be provided as specified in Section 40 66 00 – Network and Communication Equipment.

B. In addition to a communications port for the control system network, communication ports shall be provided for any other devices required (i.e., operator interface unit) plus an additional communication port for connection to a notebook computer.

C. The PLC shall be able to support various types of fieldbus communication systems for data links to field instruments (where specified) in addition to connected equipment such as power monitors, VFDs, motor protection monitors, etc. As a minimum, Profibus DP, Foundation Fieldbus, Modbus RTU Master and Slave, TCP/IP Ethernet, and Ethernet/IP shall be supported. The installing contractor shall coordinate the efforts of the necessary parties (instrumentation subcontractor, Seller, and others) to accomplish the required device and data table addressing between each PLC and the associated connected equipment.

D. Additional communication modules or protocol gateways may be required to support specific communication protocols required under this Contract and shall be supplied at no extra cost to the Owner. All such supplemental communication programming shall be provided in ladder logic format.

2.04 INPUT/OUTPUT SUBSYSTEMS

A. Input/output hardware shall be plug-in modules in associated I/O backplane/chassis or DIN-rail mounting assemblies. Each unit shall handle the required number of process inputs and outputs plus a minimum of 10 percent active pre-wired spares for each I/O type furnished, plus a minimum of 20 percent spare I/O module space for the addition of future circuit cards or modules.

B. Discrete inputs shall be 24 VDC signals (integral to the PLC) from dry field contacts. Discrete outputs shall be 24 VDC outputs sourced from the PLC, or dry relay contacts (2A minimum) as required. The PLC shall provide momentary and latched outputs as required to interface with motor controls and external devices. Interposing relays shall be provided where required to interface with field equipment. Electrical isolation shall be provided where required. Maximum density for discrete I/O modules shall be 32 per input module and 16 per output module.

C. Analog input circuits shall be isolated, minimum 16-bit resolution type. Analog input hardware shall be provided as required for all types of analog inputs being transmitted to the PLC. In general, analog input modules shall be capable of receiving 4-20 mA signals. Where required, RTD input modules shall have a minimum resolution of 0.15□C and be capable of accepting signals from 100-ohm Platinum RTDs. Analog outputs shall be coordinated with the receivers but shall generally be isolated 24 VDC 4-20 mA outputs powered from the PLC. Each input/output circuit shall have optical isolation to protect the equipment against high voltage transients. Optical isolation shall be rated at not less than 1500 V RMS. Lightning/surge protection shall be provided as specified in Section 40 78 56 – Isolators, Intrinsically-Safe Barriers, and Surge Suppressors. Maximum density for analog I/O modules shall be 8 per module.

D. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms that can be disconnected to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals. The process interface modules shall be provided with screw-type terminal blocks with barriers between adjacent terminals for connection of field inputs. Terminals shall be suitable for accepting up to and including No. 14 AWG wire. All DC output circuits to the field shall include fuses, either integral or at the terminal strip. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed either in the non-conducting mode or remain as were prior to failure. Light-emitting diodes shall be provided for status indication for each input and output point.

E. External power supplies shall be provided with the PLC as required to meet specified installed I/O power requirements plus spares. Power supplies shall be modular units, shall be fully redundant and shall alarm the PLC upon failure. Power supplies shall have a line regulation of 0.05% and meet the environmental and power requirements specified herein for the PLC.

2.05 PROGRAMMING SOFTWARE

A. The PLC programming and configuration software shall be the manufacturer's latest, full-featured version, Windows-based, and shall be fully compliant with IEC 61131-3 standards. The software package shall consist of all programming, configuration, and documentation software needed to place the control and information system in satisfactory operation. The software shall allow on-line and off-line program development and documentation. PLC programming software shall include documentation on optical media.

B. The configuration and programming software shall support communication over the network specified in Section 40 66 00 – Network and Communication Equipment to implement its functions remotely from an operator workstation.

PART 3 – EXECUTION

3.01 REQUIREMENTS

A. PLC programming shall be furnished to perform all functions described in 43 11 18 - Multistage Centrifugal Blowers. Modifications to PLC programming may be required to provide additional functions described in the contract of the installing contractor. These modifications shall be made under the services described in 43 11 18 - Multistage Centrifugal Blowers.

B. PLC programming shall make use of the various IEC languages as appropriate to the specific task and shall be performed in a modular style making extensive use of program blocks (subroutines) and program variables to be passed to the program blocks for specific equipment. It is the intent of this requirement to allow for enhanced readability and ease of modification of the program code through the elimination of multiple instances of repeated code for the same function in a “hard-coded” style.

C. Extensive comments shall be placed in the program code to describe the functions of all elements of the program code. PLC code that does not contain comments shall be rejected.

3.02 REQUIREMENTS FOR SELLER-SUPPLIED PLCS

A. PLCs that are supplied for equipment local control panels by the Seller shall be integrated into the plant control system by the installing contractor. The PLC shall continuously monitor and control the associated system and shall be configured to simultaneously provide all the required alarms, indications of system parameters, equipment statuses, etc. to the main control system at the plant.

B. Seller shall provide all monitoring and control data to be transferred between the PLC and the plant control system in contiguous blocks of PLC registers to facilitate block read

and write commands for efficient scanning by the control system SCADA servers. These contiguous registers shall be arranged in a single data transfer area, which shall be divided into eight distinct areas with an emphasis on flexibility and future expansion. The distinct areas shall be arranged by data type (analog or discrete), transfer direction (server to PLC or PLC to server), and, where applicable, implementation schedule (current or future). Where required, peer-to-peer communication between PLCs shall likewise be accomplished using separate blocks of contiguous registers.

C. The operator interface for control of each individual system shall be performed by local operator interface units as specified in Section 40 62 63 – Operator Interface Units and individual pilot devices on the equipment local control panel, as specified in 43 11 18 - Multistage Centrifugal Blowers .

D. Where operator interface and control functions are required to be provided through the plant control system, the Seller shall be responsible for assisting the installing contractor to provide a complete and working equipment control system. The Seller shall also be responsible for limiting the access of the plant control system to the equipment PLC code so as to prevent malfunctions of the equipment and any failure to continuously perform its intended functions. The Seller shall be responsible for ensuring that no actions by the plant control system can damage or otherwise adversely affect the operation of the associated equipment or the safety of personnel working on or near that equipment. The Seller shall also provide direction in the configuration of the SCADA software's security system by the installing contractor to limit access to the control functions of the equipment control system to authorized personnel only.

E. The Seller shall assist in the testing and startup of the completed system to be performed by the installing contractor, including but not limited to the following tasks:

1. Provide assistance with control system testing of inputs, outputs, and control strategies as needed.

2. Provide support or interface work necessary to perform physical checkout and field testing to the final field devices.

3. Assist as needed to maintain I/O connectivity.

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SECTION 40 66 00
PROCESS CONTROL SYSTEM NETWORKS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Seller shall furnish and test all IEEE 802.3 Ethernet local area network devices as specified. Seller shall provide all goods and services specified in this Section with the intent of the Purchaser contracting with an installing contractor for installation.

B. Local area network devices shall be provided with all spare parts, accessories, and appurtenances as herein specified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 63 43 – Programmable Logic Controllers

1.03 TOOLS, SUPPLIES AND SPARE PARTS

A. The following specific spare parts items shall be provided:

1. One spare switch of each type furnished under this Contract.

PART 2 – PRODUCTS

2.01 LOCAL AREA NETWORK (LAN)

A. An IEEE 802.3 Ethernet local area network shall be used for communications between plant devices. The Seller shall provide and install network devices, wire, and cable between and within equipment provided by the Seller. The installing contractor shall provide and install other LAN devices and cable under separate contract.

B. Network wiring shall be unshielded, twisted-pair copper cables for connections within buildings. Fiber optic media shall be used for all inter-device communication links extended outside of a building, unless specifically noted. Cables shall be as specified herein.

2.02 INDUSTRIAL ETHERNET NETWORK SWITCHES

A. Industrial Ethernet network switches shall be provided for each device that is intended to be connected to the process control system network. The switches shall be capable of creating switched Ethernet networks that conform to the IEEE 802.3 and 802.3u

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standards using copper wires or optical fibers in a bus, tree or ring network topology. Ethernet network switches shall be modular, rack mounted, or standard DIN-rail mounted within the PLC cabinet or in an adjacent communication cabinet.

B. Ethernet network switches shall support ring, bus, tree, or point-to-point network topologies. On-line signal monitoring shall be provided to detect and locate impending faults. Ethernet network switches shall be replaceable on-line without disrupting the network. The Ethernet network switches shall be integrated into the in-plant Ethernet network by the installing contractor. Switches shall support the non-proprietary Media Redundancy Protocol (MRP) and Rapid Spanning Tree Protocol (RSTP) in addition to the switch manufacturer's standard redundant ring network protocol, all of which shall provide self-healing communication recovery.

C. Ethernet network switches shall meet the following minimum performance requirements:

1. Functions: Modular managed switch with store and forward switching mode, 10 Mbps Ethernet, or 100 Mbps Fast-Ethernet, or gigabit Ethernet support, multi-address capability, auto-crossing, auto-negotiation, auto-polarity. Port speed and duplex auto-negotiation shall be configurable.

2. Management: Simple Network Management Protocol (SNMP) (v1/v2/v3) and Common Industrial Protocol (CIP) support; IGMP filtering and snooping.

3. Power Requirements: Redundant 24 VDC power supply

4. Operating Temperature: 0 to 60 degrees C

5. Relative Humidity: 10 - 95%

6. Network Size: Up to 50 nodes in ring structure

7. Port Type & Quantity (at each PLC location): minimum of four (4) 10/100Base-TX, twisted pair cable, RJ-45 sockets, 0-100 meters LAN segment and two (2) 100/1000Base-FX, multimode fiber optic cables (62.5/125 µm), LC, ST or SC sockets, 0-5000 meters LAN segment

8. Link Budget: 8 dB @ 1300 nm; 10 dB @ 850 nm

9. Wavelength: 850 or 1300 nm

D. Acceptable industrial Ethernet network switches shall be as manufactured by Cisco Systems, Hirschmann, Phoenix Contact, Weidmuller, or equal.

2.03 FIBER OPTIC MEDIA CONVERTERS

A. Fiber optic media converters shall be provided to transform the specific PLC network communications protocol into an optical signal suitable for transmission over fiber optic cable. Fiber optic media converters shall be modular, rack mounted, or mounted within the PLC rack.

B. Fiber optic media converters shall meet the following minimum performance requirements:

1. Input Power: 110/220 VAC or 24 VDC (as required) for stand-alone panel-mounted modules or +5 VDC for PLC rack-mounted modules

2. Operating Temperature: 0 to 60 degrees C

3. Node-to-Node Distance: 6500 feet

4. Wavelength: 850 or 1300 nanometers

5. Connector Type: SC, LC, or ST

C. The PLC manufacturer's standard, PLC rack-mounted fiber optic transceiver may also be used, subject to approval by the Engineer.

D. Port speed and duplex auto-negotiation shall be configurable.

2.04 UNSHIELDED TWISTED PAIR CABLE

A. Unshielded twisted pair cable shall consist of 4 pair of 24 AWG copper conductors in a flame-retardant jacket. Cable shall be plenum rated (UL 910) and meet EIA/TIA-568 Category 6 specifications. Unshielded twisted pair cable shall be Hyper Grade Extended Distance cable as manufactured by Berk-Tek, Belden equivalent, or equal. Connectors shall be modular RJ-45 plug.

END OF SECTION

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SECTION 40 67 63
UNINTERRUPTIBLE POWER SYSTEMS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Seller shall furnish and test uninterruptible power systems, with all spare parts, accessories, and appurtenances as herein specified. Seller shall provide all goods and services specified in this Section with the intent of the Purchaser contracting with an installing contractor for installation.

B. One UPS shall be provided for each programmable logic controller (PLC) panel and its appurtenant equipment provided under this Contract. However, courtesy receptacles in PLC cabinets shall not be powered by the UPS.

C. UPS units shall be mounted in or near enclosures containing digital hardware as follows:

1. UPS units for control panels containing PLCs shall be mounted either within the cabinet or in an adjacent cabinet of suitable environmental rating.

2. Where the UPS is mounted within a dedicated enclosure, that enclosure shall be properly sized for heat dissipation and all other applicable requirements.

3. Where the UPS is mounted within the PLC 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.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 63 43 – Programmable Logic Controllers

1.03 SUBMITTALS

A. The Seller shall submit UPS sizing calculations for all UPS units furnished under this Contract.

PART 2 – EQUIPMENT

2.01 UNINTERRUPTIBLE POWER SYSTEMS

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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 on 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 to allow 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 associated PLC.

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.

5. 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 loss of the AC line, low battery level or operation of the static transfer switch. Contacts shall be wired

to the closest discrete input subsystem. Alternatively, an RS-232 or USB port shall provide UPS status to an operator workstation. All required interface software and hardware shall be provided.

c. Circuit breaker for the AC input.

6. Sound absorbing enclosure.

7. EMI/RF noise filtering.

8. 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.

END OF SECTION

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SECTION 40 73 13

PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Seller shall furnish and test the pressure gauges, with all spare parts, accessories, and appurtenances as herein specified. Seller shall provide all goods and services specified in this Section with the intent of the Purchaser contracting with an installing contractor for installation.

PART 2 – PRODUCTS

2.01 PRESSURE GAUGES

A. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".

B. All gauges shall be direct reading type. Snubbers shall be provided on all gauges. Gauge full-scale pressure range shall be selected such that the maximum operating pressure shall not exceed approximately 75% of the full-scale range.

C. Features

1. Mounting: ½” NPT, lower stem mount type
2. Accuracy: 0.5% full scale
3. Case: Solid front, black phenolic material
4. Dial: White background and black letters
5. Glass: Shatterproof
6. Blow-out protection: Back
7. Pressure element: stainless steel bourdon tube
8. Movement: Stainless steel, Teflon coated pinion gear and segment
9. Gaskets: Buna-N

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D. Liquid-filled or equivalent mechanically-damped gauges shall be used if the gauges are installed with pumps, or where gauges are subjected to vibrations or pulsation. Filling fluid shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.

E. Gauge size shall be 4-1/2".

F. Diaphragm seals and isolating ring seals shall be furnished.

G. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A ½" isolation stainless steel ball valve shall be provided for each gauge assembly.

H. Pressure and vacuum gauges shall be Ashcroft Duragauge Model 1279, Ametek-U.S. Gauge Division, H.O. Trerice Co., WIKA Instrument Corporation, or equal.

END OF SECTION

SECTION 40 78 56

ISOLATORS, INTRINSICALLY-SAFE BARRIERS, AND SURGE SUPPRESSORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Seller shall furnish and test the isolators, intrinsically-safe barriers, and surge protection devices (SPDs) as specified herein.

1.02 TOOLS, SUPPLIES AND SPARE PARTS

A. The following specific spare parts items shall be provided:

1. Two of each type of surge protection device provided under this Contract.

PART 2 – PRODUCTS

2.01 SURGE PROTECTION

A. General

1. All electrical and electronic elements shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical systems.

2. Manufacturer's Requirements: All surge protection devices shall be manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years. Acceptable manufacturers shall be Phoenix Contact, Edco, Transtector, Weidmuller, or equal.

3. Surge protection device installations shall comply with UL 94, the National Electric Code (NEC), and all applicable local codes.

4. Surge protection devices shall be installed as close to the equipment to be protected as practically possible.

5. Device Locations: As a minimum, provide surge protection devices at the following locations:

a. At connections between AC power and electrical/electronic equipment, including, but not limited to, panels, assemblies, and field mounted analog transmitters.

b. At both ends of analog signal circuits that have any portion of the circuit extending outside of a building.

c. At both ends of copper-based communication cables which extend outside of a building, including at field instruments and the field side of analog valve position signals.

d. On all external telephone communication lines.

B. AC power protection

1. Surge protection device assemblies for connections to AC power supply circuits shall:

a. Be provided with two 3-terminal barrier terminal strips capable of accepting No. 12 AWG solids or stranded copper wire. One terminal strip shall be located on each end of the unit.

b. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements. The surge protection device shall be provided with provisions for mounting to interior of equipment racks, cabinets, or to the exterior of freestanding equipment.

c. Be constructed as multistage devices consisting of gas tube arrestors, high energy metal oxide varistors, or silicon avalanche suppression diodes. Assemblies shall automatically recover from surge events and shall have status indication lights.

d. Comply with all requirements of UL 1449, latest edition.

e. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.

f. Have the following characteristics:

1) Maximum Continuous Operating Voltage: 150VAC

2) Maximum Operating Current: 20 amps

3) Ambient Temperature Range: -20 degrees C to +65 degrees C

4) Response Time: 5 nanoseconds

C. Analog signal circuit protection

1. Surge protection device assemblies for analog signal circuits shall:

    a. Have four lead devices with DIN Rail mounting.

    b. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.

    c. Be constructed as multistage devices consisting of gas tube arrestors and silicon avalanche suppression diodes. Gas tube arrestors and diodes shall be separated by a series impedance of no more than 20 ohms. Assemblies shall automatically recover from surge events.

    d. Comply with all requirements of UL 497B.

    e. Be able to withstand a peak surge current of 10,000 amps based on a test surge waveform with an 8-microsecond rise time and a 20-microsecond exponential decay time, as defined in UL 1449.

    f. Limit line-to-line voltage to 40 volts on 24VDC circuits.

    g. Have the following characteristics:

        1) Maximum Continuous Operating Voltage: 28VDC

        2) Ambient Temperature Range: -20 degrees C to +65 degrees C

        3) Response Time (Line-to-Line): 5 ns

D. Communication circuit protection

1. Surge protection devices for copper-based data communication circuits shall:

    a. Be designed for the specific data communication media and protocol to be protected (e.g., telephone, serial, parallel, network, data highway, coax, twinaxial, twisted pair, RF).

    b. Provide protection of equipment to within the equipment’s surge withstand levels for applicable standard test wave forms of the following standards:

        1) IEC 60-1 / DIN VDE 0432 part 2

        2) CCITT K17 / DIN VDE 0845 part 2

        3) IEEE C62.31

c. Have a nonflammable enclosure that meets or exceeds UL 94 V0 flammability requirements.

d. Provide automatic recovery.

2.02 INTRINSICALLY SAFE BARRIERS AND RELAYS

A. Intrinsically safe relays and barriers shall be provided where required to interface with equipment located in Classified (i.e., hazardous) areas.

B. Intrinsically safe relays and barriers shall be FM approved.

C. Manufacturer shall be

1. Pepperl+Fuchs

2. Crouse Hinds

3. Square D

4. Or equal.

2.03 ISOLATORS AND CONVERTERS

A. Signal converters shall be provided as required to provide control functions and to interface instrumentation and controls, equipment panels, motor control centers and other instrumentation and controls supplied under other Divisions to the controls provided herein.

B. General Requirements

1. Converters shall be of the miniature type, utilizing all solid-state circuitry suitable for mounting within new or existing cabinetry. Where sufficient cabinet space is not available, sub panels or supplemental enclosures shall be provided.

2. Power supply shall be 120V, 60 hertz where required by the converter, unless otherwise indicated.

3. Repeatability shall be 0.1% of span, deadband shall be 0.1% span, maximum.

4. Where specific converters are not listed, but are required to interface with the process control system, they shall comply with the general requirements stated herein.

C. Current to Current (I/I) Isolators

1. Current to current isolators shall be furnished where necessary to provide an isolated current loop, calculations or signal amplification between the plant process control system and instrumentation and control loops. Isolators shall be sized such that resistance of existing loops shall not exceed maximum rated resistance.

2. Isolators shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

D. Voltage to Current (E/I) Transducers

1. Voltage to current (or current to voltage) transducers shall convert a voltage signal of one magnitude to a 4 20 milliamp DC current signal. The output current shall be directly proportional to the input signal voltage. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance.

2. Transducers shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

E. Frequency to Current (F/I) Transducers

1. Frequency to current transducers shall convert pulse rate and pulse duration signals to 4 20 mA, 24 VDC analog signals. Converters shall include field adjustable input frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines.

2. Transducers shall be Series 5100 as manufactured by AGM, or equivalent by Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

F. Current to Frequency (I/F) Transducers

1. Current to frequency transducers shall convert 4 20 mA, 24 VDC analog signals to pulse rate and pulse duration signals. Converters shall include field adjustable output frequency range. Converter power shall be 120 VAC, 60 hertz. Transducers shall be sized such that loop resistance does not exceed maximum rated resistance. Transducers shall be suitable for signal transmission via leased telephone lines.

2. Transducers shall be Series 5016 as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

G. Integrators

1. Integrators shall be provided as interchangeable plug in modules with zero and span adjustment available on the front plate of the units. Output shall range from 0 to 0.1 through 0 to 10 pulses per second. Accuracy shall be + 0.1% of input span. Integrators shall convert linear analog signals to pulse rate and provide a solid state output.

2. Integrators shall be as manufactured by AGM Electronics, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

H. Electronic Switches (Alarm Relays)

1. Electronic switches shall be furnished with a calibrated dial for adjusting set points. The input to the switch shall be 4 - 20 mA DC, and the set point shall be adjustable over the full range. Unless otherwise noted, the dead band shall be fixed at less than 2% of span. The set point stability shall be +0.1% per degree F. The repeatability shall be +0.1% of span. The units shall be furnished with SPDT relays rated at 10 amperes at 115 VAC.

2. Electronic switches shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

I. RTD to Current Signal Converters

1. RTD to current signal converters shall convert a 3-wire RTD input signal to an isolated 4 20 mADC output signal. Accuracy shall be 0.10% of span or better.

2. Signal converters shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), Phoenix Contact, Weidmuller, Acromag, or equal.

END OF SECTION

SECTION 43 11 18
MULTISTAGE CENTRIFUGAL BLOWERS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Seller shall furnish and test two (2) electric motor-driven multistage centrifugal blower units including electric motors, steel bases, inlet filter, inlet throttling valves with electric motor operators, check valves, discharge butterfly valves, control panels, reduced voltage solid state starters, and all necessary auxiliary equipment as specified herein or as required for a complete system. Seller shall provide all Goods and Services specified in this Section with the intent of the Purchaser to contract with an installing contractor goods installation.

B. Equipment shall be provided in accordance with the requirements of Section 46 00 00 – Equipment General Provisions.

C. Equipment furnished by the Seller under this Section shall include, but not be limited to:

1. Two (2) electric motor-driven multistage centrifugal blower units including electric motors, steel bases, inlet filter, inlet throttling valves with electric motor operators and pipe spools (if any), check valves, and discharge butterfly valves.

2. Two (2) PLC-based control panel assemblies

3. Two (2) local control stations

4. All necessary auxiliary equipment as specified herein or as required for a complete installation of the system

5. Shop testing

6. Field services of Blower manufacturer’s representative and of RVSS manufacturer’s representative

D. The Seller shall provide a reduced voltage solid state starter for each of the blower packages. Reference Section 26 29 13.16 – Low-Voltage Enclosed Motor Controllers – Reduced Voltage.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Division 01 – General Requirements

B. Section 46 00 00 – Equipment General Provisions

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C. Division 40 – Mechanical

D. Division 26 – Electrical

E. Division 40 – Process Interconnections

1.03 SUBMITTALS

A. The Seller shall submit complete Shop Drawings, Operation and Maintenance Manual, Instructions, and other information for the blower systems and all equipment specified herein in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings shall include full descriptive information of materials used, method of fabrication, sizes, enclosures, ratings and layout dimensions, etc. to demonstrate full compliance with the Contract Documents.

C. Shop Drawings shall include weights of all system components and total weight of the operating blowers.

D. The performance characteristic curves for the blowers shall be submitted with the shop drawings. 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, and the curves shall show horsepower draw over the range of SCFM flow rates. Additional operational data for the blowers shall be submitted including recommended vibration alarm settings and operational limits.

E. A complete description of the protective coating system to be used for all components, prior to shipment and after installation, shall be submitted with the shop drawings.

F. A listing of spare parts furnished shall be submitted with the shop drawings.

G. Seller shall submit installation instructions in accordance with Section 01 33 00 – Submittal Procedures. Installation instructions shall be complete including unloading, check-out following shipment, all storage requirements, handling, assembly, anchorage, and start-up instructions and shall be submitted prior to delivery of the blowers. Anchor bolts shall be 316SST, sized by the Seller and furnished by the installing contractor.

H. Electronic certified test reports including all details of apparatus, procedure, and results and all required calculations shall be submitted for each shop test conducted. Reports for shop tests shall be approved by the Engineer prior to shipment.

I. A detailed shop test plan shall be submitted with the Shop Drawings. The shop test plan shall fully describe the manufacturer's test facilities and the test procedure to be used.

J. Motor literature, illustrations, specifications and engineering data.

K. Instruments including product data sheets, manufacturer’s catalog information, and performance/operation criteria and requirements.

L. Panel, console, and cabinet layout drawings, component product information, wiring diagrams, and field wiring requirements specific to the project.

M. Blower control system block diagram, input/output information, hardware layout drawings, interconnection diagrams, and point-to-point interconnection wiring diagrams for field wiring.

N. Operator interface graphic layouts specific to the project shall be submitted as a separate submittal following release of equipment to fabrication.

1.04 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. The Seller shall furnish the services of a qualified service person with at least three years of experience, who is regularly involved in the inspection, operation, and maintenance of centrifugal blowers and blower systems of the size and type being furnished. The service persons shall:

1. Inspect the installed equipment to verify that installation is in accordance with the Seller’s requirements

2. Witness and check final adjustments and alignments

3. Witness and check start-up of each blower system

4. Assist the installing contractor in performing field testing and prepare a written report as specified below.

5. Troubleshoot and correct any mechanical problems with the system that are noted during initial operation.

6. Submit written certification signed by the service person that the system has been properly installed, tested, and adjusted; that the system operates as specified or as required, including date of field test, as well as a listing of all persons present during the tests.

7. Investigate and supervise correction of any operating problems that may arise during the guarantee period of the equipment.

8. Coordinate communications with plant control system via the PLC network connection.

B. The services of a qualified manufacturer's technical representative shall be furnished at no additional cost to the Purchaser and shall be provided in accordance with Section 46

00 00 – Equipment General Provisions. Field services shall include as a minimum the site visits listed below. Any additional time required to achieve successful installation and operation shall be at the expense of the Seller. Note that field service by the manufacturer of the Reduced Voltage Solid State Starters is specified in Section 26 29 13.16 – Low-Voltage Enclosed Motor Controllers – Reduced Voltage and is NOT included in the below totals.

Service	Number of Trips	Number of Days/Trip
Installation and Testing	**2**	**2**
Startup and Training	**1**	**1**
Services after Startup	**1**	**1**

C. The Seller's service person shall sign in and out every day on-site and shall comply with all Purchaser requirements for visiting the site.

D. The Seller shall additionally provide remote support for communication and programming issues during network startup and checkout.

1.05 QUALITY ASSURANCE

A. The materials covered by the Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed and constructed in accordance with the best practices and methods and shall operate satisfactorily when installed and operated per the manufacturer's recommendations.

B. All materials shall be new, and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which the units are to be subjected and shall conform to all applicable Sections of these Specifications. All parts of duplicate machines shall be interchangeable without modification. The construction of the blowers shall be such that the blowers will not be damaged during continuous operation and will not have undue vibration above the blower's surge limit. The design and construction of the blowers shall not cause any unbalanced floor loadings.

1.06 WARRANTY

A. All blower system components specified herein, including but not limited to multistage centrifugal blowers, motors, control panels, RVSS panels, valves, and accessories, are to be warranted to be free of defects in materials and quality as required and for the period indicated in the Equipment Contract.

PART 2 – PRODUCTS

2.01 GENERAL

A. The aeration blowers shall be multistage, vertically-split, centrifugal type. The blowers shall be driven at the inlet end by direct coupled electric motors with flexible couplings and guards as specified herein. The blowers, motors and all ancillary equipment shall be suitable for indoor installation under the full range of ambient conditions indicated in Section 2.02..

B. The blowers shall be Model 1607 with four A2 and three A3 impellers and Model 1607 with four A1, two A2, and one A3 impellers as manufactured by Gardner Denver, Inc.; Model LS24-5 with five IM115 impellers as manufactured by Lone Star Blower, Inc., for both blowers; or Model 451.06 with one C213 impellers and five C202 impellers and Model 500.06 with one A211 impeller and five A201 impellers as manufactured by Continental Blower, LLC. No substitutions shall be permitted. The model, number and type of impellers shall be verified by the Seller.

C. Blowers maximum dimensions shall be no more than 16 feet 3 inches in length, 6 feet 6 inches in width, and 8 feet in height. Total height of blower including inlet valve, spools, and filter shall be no more than 12 feet 6 inches.

2.02 PERFORMANCE REQUIREMENTS

A. The proposed blowers shall satisfy the conditions of service and requirements listed below. Standard cubic feet per minute (SCFM) is defined as the delivered airflow rate at the blower discharge in terms of standard conditions (68°F, 14.7 psia and 36% relative humidity). The blowers shall be capable of delivering the specified design flow rate per blower (in SCFM) at the specified discharge pressure at the minimum inlet pressure, design maximum air temperature and relative humidity at the design maximum temperature as specified for the blower primary design point below. The design air temperatures and inlet pressure listed shall be at the inlet to the blower and do not include the impacts of inlet throttling. Motor horsepower shall not exceed the maximum rated motor horsepower specified. The blowers shall be capable of turndown to the minimum flow rate specified below at the minimum design temperature and humidity specified.

Ambient Conditions	
Site Elevation, ft	**30**
Ambient Barometric Pressure, psia	**14.7**
Ambient Temperature Range, °F	**30-110**
Ambient Relative Humidity Range, %	**0-100**

Design Inlet Conditions		
Minimum Inlet Pressure, psia	**14.4**	
Design Air Temperature, °F	**100**	
Relative Humidity at Design Temperature, %	**60**	
Design Minimum Air Temperature, °F	**40**	
Relative Humidity at Design Min. Temperature, %	**0**	
Capacity Requirements	**Small Blower**	**Large Blower**
Number of Blowers	**1**	**1**
Mass Flow Rate/Blower at Design Max Inlet, SCFM	**7,500**	**9,000**
Volumetric Flow Rate/Blower at Design Max Inlet, ICFM	**8,380**	**10,050**
Discharge Pressure, psig	**11.3**	**11.3**
Discharge Pressure (absolute), psia	**26.0**	**26.0**
Maximum Shaft Power at Design Point, HP	**520**	**650**
Minimum Flow Rate/Blower at Design Min. Inlet, SCFM	**4,500**	**5,400**
Minimum Surge Pressure - Unthrottled, psig	**11.7**	**11.7**
Motor Requirements		
Voltage, V	**460**	**460**
Maximum Horsepower, HP	**600**	**750**
Minimum Full-Load Efficiency[1]	**94.5%**	**94.5%**
Enclosure Type	**TEFC**	**TEFC**

Notes:

1. For motors 500HP and less, minimum efficiency shall be the greater of the above or that specified per 26 05 60 - Low-Voltage Electric Motors.

B. Surge volume of each blower shall be less than the minimum flow rates indicated in the table above under the range of ambient temperature conditions shown. Surge volume is defined herein as the airflow rate at which the discharge throttled blower exhibits the first indication of pressure pulsations or flow reversal.

C. The large blower shall not draw more than 750 horsepower at any flow rate for any temperature in the range of 30°F to 104°F and the inlet pressure specified, and the small blower shall not draw more than 600 horsepower at the same conditions; blower motors shall be non-overloading assuming un-throttled operation throughout the range of

expected inlet conditions. The blower shall have a "non-overloading" characteristic through the use of backward leaning impellers.

D. The blower system will be designed to deliver varying airflow rates by throttling at the blower suction. Control of minimum airflow delivery and inlet valve throttling will be based on blower drawn amperage or power.

E. All process air valves and appurtenances shall be designed to withstand operating and test pressures up to 25 psig. All valves shall be provided with 125# ANSI B16.1 flanges except wafer check valves shall be compatible with the same.

2.03 BLOWER MOTORS

A. The Seller shall be responsible for furnishing the electric motors for each blower. Maximum rated horsepower for each blower is specified in Paragraph 2.02. The Seller shall be responsible for the proper selection, testing, installation, and operation of the motors and for coordinating the motors with the compressor equipment. Motors shall be new and both materials and quality shall be of the very best quality. Motors shall be XE Premium Efficiency motors as manufactured by Baldor/Reliance Electric Company; Nidec Motors; Toshiba Industrial and Power Systems, Inc.; Siemens Energy & Automation, Inc.; General Electric Company, or TECO Westinghouse.

B. Motors shall be horizontal squirrel cage induction motors designed in accordance with the latest ANSI, NEMA, and IEEE standards. Motors shall be 460 volts, 3 phase, 60 Hz. Motors shall be designed and manufactured for continuous duty for operation under the following conditions:

1. Altitude below 3,300 ft.

2. Ambient temperature ranging from 20°F to 122°F.

3. Voltage variations of plus or minus 10 percent.

4. Frequency variation of plus or minus 5 percent.

5. Combined voltage and frequency variation of plus or minus 10 percent with frequency variation not exceeding plus or minus 5 percent.

C. The motor shall provide a service factor of 1.15. Motor horsepower shall be equal to or greater than the load over the full range of operating conditions including unthrottled operation. Motor speed shall not exceed 3600 rpm.

D. Motor torque characteristics shall be at least 20 percent greater than the maximum full load torque requirements over the full range of operating conditions from start-up to full load.

E. Motor shall be in TEFC enclosures and shall be designed for quiet operation. Motor sound pressure shall not exceed nominal 87 dBA, measured 3 feet from the motor.

F. Motors shall provide premium efficiencies and power factors throughout their operating range. The power factors specified shall be achieved without the use of power factor correction capacitors.

G. Motor insulation shall be Class H insulation; however, temperature rise shall be limited to that of Class B insulation. Manufacturer's premium grade insulation shall be used.

H. The stator shall be assembled from high grade electrical sheet steel laminations adequately secured together. Stator windings and end turn connections shall be fully braced to withstand all mechanical, electrical, and thermal stresses. The shaft shall be made of high-grade machine steel or steel forging and of size and design adequate to withstand the load stresses. The rotor shall be fabricated of high-grade electrical sheet steel laminations adequately fastened together and to the shaft.

I. Bearings shall be grease lubricated ball bearings. Bearings shall be capable of being inspected or replaced without disturbing alignment.

J. Motor leads shall be suitably marked and identified. Each motor shall be provided with an oversized terminal box with space for full stress cone terminations and shall be constructed of cast iron or fabricated steel, neoprene gasketed and bolted. The three stator phase leads shall be provided with 2-hole pad connectors for the incoming cables.

K. Motors shall be designed and manufactured for operation in the direction required for the blowers. The phase sequence shall be marked permanently and plainly inside the stator lead junction box.

L. Motors shall have breather and drain plugs to allow for drainage of any moisture from inside.

M. Motor Winding Temperature Monitors: Each motor shall be provided with six (two per phase) platinum resistance temperature detectors (RTDs) embedded in the stator winding. RTDs shall be 100-ohm, platinum, 3 wire type having a stability of better than 0.2 percent of maximum exposed temperature for one year of service, or 0.25°C, whichever is greater. Two detectors per phase are required and shall be placed at locations determined by the manufacturer to give close approximation of the hottest spot temperatures.

N. Motor Bearing Temperature Monitoring: Each motor shall be furnished with two platinum motor bearing resistance temperature detectors (RTDs) for connection to the respective blower control panel PLC input/output interface. Motor bearing RTDs shall be mounted in Type 316 stainless steel thermowells coordinated and furnished by the Seller.

O. Motor Bearing Vibration Monitoring: Each blower shall be furnished with two motor bearing vibration sensors for connection to the respective blower control panel PLC input/output interface.

P. Motors shall be supplied with space heaters for 120V operation. Starters shall include circuitry and 120-volt power supply to automatically power the space heaters when the motors are not running and vice-versa.

Q. Motor power supply shall be connected to an oversized junction box mounted on the motor housing.

R. Motors shall comply with Division 26 requirements, except where modified herein.

2.04 BASES

A. A welded steel fabricated base shall be provided for mounting the blower, electric drive and driver base. The base shall be of a rigid box section shape. The box section shall be properly ribbed for stiffness and present large bearing areas for carrying the load on the foundation and shall include lifting lugs. The base shall be rigid to prevent deflection during start-up and normal operation that would affect alignment. Rubber vibration isolation pads shall be provided between the concrete mounting and the base of the blower unit. The base shall have machined surfaces at blower and motor installation pads.

2.05 HOUSING AND HEADS

A. The housing, inlet and outlet heads shall be constructed of close-grained cast iron sections, ASTM A48, fitted with babbit joints held securely by steel tierods and able to withstand the operating pressures. Heads shall be provided with mounting legs. Approved eye bolts or lugs shall be provided for lifting. Where the blower shaft passes through both the inlet and outlet heads, non-contact labyrinth seals with babbit inserts or carbon ring seals shall be provided to prevent air leakage and to assure non-contamination of the bearing lubricant. Internal seals between stages shall be of the labyrinth type to restrict inter-stage leakage. Inlet and outlet flange connections shall be ANSI Standard 125-pound drilled through bolt pattern and will be an integral part of the heads.

B. Air passage shall be finished by hand or other means to obtain smooth surfaces and minimize friction losses. Casing shall be accurately machined to gauge, where necessary, to ensure interchangeability of all parts.

C. The compressors shall be built from parts cast in patterns from which previous units have been built and tested. The compressor shall be of the manufacturer's standard design.

2.06 IMPELLERS AND SHAFTS

A. Impellers shall be cast aluminum alloy, keyed to the shaft and held by a lock nut. Hubs of the impellers shall butt against each other directly or through one-piece metal spacers. Impellers shall be individually precisely machine balanced. Impellers shall be individually replaceable without requiring dynamic rebalancing of the entire rotating assembly to maintain factory vibration specifications. Vibration shall not exceed 1.25 mils in the vertical plane measured at the blower bearing housing.

B. Shaft shall be of sufficient diameter to operate below the first critical speed and be made of stainless steel. Shaft speed shall not exceed 3,600 rpm.

2.07 BEARINGS

A. Each blower shall have two oil lubricated ball bearings which can be lubricated, inspected or replaced without disconnecting piping or disassembling the blower. The bearings shall be contained in outboard bearing housings designed to isolate the bearings from blower temperature.

B. A balance piston will be integrally shaft mounted on the discharge end of the blower. The balance piston will reduce the thrust load on the thrust bearing by 75 percent.

C. Lubrication shall be accomplished by means of an oil slinger that circulates lubrication oil from an inner reservoir through the bearing and returns the oil to the outer reservoir. Oil recirculation shall be at the rate of at least 1.5 pints per minute. The oil level in the bearings housings shall be viewable through a sight glass.

D. Blower Bearing Temperature Monitoring: Each blower shall be furnished with two platinum blower bearing resistance temperature detectors (RTDs) for connection to the respective blower control panel PLC input/output interface. Blower bearing RTDs shall be mounted in Type 316 stainless steel thermowells coordinated and furnished by the Seller.

E. Blower Bearing Vibration Monitoring: Each blower shall be furnished with two blower bearing vibration sensors for connection to the respective blower control panel PLC input/output interface. Locations shall be coordinated by the Seller.

F. Each blower shall be equipped with a high velocity cooling fan on the discharge of the blower to reduce bearing temperature to below 190F. The fan shall be provided with a protective covering.

2.08 COUPLINGS

A. A flexible, disc spacer coupling of an approved type shall be furnished for connecting the blower and motor. The coupling design shall take care of inaccuracies of alignment and permit axial adjustment. The coupling shall have a minimum service factor of 1.35 over motor nameplate horsepower. Spacer coupling shall have a minimum length of seven inches. The construction of the couplings shall be such that either hub of a unit may be

removed without disturbing adjustment of the blower or motor. A factory laser alignment shall be conducted prior to shipment to facilitate alignment in the field.

B. The Seller shall provide a suitable steel or “OrangePeel” aluminum coupling guard for the coupling between blower and motor. The guard shall have a sheet metal top covering and expanded metal front and be designed to meet current OSHA requirements.

C. The Seller shall provide a torsional critical speed analysis to ensure that the blower, motor, and coupling are properly designed and to ensure that there are no torsional critical speeds within the operating range of the unit.

2.09 PRESSURE, TEMPERATURE AND POWER MONITORING

A. Temperature Indicating Transmitters: Each blower shall be provided with inlet and discharge thermowells and temperature indicating transmitter assemblies on the suction and discharge sides located as recommended by the Seller.

B. Temperature indicating transmitters shall be mounted in Type 316 stainless steel thermowells coordinated and furnished by the Seller. Thermowell locations on piping shall be coordinated by the Seller.

C. Differential Pressure Transmitter: Shall be provided at the discharge of the filter/silencer unit. Vacuum and pressure taps shall be provided by the Seller for stable measurement and accurate evaluation of pressure loss across the filter.

D. Pressure gauges shall comply with the requirements of Section 40 73 13 – Pressure and Differential Pressure Gauges.

E. Taps and connections for sensing instruments shall be sized to suit each individual installation and the requirements of the instrument served. The location, orientation, and dimensions of the connections and taps for instrumentation shall provide for the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage, and accessibility for maintenance while the equipment is in operation. Isolation valves shall be provided at all instrumentation taps, where applicable.

F. Instrumentation shall withstand temperatures up to 300ºF

G. The Seller shall provide current monitoring devices (CTs) to be installed in the RVSS starters by the RVSS manufacturer. The Blower Control Panel PLC shall receive motor current signals from the CTs for hardwired blower surge protection. The Seller shall coordinate the requirements for the CTs, including mounting space required, with the RVSS manufacturer.

2.10 BLOWER CONTROL PANELS

A. The Seller shall furnish a NEMA 12 Blower Control Panel for each of the blowers. Each Blower Control Panel shall include a PLC for monitoring, controlling, and protecting the blowers, and a PLC operator interface panel with touchscreen. Blower Control Panel shall be suitable for wall-mounted installation by the installing contractor within the blower electrical building. Each Blower Control Panel shall contain controls for blower motor starting and stopping, surge and overload detection, alarm and emergency shutdown systems, and for the inlet throttling valve. The panel shall be supplied with a disconnect switch on the 120-volt power supply to the panel.

B. The Seller shall furnish a NEMA 4X Local Control Station for each of the blowers. Each Local Control Station shall include a mushroom-type emergency stop button, and pilot lights to indicate blower running and fault conditions. Match pilot light and button colors to those indicated below.

C. All electrical work associated with the panels, instruments, and controls shall be in accordance with the codes specified in Division 26. All electrical work shall be of the same quality and characteristics as that provided under Division 26. All control devices shall be as specified in Section 26 09 16 – Electric Controls and Relays.

D. All conduit and wiring for devices associated with the system shall be pre-wired by the Seller to integrally mounted junction boxes. Separate junction boxes shall be provided for control and signal wiring, with all wiring identified and brought to numbered terminal strips. All wiring shall be neatly installed in vertical or horizontal runs and shall not interfere with the disassembly and/or hoisting of any system component. All rigid conduit shall be heavy walled rigid aluminum conduit. All flexible conduit shall be UL listed liquid tight flexible metal conduit.

E. Engraved plastic nameplates shall be mounted on the front and inside of each panel or junction box to designate the unit served and to identify the various indicators, switches, devices, instruments, etc. Nameplates shall have white letters on a black background and secured with stainless steel screws. Suitable warning labels shall also be included inside of the panel to alert the operator of the presence of live control power and to provide clear disconnection instructions.

F. In addition to the AC safety ground system provided in each panel, a separate grounding system shall be provided for the control system power and logic circuits (i.e., the DC signals). The DC ground bus shall be a separate bare copper ground bus with standoffs for isolation from the cabinet. The DC ground system for the Blower Control Panels containing digital hardware shall be tied together to ensure a single DC ground potential for the panels. The busses shall be furnished with 10/32 binding head screws for termination of shield drain wires. The DC ground conductor shall be a #1/0 insulated wire run directly from the panels to a separate copper ground rod outside the building.

G. Each Blower Control Panel shall be furnished with a PLC. PLC shall be Allen Bradley CompactLogix, and shall be provided in accordance with the requirements under Section 40 63 43 – Programmable Logic Controllers. The PLC shall be provided complete with rack, power supply, I/O cards, special function cards, instructions, memory, input/output capacity, operator interface unit (see Section 40 62 63 – Operator Interface Units), and appurtenances to provide all required features and functions.

1. Additional communication ports shall be provided for the Operator Interface and other devices as required.

2. Each Blower Control Panel shall include a UPS to provide uninterruptible power to the PLCs for a minimum of 30 minutes in the event of an electrical power failure. The Seller shall submit detailed load calculations to illustrate how the UPS was sized including the BTU heating load developed from the UPS at full load conditions. UPS shall be provided in accordance with additional requirements as specified in Section 40 67 63 – Uninterruptible Power Systems.

3. Each blower PLC system shall be provided with an Ethernet network interface card for communications with the Plant SCADA System

H. Each Blower Control Panel shall be furnished with a minimum 9-inch color touchscreen operator interface mounted on the front of the NEMA 12 enclosure. The operator interface shall be Allen Bradley PanelView Plus 7 series. The operator interface shall provide the following functions at a minimum:

1. Surge protection with impending warning and trip functions in amperage and horsepower (calculated) displayed as digital readouts.

2. Blower bearings vibration level indication with impending warning and trip functions and levels displayed as digital readouts. A warning shall be activated through the monitor when vibration exceeds 0.2 inches/sec. An alarm and shutdown shall be provided when vibration exceeds 0.4 inches/sec. Blower system manufacturer to confirm final settings.

3. Blower bearings temperature indication with impending warning and trip functions and levels displayed as digital readouts.

4. Blower “Run” Light (Red)

5. Common Warning Light (Amber)

6. Common Fault Alarm Light (Amber)

7. Motor windings temperature indications with impending warning and trip functions and levels displayed as digital readouts.

8. Inlet butterfly valve position indication with automatic/manual control functions, status monitoring (% open, fault status, available status (power on and in remote)) with % open and set-point displayed as digital readouts.

9. Inlet and discharge air temperature indications with impending warning and trip functions and levels displayed as digital readouts.

10. Inlet filter differential pressure indications with impending warning and trip functions and level displayed as digital readouts.

11. Motor horsepower and amperage displayed as digital readouts (signal from the current transformers).

12. Blower flow rate calculated from motor amperage expressed as SCFM displayed as a digital readout. Inlet air temperature measurement shall be used to compensate for changes in the amperage/SCFM relationship with temperature.

I. Adjustable time delays shall be incorporated to allow uninterrupted motor starts and stops to prevent nuisance shutdowns.

J. All trip functions shall be frozen upon a shutdown so that shutdown status can be determined and the values at shutdown preserved. The PLC shall store and display the 50 most recent shutdown alarms including identification of alarms, time and date of occurrence, and value on trip.

K. The control panel shall be completely pre-wired and tested at the factory by the blower system manufacturer.

L. An as-built diagram of the completed panel shall be encased in plastic inside the panel.

M. Panel layout and wiring diagrams shall be submitted with the submittal drawings.

N. Alarms shall not be annunciated under normal start-up and shut-down conditions.

O. Motor and blower bearing vibration and temperature warning and alarm/shutdown settings and blower inlet/discharge air temperature warning and alarm/shutdown settings shall be as recommended by the Seller (except for inlet air temperature, which will be for indication only).

P. The surge protection system shall prevent surge conditions by use of both motor horsepower and amperage. Adjustable time delays shall be incorporated to prevent nuisance shutdowns. Initial setting for the large blower shall be 715 horsepower (or equivalent current) for overload shutdown and 275 horsepower (or equivalent current) for low horsepower (surge) shutdown. Initial setting for the small blower shall be 600 horsepower (or equivalent current) for overload shutdown and 275 horsepower (or

equivalent current) for low horsepower (surge) shutdown. The Seller shall coordinate the range and calibration information with the installing contractor.

Q. The PLC shall provide a common failure relay output activated by any of the shutdown conditions. Another relay output shall be wired into the motor control circuit in the blower motor starter to shut down the blower.

R. Panel shall be prewired with a master terminal strip to accommodate all inputs and outputs. A UL label is required. Each end of each wire shall be identified by a unique wire number printed on a heat shrunk sleeve marker.

S. All wiring external to control components within the panel shall be multi-strand copper no smaller than 14 gauge with each end properly numbered according to the manufacturer's drawings. Wiring will be done in a professional quality manner and run in covered trays. All wires that attach to door mounted components shall be neatly bundled and tied. All external connections shall terminate on a common terminal strip with at least 20% spare connection points.

2.11 REQUIREMENTS FOR INTERFACE WITH THE PLANT PLC SYSTEM

A. The Seller shall provide source code for all blower control and monitoring programs in printed form and on uploadable media to enable the Purchaser to reload all necessary programming onto a new blower PLC in the event of PLC failure.

B. The Seller shall provide all coordination required for communication of information between the Blower Control Panels and the Plant PLC System. The Seller will make available in separate registers the required digital and analog information to the Plant PLC System through network communication. The Seller shall submit copies of the graphic displays for approval. The existing Plant PLC System shall receive all necessary information from each Blower Control Panel PLC to be able to do the following:

1. Log all monitored points for trend analysis

2. View real time trends

3. View historical information

4. Display graphs and charts

5. Date/time history of alarms including surge

2.12 BLOWER PROTECTION

A. Emergency Stop capability shall be provided at the blower Local Control Station, through the Blower Control Panel, at the motor starter and through the Plant PLC System through a single-click function. Emergency Stop shall de-energize all equipment on the

blower base. The blower will not be permitted to be reset or reactivated until the maintained Emergency Stop has been manually released.

B. The Blower Control Panel shall include protective shutdown interlocks to protect the blower from abnormal operating conditions including:

1. Motor High Bearing/Winding Temperature

2. High Discharge Air Temperature

3. High Motor Horsepower

4. Surge

5. No Run Status Contact Feedback from Starter During Starting

6. Loss of Run Status Contact Feedback from Starter

7. Sequence Failure

8. Motor/Blower High Vibration

9. Pushing Emergency Stop Pushbutton

10. PLC Failure

11. Blower Bearing High Temperature

12. Inlet Throttling Valve Fault or “Not Available”

2.13 BLOWER MACHINE MONITORING PROGRAMS

A. The Blower monitoring programs shall be provided by the Seller in each Blower Control Panel as follows:

1. Monitoring and protection of the blowers from abnormal operating conditions shall be provided through the PLC.

2. Horsepower and current inputs to each PLC shall be from a current transformer provided in the motor starter.

3. Provide monitoring of all analog inputs. The PLC shall shut down the blower if inputs are not within the acceptable range. Hold-out circuitry shall be provided in the PLC programming to prevent shut-down on alarm condition while the blower is being started.

B. The following is a general listing of the minimum data link, analog, CT and RTD inputs to the PLC at each Blower Control Panel. Data link, analog, CT and RTD inputs shall be monitored/displayed at the Blower Control Panel and monitored/logged/displayed through the Plant Distributed PLC System via network communication.

1. Blower RTD Drive-End Bearing Temperature
2. Blower RTD Non-Drive-End Bearing Temperature
3. Blower Inlet Air Temperature
4. Blower Discharge Air Temperature
5. Blower Drive-End Bearing Vibration
6. Blower Non-Drive-End Bearing Vibration
7. Blower Horsepower (from CTs)
8. Blower Amperage (from CTs)
9. Inlet Throttling Valve Position
10. Motor RTD Winding Temperatures
11. Motor RTD Drive-End Bearing Temperature
12. Motor RTD Non-Drive-End Bearing Temperature
13. Motor Drive-End Bearing Vibration
14. Motor Non-Drive-End Bearing Vibration
15. Inlet Filter Differential Pressure

C. The Blower Control Panel PLC shall include programming to report the order in which alarm conditions are received, such that operators can determine the alarm that caused blower shut-down.

D. Discrete inputs to each blower PLC shall include:

1. Blower motor run status (from soft starters)
2. Electrical malfunction alarm (from soft starters)
3. Inlet throttling valve operator in local

4. Inlet throttling valve operator “available” (power on and in remote)

5. Inlet throttling valve operator fault

6. Surge Indication Alarm

E. Discrete outputs from the Blower Control Panel PLC shall include:

1. Blower Start (to soft starter)

2. Blower Stop (to soft starter)

3. Impending surge indication (not a discrete output but displayed on OIU)

F. Analog outputs from the blower PLC shall include:

1. Inlet Throttling Valve Position Set-point (to valve)

G. Discrete and analog inputs to the Blower Control Panel PLCs from the Plant Distributed PLC System shall include, but are not limited to, the following:

1. Blower start command

2. Blower stop command

3. Inlet Throttling Valve Position Set-point

2.14 EQUIPMENT IDENTIFICATION

A. Each blower shall be provided with a substantial stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data (flow in scfm, discharge pressure, speed and design inlet conditions).

2.15 PRESSURE GAUGES

A. Inlet and discharge pressure gauges shall be provided on the suction and discharge of each blower. Vacuum and pressure tap locations shall be selected for stable measurement and accurate evaluation of pressure rise across the blower.

B. The inlet vacuum gauge shall be located upstream of the inlet throttling valve and shall be a bellows gauge with a range of 0-10 inches water vacuum. Scale shall be a 270° arc. Dial size shall be 4-1/2 inches with black phenolic case. Gauge tap shall be 1/4 inch minimum.

C. The discharge pressure gauge shall be a 316 stainless steel bourdon type with a range of 0-20 psi. Scale shall be a 270° arc scale with figure interval every 1 psi and minor

graduations every 0.1 psi. Dial size shall be 4 1/2 inches with black phenolic case. Gauge tap shall be 1/4 inch minimum.

D. Gauges shall have an accuracy of ±1 percent. All gauges shall be by the same manufacturer and meet the requirements of Section 40 73 13 – Pressure and Differential Pressure Gauges except where specified herein.

2.16 EXPANSION AND FLEXIBLE COUPLINGS

A. Discharge filled, single arch expansion joints shall be provided for each blower. Each expansion joint shall be capable of withstanding the vacuum and pressure under all operating conditions and shall be rated for 300°F continuous service. Expansion joints shall provide a minimum of 2-1/4 inches of movement in compression, 1-1/2 inches of elongation, and 1-1/4 inches of lateral movement. Expansion joints shall be Maxi-Joint Style 1101 as manufactured by General Rubber Corporation or equal.

2.17 CHECK VALVES

A. The Seller shall furnish discharge check valves for each blower. Check valves shall be 18-inch nominal size. Check valves shall be a wafer type discharge check valve of the dual, flat-plate type with center hinge, metallic center post, spring or non-spring closure, steel or cast iron body, Viton-B seal, aluminum-bronze plates, Inkonel 600 springs, and rated for temperatures up to 300°F. Check valve shall be Crane Duo Check II, Flexi-Hinge Type 518, or equal. The check valves shall be installed by the installing contractor. The installing contractor shall perform any piping modifications necessary to incorporate the check valve provided by the Seller at no cost to the Purchaser. Check valves shall be installed in the horizontal position.

2.18 INLET THROTTLING AND DISCHARGE ISOLATION VALVES

A. The Seller shall furnish inlet throttling butterfly valves with electric operators and discharge isolation butterfly valves with manual operators for each blower. For large blower, discharge isolation butterfly valve shall be equipped with chainwheel operator. For purposes of estimating quantities, Seller shall assume discharge isolation butterfly valves are installed 10 feet above finished floor; actual height shall be confirmed during shop drawing review. For small blower, discharge isolation butterfly valve shall be equipped with handwheel operator. The Seller shall verify the diameter of the blower inlet throttling valves to guarantee adequate blower control to meet the minimum and maximum flow requirements under the conditions provided in Paragraph 2.02. Unless otherwise required to meet the flow requirements, the inlet throttling valves shall be in the same size as the blower inlet for installation above the blower, direct to the blower suction inlet. Discharge isolation butterfly valves shall be 18-inch nominal size.

B. Valves shall be resilient-seated butterfly valves as specified in Section 40 05 64 – Butterfly Valves. The butterfly valves shall be installed by the installing contractor.

C. Motor actuators shall be provided for inlet throttling valves. Actuators and associated appurtenances shall meet the requirements of specification Section 40 05 57 – Valve Operators and Electric Valve Actuators. Motor actuators for the inlet 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. Installing contractor shall wire 4-20 ma position signals to the PLC.

1. Actuators shall be designed for a maximum differential pressure of 25 psi.

2. Seller shall furnish a NEMA 4X remote control station for each inlet throttling valve to be field located by the installing contractor. Connecting cable between remote control station and motorized actuator shall be furnished. For purposes of estimating quantities, 30ft of connecting cable per actuator shall be assumed and the actual length shall be coordinated during shop drawing review.

3. The inlet throttling valve shall be configured with a minimum percent open position at a setting per the Seller's recommendation in order to avoid surge conditions. The manual controls shall not be capable of overriding the minimum position.

2.19 INLET FILTER AND SILENCER

A. The manufacturer shall provide a combination inlet filter/silencer for each blower as specified herein. Inlet filter/silencers shall be of the free standing, flanged, removable cartridge filter type with attached silencing section capable of a minimum 20 dBA noise attenuation on the midrange octave band (500 to 1000 Hz). Filters shall be constructed of mild steel with polyester powder coated interior and exterior (no liquid or oil-based paint). The filter silencer housings shall be single-stage, cartridge-style, and suitable for outdoor service. Flanges shall be 125# ANSI flange, sized to match the inlet throttling valve for installation direct to the inlet throttling valve. The seller shall include any flanged pipe spools or reducers between blower inlet, inlet throttling valve, and inlet filter/silencer. Spools shall be in same material and pressure ratings as inlet throttling valve and shall include gaskets and hardware.

B. Maximum clean filter pressure drop of the inlet filter/silencer with the elements installed shall not exceed 2-inches WG (0.07 psi) at the design airflow specified in Paragraph 2.02 when measured at the filter silencer outlet. Maximum pressure drop with dirty inlet filters shall be 12-inches WG (0.43 psig) at the design airflow specified in Paragraph 2.02 when measured at the filter silencer outlet. Filter silencer pressure loss rating shall include total restriction, including losses induced by filter housing and filter elements.

C. Filter element face velocity shall not exceed 75 fpm at rated flow, and allowable final differential pressure shall be rated not less than 12-inches WG.

D. Filter medium shall be synthetic, self-supporting, not require a support scrim, and shall not be affected by relative humidity. Filters shall have a minimum efficiency of 98% at

10-micron (nominal). Filter element changes shall not require hand tools and filter element weight shall not exceed 25 lbs. Filter elements shall be cleanable.

E. Filter silencer shall be Endustra Tri-Vent® P09 Series w/ Enduralast® Hi-Flow Synthetic Medium or equal.

2.20 SPARE PARTS

A. The Seller shall submit a list of recommended spare parts with long lead items clearly identified.

B. The Seller shall provide spare parts only for items that will be consumed during startup and testing including sufficient quantities of recommended lubricants.

C. One spare filter element shall be provided for each blower intake filter/silencer.

2.21 PAINTING

A. Blowers, base, and motor shall have prime and finish painting done at the factory using the manufacturer’s premium grade paint specifications. Paint system shall be submitted for approval with the shop drawings. A color chart shall be submitted with the shop drawings for Purchaser selection of color for the blower and motor.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All equipment specified herein shall be installed in accordance with the Seller's instructions and checked by the respective Seller's representative, in conformity with the applicable Sections of this Specification. After installation, the equipment shall be aligned and adjusted as required for proper operation.

3.02 SHOP TEST

A. Factory testing of the blowers and components prior to shop performance tests is required. Impellers shall be statically and dynamically balanced and over-sped to 115% of rated speed. Dimension checks shall be made throughout fabrication.

B. Shop running and performance tests for each blower shall be made by the Seller and certified curves and reports shall be submitted for approval.

C. After approval of preliminary performance tests, each blower shall be factory performance tested in accordance with the most recent edition of the ASME Wire-To-Air Performance Test Code for Blower Systems (PTC-13) and as specified herein. Test results shall be reported in accordance with the same code and as specified herein and the results submitted prior to shipment.

D. Factory performance tests are to be conducted with the job specific motor. Calibrated shop motors are acceptable for the witness test according to the most recent edition of the ASME Power Test.

E. The factory performance tests shall be conducted for each blower to demonstrate compliance with all performance requirements. Performance tests shall include a minimum of six (6) points to determine the blower flow-pressure-horsepower characteristic with inlet valve wide open over the full range of specified conditions. Test points shall include points to define the blower surge limit (with inlet modulating valve wide open). Tolerances allowable in testing shall be as approved by the Engineer.

F. A calibrated torque meter shall measure the shaft input horsepower as per Paragraph 4.35 of the Code to verify shaft power draw measurements. Compressor net delivered flow rate and discharge pressure shall be guaranteed with no negative tolerance. There shall be no other tolerances or measuring uncertainties used in reporting test results (i.e., the tests shall be reported with ±zero percent tolerance).

1. The capacity of the blower shall be defined as per Paragraph 4.26 of the ASME PTC-10 Power Test Code. Specifically, capacity is defined as, "the net rate of flow compressed and delivered, expressed in terms of cubic feet per minute at the prevailing inlet temperature and pressure. It shall be measured in a suitable manner to exclude effectively all external leakage losses from sources such as shaft seals." That is, air flow shall be measured on the discharge side of the compressor at zero percent tolerance.

2. Complete instrumentation layout and manufacturer's information for all instrumentation used during testing shall be submitted including the arrangement and device for flow measurement, conversion tables/graphs, and accuracies over the specified flow range. All test equipment shall be calibrated and certified by an independent test agency no more than twelve (12) months prior to the test date. Certificates shall show the stability of calibration over a period of at least one year per ISO 9001, Paragraph 4.1.1.

3. Velocity vibration versus frequency levels shall be recorded within 10-1,000 and 10-10,000 Hz frequency range.

G. In case of failure of any unit to meet the test requirements, the Seller, at their own expense, shall make such alterations as are necessary and the tests shall be repeated without additional cost to Purchaser until the equipment is satisfactory.

H. The Seller shall prepare and submit test results, performance curves, and all calculations with a statement certifying that shop tests were successfully conducted in accordance with the test requirements and that all specified performance conditions were demonstrated for each blower system. Certified performance curves based on the results of the shop performance test 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, at the actual blower speed for each point. SCFM shall be plotted against pressure at both standard and design conditions, and the curve shall show standard horsepower draw over the range of SCFM flow rates.

I. The Blower Control Panel shall be fully tested prior to shipment, including a test of all alarm and trip functions.

3.03 FIELD TESTS

A. Field running tests shall be conducted by the factory service people with assistance of the installing contractor.

B. Running tests shall be conducted under actual operating conditions for a period of not less than 8 hours for each blower. Running tests shall demonstrate that the blower is free from all objectionable vibration and noise and overheating throughout the entire range of specified operation. Initial running tests shall demonstrate that all instruments, controls, and protective shutdown interlocks function properly.

C. Each blower shall be run for 4 hours at full load and for 4 hours just above surge. Temperature and vibration readings for all monitored points shall be recorded after 4 hours and at the conclusion of the 8-hour run period for the operating blower(s). Any shutdown of the blower(s) during the test periods shall be recorded and the cause noted. Any defects or operating problems found during running tests shall be promptly corrected.

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SECTION 46 00 00
EQUIPMENT GENERAL PROVISIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Seller shall furnish and test all mechanical equipment and all accessories as specified herein 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 Seller shall provide the Purchaser complete and operational equipment/systems. To this end, it is the responsibility of the Seller to coordinate all interfaces with related mechanical, structural, electrical, instrumentation, and control work and to provide necessary ancillary items such as controls, etc., to make each piece of equipment operational as 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 and 43.

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 the specifications.

1.03 ACTION/INFORMATIONAL SUBMITTALS

A. Product Data: Comply with Section 01 33 00 – Submittals Procedures

B. Shop Drawings shall be submitted to the Engineer for all equipment in accordance with 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.

3. Detailed equipment dimensional drawings and setting plans.

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4. Drive and motor data as required by Division 26 Electrical.

5. Information on bearing types and bearing life.

6. Gear box design and performance criteria and AGMA service factor.

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. Any additional information required to demonstrate conformance with the equipment specifications.

12. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

13. Shipment, delivery, handling, and storage instructions.

1.04 CLOSEOUT SUBMITTALS

A. Submit warranty documentation in compliance with:

1. Section 01 33 00 – Submittal Procedures

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. Spare Parts:

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,

1.06 QUALTIY 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. Preliminary field test data

E. Final field test data

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.

1.08 EQUIPMENT WARRANTIES

A. Warranty requirements shall be as specified in 43 11 18 – Multistage Centrifugal Blowers and in the Equipment Contract.

PART 2 – PRODUCTS

2.01 ANCHORS AND SUPPORTS

A. The installing 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 Seller, and suitable templates shall be used by the installing contractor when required in the detailed equipment Specifications.

B. Anchor bolts and fasteners shall be furnished by the installing contractor in accordance with the individual equipment Specifications. All anchor bolts shall be a minimum of 1/2-inch diameter. All anchor bolts, guard bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.

C. The installing contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 6” high and shall be doweled.

D. Pipe sleeves or other means of adjusting anchor bolts shall be provided by the installing contractor where indicated or required. 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 non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps, or chemical grout).

2.02 STRUCTURAL STEEL

A. 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.

2.03 DISSIMILAR METALS

A. All dissimilar metals shall be isolated to the satisfaction of the Engineer.

2.04 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.

2.05 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 unless otherwise noted. If a larger motor is required to meet the specified operating conditions and performance requirements, the Seller shall furnish the larger sized motor and shall upgrade associated electrical components (wires, starters, etc.) at no additional cost to the Purchaser.

2.06 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 the manufacturer's name, year of manufacture, serial number, and principal rating data.

B. Each pump and other 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". 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 until the Engineer has been furnished a certified copy of test results and has notified the Seller, in writing, that the results of such tests are acceptable.

C. A certified copy of the Seller'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 Purchaser/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 Purchaser.

E. Shop testing of electric motors shall conform to:

1. Section 26 05 60 – Low-Voltage Electric Motors

3.02 MANUFACTURER'S FIELD SERVICES

A. The Seller shall arrange for a qualified factory trained Technical Representative 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 Purchaser. 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 Seller 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.

B. 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.

C. For each site visit, the Technical Representative shall submit jointly to the Purchaser, the Engineer, and the installing contractor a complete signed report of the results of his

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.

D. The Seller'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 installing contractor. If equipment or installation problems are experienced, the Seller’s representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Purchaser. 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 as specified in Section 43 11 – Multistage Centrifugal Blowers.

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 Purchaser. 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 Purchaser in writing that his 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 Purchaser until the problems are

corrected and the equipment demonstrates a successful thirty (30) days operating period.

E. 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.

F. The Seller shall notify the Engineer at least 14 days in advance of each equipment test or Purchaser training session.

G. 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.

3.03 INSTALLATION

A. The Seller shall provide written installation manuals prior to installation. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.

B. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.

C. All equipment sections and loose items shall be match-marked prior to shipping.

D. For equipment that requires field alignment and connections, the Seller 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.

E. The Seller 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.

3.04 ALIGNMENT

A. This section 3.04 is to be performed by the installing contractor.

B. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/- 1/16 inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.

C. General Equipment Leveling: Non-rotating equipment shall be set level to +/- 1/16 inch per 10-foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate 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. Grouting

1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.

2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale. Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.

3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.

4. Finishing. Point the edges of the grout to form a smooth 45-degree slope.

5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.

6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.

E. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.

F. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint, and dirt.

G. Assembled equipment shafts shall be set level to .0015 inches per foot of shaft length (+/- .0005 inches) up to a maximum of 0.015 inches for any length shaft unless the manufacturers requirements are more stringent or unless otherwise noted in the equipment specifications. 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.

H. Sprocket and Sheave Alignment. 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.

I. Belt tensioning. Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.

J. 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.

K. Rotating Shaft Alignment

1. Fixtures will be set up on the driver and driven machine, machines shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.

2. Primary alignment method for direct drive machines is when coupled. Uncoupled alignment will be used only when approved by the Engineer.

3. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.

4. Uncoupled machines must be connected so that both shafts turn together without relative motion during alignment.

5. Indicator bar sag will be measured and included for each reverse indicator alignment setup.

6. Reverse Dial Indicator. The final maximum allowable misalignment: vertical and horizontal from the desired targets of .000 inches (for a non-thermal growth machine) or from the given target readings (for a thermal growth machine) must meet BOTH of the following conditions simultaneously: 1/2 the final total indicator reading at each indicator will be no more than shown in the table below AND the final remaining correction at each machine foot be no more than .001 inches of required movement.

Machine Speed (RPM)	Total Misalignment* (inches)
Up to 1800	.002
1800 and greater	.001

* 1/2 indicator reading

3.05 FIELD TESTING

A. All equipment shall be set, aligned, and assembled by the installing contractor in conformance with the manufacturer's drawings and instructions. Submit report certified by the Seller's representative.

B. Preliminary Field Tests, Yellow Tag

1. As soon as conditions permit, after the equipment has been secured in its permanent position, the installing 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. Installing contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's 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 installing 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 his 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.

C. 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 his assigned representative and the Purchaser or his 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 as specified herein.

    b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded.

    c. Recheck alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.

D. Additional field testing recommended by the manufacturer shall be performed at no cost to Purchaser.

E. Until final field tests are acceptable to the Engineer, the Seller shall make all necessary changes, readjustments, and replacements at no additional cost to the Purchaser.

F. 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.

G. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.

H. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Purchaser unless otherwise specified in the individual equipment specifications.

I. Field testing of electric motors shall be in accordance with Section 26 05 60 – Low-Voltage Electric Motors.

3.06 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 Seller by replacements or otherwise.

B. If the Seller fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Purchaser, notwithstanding his

having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Seller to remove it from the premises at the Seller's expense.

C. The Seller shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Purchaser, adjust the contract price to reflect not supplying the specific equipment item.

D. In case the Purchaser rejects said equipment, then the Seller hereby agrees to repay to the Purchaser 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 Purchaser will execute and deliver to the Seller a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the Purchaser obtains from other sources other equipment to take the place of that rejected.

F. Said bill of sale shall not abrogate Purchaser's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.07 PAINTING

A. Seller shall coordinate with installing contractor to ensure all shop coatings are compatible with proposed field coatings.

B. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high-quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.

C. 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.

3.08 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 installing 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 installing 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