Rock River Water Reclamation District
Rockford, Illinois

Bidding Requirements and Contract Forms

for

Cherry Valley Lift Station – Pump 2 and Pump 3 Replacement

Capital Project No. 1911

Bid Doc. No. 19-414

Rock River Water Reclamation District
Rockford, Illinois

Bidding Requirements and Contract Forms
and
General Provisions and Technical Specifications
for
Sanitary Sewer Construction

for

Cherry Valley Lift Station – Pump 2 and Pump 3 Replacement

Capital Project No. 1911

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Section I

Bidding Requirements

Article 1 — Notice to Bidders

The Rock River Water Reclamation District (District) will receive signed, sealed bids for the Cherry Valley Lift Station – Pump 2 and Pump 3 Replacement, Capital Project No. 1911, at the District office located at 3501 Kishwaukee Street, Rockford, Illinois until 11:00 a.m. on August 30, 2019 at which time and place responsive/responsible bids will be publicly opened and read aloud.

The Cherry Valley Lift Station – Pump 2 and Pump 3 Replacement, Capital Project No. 1911, consists of the removal of two (2) existing pumps, motors, and variable frequency drives (VFD's) and installation of two (2) new 400 hp pumps, motors, and VFD's provided by the District. The project includes the demolition of the existing concrete pump/pipe supports, replacement of portions of suction and discharge piping, constructing new pump/pipe supports, electrical, and all other appurtenances as indicated on the plans and in the specifications.

Bidder's attention is called to Article 2 – Instructions to Bidders 3.8 requirements for Statement of Qualifications. Bidder must have a permanent business office within forty (40) miles of the District office at 3501 Kishwaukee Street in Rockford, IL.

All demolition, construction, testing, and restoration shall be completed within one hundred twenty (120) calendar days of receipt of the Notice to Proceed. Liquidated damages shall be $300.00 per calendar day.

Bid documents may be obtained at a cost of $50.00 per set (non-fundable) by contacting the District Engineering Department at 815.387.7660.

Plans and specifications may also be viewed at the offices of the Northern Illinois Building Contractors Association at 1111 S. Alpine Rd, Rockford, IL. For more information, visit the District website at www.rrwrd.dst.il.us.

All construction will be done in accordance with specifications on file with the District, including the *General Provisions and Technical Specifications for Sanitary Sewer Construction* (Current Edition) of the Rock River Water Reclamation District of Rockford.

Each proposal must be accompanied by the District Bid Bond form with an acceptable Bid Security attached, in the amount of ten percent (10%) of the total bid price. This amount is a guarantee that, if the Proposal is accepted, a contract will be entered into and its performance properly secured.

A Mandatory Pre-Bid Meeting for this project will be held on Tuesday, August 20, 2019 at 1:30 p.m. at the Cherry Valley Lift Station, 4020 Barley Ridge Trail, Cherry Valley, Illinois. All Contractors intending to bid on this project must attend this meeting.

The successful bidder will be required to furnish a satisfactory Performance Bond in the full amount of the bid or proposal. No bid shall be withdrawn without the consent of the District for a period of sixty (60) days after the scheduled time of receiving bids.

The District, reserves the right to reject any or all bids, or any part thereof, or to accept any bid or any part thereof, or to waive any formalities in any bids, deemed to be in the best interest of the District.

Dated this 12th day of August, 2019.

BY: Chris Black, Business Manager

Article 2 — Instructions to Bidders

1 General

1.1 Scope and Intent

This section of the contract documents is concerned with furnishing detailed information and requirements for preparing bids to prospective bidders, bidders' responsibility, the preparation and the submission of bids, basis for awarding the contract and other general information concerned with bidding and executing the contract.

1.2 Contradictions

If in the case of apparent contradiction between or among the Contract Documents, the Contract Documents shall be consulted in the following order: Addenda, Agreement, Supplementary Drawings, Instructions to Bidders, Technical Specifications, Plans, District General Provisions and Technical Specifications for Sanitary Sewer Construction. The language in the first such document in which language regarding the conflict, error or discrepancy occurs shall control.

2 Legal Requirements

2.1 Illinois Regulations

1. The undersigned, as Bidder, declares he will comply with prevailing wages in accordance with the Illinois Department of Labor Standards. The State of Illinois requires contractors and subcontractors on public works projects (including Rock River Water Reclamation District) to submit certified payroll records on a monthly basis, along with a statement affirming that such records are true and accurate, that the wages paid to each worker are not less than the required prevailing rate and that the contractor is aware that filing false records is a Class B Misdemeanor.

   The certified payroll records must include the name, address, telephone number, social security number, job classification, hourly wages paid in each pay period, the number of hours worked each day, and the starting and ending time of work each day, for every worker employed on the project. Any contractor who fails to submit a certified payroll or knowingly files a false certified payroll is guilty of a Class B Misdemeanor. Certified payroll reports shall be submitted on standard IDOT forms.

2. Public Act 83–1030 entitled "Steel Products Procurement Act" requires that steel products used or supplied in performance of this contract or subcontract shall be manufactured or produced in the United States with three exceptions.

   The provisions of this Section shall not apply:

   a. Where the contract involves an expenditure of less than $500.

   b. Where the executive head of the public agency certifies in writing that
      i. the specified products are not manufactured or produced in the United States in sufficient quantities to meet the agency's requirements, or
      ii. obtaining the specified products, manufactured or produced in the United States would increase the cost of the contract by more than 10%.

   c. When its application is not in the public interest.

3. Public Act 96-929 (30 ILCS 570) provides that Illinois residents be employed on Illinois public works projects, provided there has been a period of excessive unemployment (5%) in the State of Illinois as defined in the Act; and, further, that Illinois workers are available and capable of performing the particular type work involved.

4. Public Act 99-0933 requires that any party to a contract adopt and promulgate written sexual harassment policies that include, as a minimum, the following information:
    a. the illegality of sexual harassment
    b. the definition of sexual harassment under Illinois State law
    c. a description of sexual harassment, utilizing examples
    d. my (our) organization's internal complaint process including penalties
    e. the legal recourse, investigative and complaint process available through the Illinois Department of Human Rights and the Illinois Human Rights Commission
    f. directions on how to contact the Department and the Commission
    g. protection against retaliation as provided by Section 6-101 of the Illinois Human Rights Act

    Upon request, this information shall be provided to the Illinois Department of Human Rights and the District.
5. With regard to nondiscrimination in employment, the Contractor for this project will be required to comply with the Illinois Fair Employment Practices Commission's Rules and Regulations.
6. The Contractor for this project shall comply with the Occupational Safety and Health Act.
7. The Contractor for this project shall comply with the Federal Drug-Free Workplace Act.
8. Public Act 96-1416 requires the Certification of Clean Construction and Demolition Debris (CCDD) and uncontaminated soil prior to disposal at a CCDD fill site. The Contractor for this project shall comply with Public Act 96-1416 and be responsible for the certifications and any fees associated with the disposal at a CCDD fill site.
    a. In the event that contaminated soil is uncovered on the project, the Contractor shall notify the District immediately. Any extra costs resulting from the presence of contaminated soil shall be evaluated in accordance with District General Provisions & Technical Specs for Sanitary Sewer Construction; General Conditions: Article 5 – Time Provisions and Article 8 – Changes.

2.2 Americans with Disabilities Act

The Contractor for this project will comply with all applicable requirements of the Americans with Disabilities Act of 1990 (ADA). The Contractor will hold harmless and indemnify Rock River Water Reclamation District (District) and their representatives from all:

1. suits, claims, or actions
2. costs, either for defense (including but not limited to reasonable attorney's fees and expert witness fees) or for settlement
3. damages of any kind (including but not limited to actual, punitive, and compensatory damages)

relating in any way to or arising out of the ADA, to which said firm is exposed or which it incurs in the execution of the contract.

3 General Instructions

3.1 Bidder's Responsibility

Bidders are cautioned not to submit proposals until having carefully examined the entire site of the proposed work and adjacent premises and the various means of approach and access to the site, and having made all necessary investigations to inform themselves thoroughly as to the facilities for delivering, placing and handling the materials at the site, and having informed themselves thoroughly as to all difficulties involved in the completion of all the work under this Contract in accordance with its requirements.

Bidders must examine the Plans, Specifications and other Contract Documents and shall exercise their own judgment as to the nature and amount of the whole of the work to be done and for the bid prices must assume all risk of variance, by whomsoever made, in any computation or statement of amount or quantities necessary to complete fully the work in strict compliance with the Contract Documents. The Bidder must satisfy himself by making borings or test pits, or by such methods as he may prefer, as to the character and location of the materials to be encountered or work to be performed. No pleas of ignorance of conditions that exist or that may hereafter exist, or of conditions or difficulties that may be encountered in the execution of the work under this Contract, as a result of failure to make the necessary examinations and investigations, will be accepted as an excuse for any failure or omission on the part of the Contractor to fulfill, in every detail, all of the requirements of the Contract Documents, or will be accepted as a basis for any claims whatsoever for extra compensation or for an extension of time.

The Contractor is responsible for verifying the location of all existing utilities in the project areas.

The Bidder, therefore, shall satisfy himself by such means as he may deem proper as to the location of all structures that may be encountered in construction of the work.

3.2 Addenda and Interpretations

No interpretation of the meaning of the Plans, Specifications, or other Contract Documents will be made to any bidder orally. Every request for such interpretation must be in writing addressed to the Rock River Water Reclamation District, 3501 Kishwaukee Street, Rockford, Illinois. To be given consideration, such request must be received at least five (5) days prior to the date fixed for the opening of bids. Any and all such interpretations and any supplemental instructions will be in the form of written addenda which, if issued, will be sent by email, fax, or certified mail with acknowledgement of receipt requested, to all prospective bidders, at the respective addresses furnished for such purposes, not later than three (3) days prior to the date fixed for the opening of bids. Failure of any bidder to receive any such addenda or interpretation shall not relieve said bidder from any obligation under his bid as submitted. All addenda so issued shall become part of the Contract Documents.

3.3 Laws and Regulations

The prospective bidder is warned that he must comply with all laws of the United States Government, State of Illinois, all ordinances and regulations of the District in the performance of the work under this contract. The Bidder's attention is specifically called to that provision of the General Conditions regarding the rate of wage to be paid on the work.

3.4 Quantities Estimated Only

Bidders are warned that the estimate of quantities of the various items of work and materials, as set forth in the proposal form, is approximate only and is given solely to be used as a uniform basis for

the comparison of bids. The quantities actually required to complete the contract work may be less or more than so estimated, and if awarded a contract for the work specified, the Contractor further agrees that he will not make any claim for damages or for loss of profits or for an extension of time because of a difference between the quantities of the various classes of work assumed for comparison of bids and quantities of work actually performed.

3.5 Form, Preparation, and Presentation of Proposals

For particulars as to the quantity and quality of the supplies, materials and equipment to be furnished, and the nature and extent of the work or labor to be done, prospective bidders are referred to the Contract Documents, which may be examined or obtained at the office of the District.

Each bid will be submitted upon the prescribed proposal form. All blank spaces for bid prices must be filled in, in ink, with the unit or total sum or both for which the proposal is made. If the proposal contains any omissions, erasures, alterations, additions or items not called for in the itemized proposal, or contains irregularities of any kind, such may constitute sufficient cause for rejection of bid. In case of any discrepancy in the unit price or amount bid for any item in the proposal, the unit price as expressed in figures will govern. In no case is the agreement form to be filled out or signed by the bidder.

Bidders may opt to contact the District's Engineering Department at 815.387.7660 to obtain an electronic Proposal form. If used, this form must be attached to the hard copy proposal form and appropriately signed and executed with the bid.

The bid must be verified and be presented on the prescribed form in a sealed envelope on or before the time and at the place stated in the Advertisement for Bids, endorsed with the name of the person, firm or corporation presenting it, the date of presentation, and the title of the work for which the bid is made. If forwarded by mail, the sealed envelope containing the proposal and marked as directed above, must be enclosed in another envelope addressed to Clerk of the Rock River Water Reclamation District, 3501 Kishwaukee Street, Rockford, Illinois, 61109 and be sent preferably by certified mail. The District will not accept facsimile generated bids.

3.6 Bid Security

Each proposal must be accompanied by the District Bid Bond form with an acceptable Bid Security attached, in the amount specified in Article One, Notice to Bidders. This sum is a guarantee that, if the Proposal is accepted, a contract will be entered into and its performance properly secured. The District's Bid Bond Form included in the bid packet must be used. No other Bid Bond form may be substituted.

Within ten (10) days after the opening of bids, the deposits of all but the three lowest bidders will be returned. The deposits of the remaining two unsuccessful bidders will be returned within three (3) days after the execution of the contract, or, if no such contract has been executed, within sixty (60) days after the date of opening bids. The deposit of the successful bidder will be returned only after he has duly executed the contract and furnished the required bond and insurance.

3.7 Affidavit of Compliance

Each proposal must be accompanied by an executed Affidavit of Compliance. A separate Affidavit of Compliance form is enclosed with the Proposal packet. Failure to submit an executed Affidavit of Compliance with the proposal may constitute sufficient cause for rejection of the bid.

3.8 Statement of Qualifications

Each proposal must be accompanied by a Statement of Qualifications certifying that the bidder is registered to do business in the State of Illinois, has a permanent business office within forty (40)

miles of the District office at 3501 Kishwaukee Street in Rockford, IL, and provides documentation that the bidder possesses the appropriate financial, material, equipment, facility and personnel resources and expertise necessary to meet all contractual obligations. The bidder shall document no less than three (3) contracts for sanitary sewer pump stations within the past five (5) years having equal or greater value to the bid being submitted. The District reserves the right to request additional information as needed to evaluate bids prior to making an award.

3.9 Comparison of Proposals

Bids on item contracts will be compared on the basis of a total computed price arrived at by taking the sum of the estimated quantities of each item, multiplied by the corresponding unit prices and including any lump sum bids on individual items, in accordance with the estimate of quantities set forth in the proposal form. Bids on lump sum contracts will be considered upon the basis of the lowest sum bid.

3.10 Acceptance of Bids and Basis of Award

No bidder may withdraw his bid after the scheduled closing time for receipt of bids, for at least sixty (60) days.

The contract will be awarded, if at all, to the lowest responsive, responsible bidder. The Rock River Water Reclamation District also reserves the right to reject any or all bids.

The bidder whose proposal is accepted shall enter into a written contract for the performance of the work and furnish the required bonds and insurance certificate within ten (10) days after written notice by the Engineering Manager of the District has been served on such bidder personally or by mailing a postpaid wrapper to such bidder at the address given in his proposal. If the bidder to whom the contract is awarded refuses or neglects to execute it or fails to furnish the required bond and insurance within five (5) days after receipt by him of the notice, the amount of his deposit shall be forfeited and shall be retained by the District as liquidated damage and not as a penalty. It being now agreed that said sum is a fair estimate of the amount of damages that the District will sustain in case said bidder fails to enter into a contract and furnish the required bond and insurance. No plea of mistake in the bid shall be available to the bidder for the recovery of his deposit or as a defense to any action based upon the neglect or refusal to execute a contract.

3.10.1 Evaluation of Responsiveness

The responsiveness of bidders will be judged on the basis of the completeness of the bid submitted. To be responsive, a Bid must be submitted on the forms provided as part of the Bid Documents and comply with all the requirements of the Instruction to Bidders. Within five (5) business days of the bid opening, the successful bidder must provide an approved Schedule of Values.

3.10.2 Evaluation of Responsibility

To be judged as responsible, the bidder shall:

a. Have adequate financial resources for performance, the necessary experience, organization, technical qualifications, and facilities, or a firm commitment to obtain such by subcontracts;

b. Be able to comply with the required completion schedule for the project;

c. Have a satisfactory record of integrity, judgment, and performance, including, in particular, any prior performance on contracts from the District;

d. Have an adequate financial management system and audit procedures, that provide efficient and effective accountability and control of all property, funds, and assets;

e. Conform to the civil rights, equal employment opportunity and labor law requirements of the Bid Documents.

f. Have satisfactorily completed no less than three (3) sanitary sewer system contracts within the past five (5) years of equal or greater value to the bid being submitted.

3.11 The Rejection of Bids

The District reserves the right to reject any bid if the evidence submitted in the statement of the bidder's qualifications, or if investigation of such bidder fails to satisfy the District that such bidder is properly qualified to carry out the obligations and to complete the work contemplated therein. Any or all proposals will be rejected if there is reason to believe that collusion exists among the bidders. Conditional bids will not be accepted. The District reserves the right to reject any and all bids and to accept the bid which they deem most favorable to the interest of the District after all proposals have been examined and canvassed.

3.12 Insurance and Bonding

Contractor shall provide all necessary insurance and bonds required to complete the project. No more than ten (10) calendar days subsequent to the District's issuance of an award letter, the Contractor shall provide documentation to prove that he has obtained all required insurance and bonds. The District shall be the sole judge as to the acceptability of any such proof.

Contractor shall provide and maintain all insurance and bonds as required by the District.

3.12.1 General

The Contractor shall ensure that:

1. All insurance policies shall be specific to the project.
2. The insurance certificate shall state: This certifies that the insurance coverage meets or exceeds that required for Cherry Valley Lift Station – Pump 2 and Pump 3 Replacement, Capital Project No. 1911.
3. The District shall be named as Additional Insured in all policies; this shall include the Owners Contractors Protective Policy option.
4. All completed operations coverages and bonds shall remain in force for a period of two (2) years following acceptance of the project and completed operations shall stay in force for two (2) years following completion of the project.

3.12.2 Insurance

The Contractor shall, for the duration of the contract and for two (2) years following project acceptance, maintain the following:

1. General Liability: $1,000,000 combined single limit per occurrence for bodily injury, personal injury and property damage. If Commercial General Liability Insurance or other form with a general aggregate limit is used, either the general aggregate limit shall apply separately to this project or the general aggregate limit shall be twice the required occurrence limit. The Contractor shall provide "XCU" coverage.
2. Automobile Liability: $1,000,000 combined single limit per accident for bodily injury and property damage including coverages for owned, hired or non-–owned vehicles, as applicable.
3. Workers' Compensation and Employers Liability: Workers' Compensation limits as required by statute and Employers Liability limits of $500,000 per accident and $500,000 per disease.

4. Umbrella: $2,000,000 per occurrence/aggregate for contracts valued at $500,000 or over, or $1,000,000 for contracts below $500,000. $10,000 is maximum allowable self-retained limit.
5. Errors and Omissions: If the Contractor performs professional services, he shall maintain errors and omissions insurance with a limit no lower than $1,000,000 for the duration of the contract.

The policies shall contain, or be endorsed to contain, the following provisions in the General Liability and Automobile Liability Coverage's:

a. Unless otherwise provided in paragraph "c" of this section, the District, its officers, officials, employees and volunteers shall be covered as additional insureds as respects liability arising out of activities performed by or on insured's general supervision of the Contractor, products and completed operations of the Contractor, premises owned, occupied or used by the Contractor, or automobiles owned, leased, hired or borrowed by the Contractor. The coverage shall contain no special limitations on the scope of protection afforded to the District, its officers, officials, employees, volunteers, or agents.
b. Unless otherwise provided in paragraph "c" of this section, the Contractor's insurance coverage shall be primary insurance as respects the District, its officers, officials, employees, volunteers, and agents. Any insurance or self-insurance maintained by the District, its officers, officials, employees, volunteers, or agents shall be excess of the Contractor's insurance and shall not contribute with it.
c. As an acceptable alternative to provisions "a" and "b" of this section, the Contractor may provide owner's and contractor's protective liability insurance with coverage limits, named insureds, and in conformity with all applicable specifications of this section.
d. Any failure to comply with reporting provisions of the policies shall not affect coverage provided to the District, its officers, officials, employees, volunteers, or agents.
e. The Contractor's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.
f. All Coverages — Each insurance policy required by this clause shall not be suspended, voided, canceled by either party, reduced in coverage, or in limits except after thirty (30) days' prior written notice by certified mail, return receipt requested, has been given to the District.

3.12.3 Best's Ratings

The District shall be the sole judge of whether or not said insurer's ratios are satisfactory. The District's decision shall be final and the District's bidding procedures contain no appeal provision.

1. Alphabetical Rating: For purposes of this Request for Bids, "insurer" shall mean any surety, insurance carrier, or other organization which proposes to provide an insurance policy or bond for the Contractor. No insurer or surety rated lower than "A-, Excellent" in the current *Best's Key Rating Guide* shall be acceptable to the District.
2. Financial Size Rating: Provided an insurer's alphabetical rating is satisfactory, the District will examine said insurer's financial size rating.

    a. If Best classifies the insurer XII or larger, said insurer shall be acceptable to the District.

b. If Best classifies the insurer as smaller than XII, but larger than VI, said insurer shall be submitted to the District's Business Manager and/or the District's insurance consultant for review.

Financial Size ratings less than VII are not acceptable and will disqualify the Contractor.

3.12.4 Performance Bond and Labor & Materials Payment Bond Form

The Contractor shall provide a Performance Bond and Labor & Materials Payment Bond form acceptable to the District. The performance bond shall be for either 100% of the contract price or for the Contractor's unit price times the estimated number of units, as applicable.

This Request for Bids contains a Performance Bond and a Labor & Material Bond form for the Contractor's use.

If the Contractor fails to provide acceptable bonds within the specified time, he shall be in default.

3.12.5 Correction of Contractor's Insurance or Bond Deficiencies

If the District determines that the Contractor's insurance or bond documentation does not conform to these specifications, the District shall inform said Contractor of the non-conformity. If said Contractor fails to provide conforming insurance or bond documentation within five (5) calendar days of the District's deficiency notice, he shall be in default.

3.12.6 Indemnification Clause

Contractor shall protect, indemnify, hold and save harmless and defend the District, its officers, officials, employees, volunteers, and agents against any and all claims, costs, causes, actions and expenses, including but not limited to attorney's fees incurred by reason of a lawsuit or claim for compensation arising in favor of any person, including the employees, officers, independent contractors, or subcontractors of the Contractor or District, on account of personal injuries or death, or damages to property occurring, growing out of, incident to, or resulting directly or indirectly from the performance by the Contractor or subcontractor, whether such loss, damage, injury or liability is contributed to by the negligence of the District or by premises themselves or any equipment thereon whether latent or patent, or from other causes whatsoever, except that the successful bidder shall have no liability for damages or the costs incident thereto caused by the sole negligence of the District.

The indemnification shall not be limited by a limitation on amount or type of damages payable by or for the Contractor or its subcontractor under any employee benefits act including, but not limited, to the Workers Compensation Act.

No inspection by the District, its employees, or agents shall be deemed a waiver by the District of full compliance with the requirements of the Contract. This indemnification shall not be limited by the required minimum insurance coverages in the Contract.

3.13 Tax Exemption

The District is exempt, by law, from paying bidder Federal Excise Tax and Illinois Retailers' Occupational Tax. Therefore, the bidder shall exclude those taxes from his bid. The District's tax exemption number is E9992-3696-06. The bidder shall include all applicable taxes in his bid price.

Article 3

Technical Specifications

SECTION 01000

SUMMARY OF WORK

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. This section summarizes the work covered by the Contract Documents, and defines special conditions peculiar to this project. This section is not intended to be all-inclusive. Contractors should closely review the standard technical specification sections and the plan sheets.

1.2 SUMMARY OF WORK

A. The work for this Contract includes work to be completed at Cherry Valley Lift Station located at 4020 Barley Ridge Trail, Cherry Valley, IL. Work at the existing facility includes modification to existing structural, mechanical, and electrical systems at this location.

B. The work for this project can be generally described as follows:

Demolition: Demolition of the existing Pumps No. 2 and No. 3, including: pump, motors, VFD's, piping, concrete pedestals, and electrical conductors for each. See Contract Drawings for salvage requirements for the removed equipment.

Structural: Installation of new pump/motor support frame and associated piping.

Process Piping and Equipment: Installation of new pumps. Construction of new intake and discharge piping to the new pumps. Connections shall be made to existing piping at locations as shown on the Contract Drawings. Prior to construction of new process piping, the Contract shall remove all debris from the existing pump suction lines that extend into the wet well. See Contract Drawing 30-M-1 for cleaning requirements.

Electrical and Instrumentation: Installation of new motors and VFD's. Installation of new supply power and control wiring from the existing distribution locations to new connections as shown on the Contract Drawings. The electrical and instrumentation work shall also include the replacement of the existing breakers for Pumps No. 2 and No. 3, as well as the integration of the new District supplied VFD's for each pump.

Pump Testing and Startup: Upon installation, the Contractor shall coordinate the inspection and testing of each pump by the manufacturer's representative per Appendix A. Field testing of the installed pumps shall be one at a time with testing including, but not limited to, vibration testing, power monitoring, bearing temperatures, and other testing as listed. Pump Startup Services shall be by the pump manufacturer (Grundfos) as listed in the Appendix A Section and approved submittal.

VFD Commissioning and Startup: Upon installation, the Contractor shall coordinate the inspection and testing of each VFD by the manufacturer's representative per Appendix

B. Startup Services of the installed VFD's shall be one at a time including, but not limited to, verification of proper operation, motor amp and kW at high and low limit speeds, acceleration and deceleration settings, and other testing as listed. VFD Startup Services shall be by the VFD manufacturer (Danfoss) as described in the VFD Technical Specification in Appendix B.

1.3 SEQUENCING OF CONSTRUCTION

A. Pre-Construction Schedules:

The Contractor must submit a proposed construction schedule, shop drawing submittal schedule, and a Schedule of Values per the requirements of Section 01330 – Submittal Procedures. The Schedule of Values must be submitted within five (5) days of the bid opening and will be used for discussion at the pre-construction meeting. The proposed construction schedule is subject to review and approval by the Owner. A proposed schedule shall be submitted within fifteen (15) calendar days of receipt of the Notice to Proceed.

B. Work Impacting Facility Operations

The Contractor must request and receive approval from the Owner before proceeding with any work on existing structures, equipment, or pipelines that may interfere with the Owner's operation of the facility. Such Contractor requests must be made at least fourteen (14) calendar days in advance of work to allow the Owner adequate time to evaluate the request, and to make the necessary accommodations.

C. Construction Sequence Overview

Because the lift station will have to continuously pump wastewater, it will be necessary to stage construction activities so as to not disrupt the overall operation. This will require work on Pump No. 2 to be completed before work can proceed to Pump No. 3.

Possible scenarios for staging of work activities are presented below. If work tasks are required within a certain timeframe these will be so noted. Alternative staging scenarios will be considered for approval if they accomplish the intended goals of completing the work while allowing District's staff to maintain the lift station in continuous operation.

1. The Cherry Valley Lift Station must remain in operation for the duration of construction. Replacement of Pumps No. 2 and No. 3 shall occur sequentially such that a maximum of one (1) pump is out of service at any time. Equipment shutdowns shall be scheduled seventy-two (72) hours in advance with the Plant Operations Supervisor.
2. The District reserves the right to postpone or delay any scheduled work if excessive flows are forecasted.
3. Contractor shall have all materials and tools needed for the new pump equipment installation on-site prior to the start of demolition of the existing pump equipment.
4. Disconnect power from Pump No. 2 motor and remove connections and conduit to pump breaker cabinet per electrical plans and specifications.
5. Remove existing supports for Pump No. 2 per the Contract Drawings. Install the new motor and pump supports per the Contract Drawings.
6. Remove debris from the suction line from the existing 20-inch knife valve to the

end of the pipe in the existing wet well by jetting the line. Access to the wet well for cleaning shall be coordinated with the Owner.

7. Install new Pump No. 2 assembly, including pump, motor, VFD, piping and appurtenances.
8. Provide new wiring to Pump No. 2. See Contract Drawings.
9. Perform pump testing and system startup for Pump No. 2 per the manufacturers' recommendations as outlined in Appendices A and B.
10. When Pump No. 2 installation and startup is complete, repeat steps for Pump No. 3.

1.4 SPECIAL PROVISIONS

A. Section 01640 and 01641 – Owner Furnished Equipment

1. The District has purchased from Grundfos Water Utility, Inc., two (2) Morris Pumps, 7100 Series, vertical, non-clog pumps for the Contractor to install. These pumps will be delivered to the RRWRD Wastewater Treatment Plant, 3333 Kishwaukee St., Rockford IL, by the manufacturer. The Contractor shall be responsible for loading and transporting the pumps to the job site. A copy of the approved Submittals for these pumps, along with the Pump Manufacturer's Checklist for Installation are included in Appendix A.
2. The District has purchased from Gasvoda & Associates, Inc. two (2) VFD's, Danfoss Aqua PHD, for the Contractor to install. These VFD's will be delivered to the site by the manufacturer for the Contractor to unload and install. A copy of the Technical Specifications for the VFD's is included in Appendix B.

B. Equipment Startup and Testing

1. The Pump and VFD Manufacturers are required to conduct equipment testing at startup of each pump as identified in Section 01640 – Owner- Furnished Equipment. Contractor shall be required to coordinate this work with the Pump and VFD Manufacturers.

C. Access to Wet Well for Cleaning of Suction Pipe

1. As noted on the Contract Drawings, the Contractor shall be responsible for removing debris from the existing suction pipes for Pump Nos. 2 and 3. This work must be coordinated with the Owner a minimum of seven (7) days prior to the work commencing. To facilitate this work, it is suggested that it be completed during periods of lower flow (i.e., early morning, late evening).
2. Each side of the wet well can be isolated to minimize the amount of flow entering. The Owner will isolate the appropriate side of the wet well and draw the water level down as far as possible with the existing pumps.
3. The Contractor may need to use portable pumps to lower the level to below the invert of the suction pipes. The water may be pumped up to the influent channel.
4. All debris must be removed from the suction pipes prior to pump startup. Jetting the pipe is one method that can be utilized to clean the pipes. The Contractor may propose a different method of cleaning the pipes for approval by the Owner.
5. The debris removed from the pipe does not have to be removed from the wet well. The Contractor shall be responsible for distributing the debris evenly so that it is not drawn into the pump during startup.
6. It is anticipated that debris may be concentrated adjacent to the suction pipe for Pump No. 2 as it has not been in operation for over 2 years. The Contractor shall be responsible for moving this debris away from the suction pipe so that it is not

drawn into the pump during startup.

1.5 ITEMS OF EMPHASIS

A. Each section of the Specifications may include reference to specific material types and/or specific equipment items. Unless approved by the Engineer, the Contractor will be allowed to furnish only those materials or products listed in the specifications and/or described on the plan sheets.

B. When the word "provide" or "provision" is used herein it shall mean to "furnish and install, complete in place, fully tested as required, with final acceptance by the Owner.

1.6 WORK PERFORMED BY OWNER AND ENGINEER

A. The Owner's project management representative will be provided by the District's Engineering Department. Duties will include review of submittals, determining suitability of Contractor pay requests, liaison with the Contractor's project manager and staff, and providing clarification of the design intent. All Contractor liaisons with the Owner from the site must be channeled through the Owner's representative.

1.7 STAGING AREAS

A. Construction activities shall be limited to the facility site, and any construction limits designated on the Plans.

B. The Contractor must allow District staff access to all operational equipment for pump control and maintenance at all times at the existing facility unless the Owner has expressly given the Contractor approval to do otherwise.

C. The Contractor shall be responsible for protection and safekeeping of materials and equipment stored on site, and locating these items so as not to interfere with facility operations. The Contractor shall also be responsible for protection and safekeeping of the existing structures and equipment at the existing facility.

1.8 INCIDENTAL WORK

A. The bid items represent complete compensation for all work anticipated for the proposed upgrade. Any work shown on the plans or described in the Technical Specification sections for which no specific bid item is provided shall be considered incidental to those bid items which are provided.

B. "Incidental", as used in these documents, means included as part of other work and has no implication regarding size or magnitude.

1.9 UNFORESEEN CONDITIONS

A. During the course of the work, it is anticipated that there will be periods of time when unforeseen conditions will be encountered. These circumstances will require investigative time and consultation by the Engineer, the Contractor and the Owner to make appropriate decisions as to the course of action to be undertaken. This time

will be considered as ordinary "down time" and the Contractor will not be eligible for compensation for this delay.

B. The Owner will make available to Bidders upon request all drawings of the existing site utilities currently in the Owner's possession.

1.10 REQUIRED POSTINGS

A. The Contractor shall comply with all the requirements of Agreement for Project wage rates. It is emphasized that the Contractor shall post wage rates (both State and Federal) in a visible location on the job site.

1.11 SUBMITTALS

A. The Contractor shall be responsible for submitting all product data and shop drawings within forty-five (45) calendar days from receipt of the Notice to Proceed.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

A. Not Used.

END OF SECTION

SECTION 01300

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Coordination and project conditions.
2. Field engineering.
3. Preconstruction meeting.
4. Progress meetings.
5. Definitions

B. Engineer: The Resident Engineer for this project will be the District Engineering Manager or his designee, not Applied Technologies, Inc. No direct contact with the Contractor shall be performed by Applied Technologies, Inc. without prior District approval.

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various sections of the specifications to ensure efficient and orderly sequence of installation of interdependent construction elements.

B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Contract Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.

E. Coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities. Owner will occupy premises throughout the work.

1.3 FIELD ENGINEERING

A. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

B. Maintain complete and accurate log of control and survey work as Work progresses.

1.4 PRECONSTRUCTION MEETING

A. Owner will schedule meeting after the Notice of Award has been issued.

B. Attendance Required: Owner, Contractor, and major subcontractors.

C. Agenda:
1. Distribution and discussion of:
   a. List of major subcontractors and suppliers.
   b. Projected construction schedules, working hours, starting dates, and completion dates.
2. Critical work sequencing, equipment, and manpower requirements.
3. Major deliveries and priorities.
4. Designation and emergency phone numbers of personnel representing parties in Contract.
5. Procedures and processing of:
   a. Field decisions
   b. Submittals
   c. Substitutions
   d. Requests for Proposal
   e. Change Orders
   f. Applications for Payment
   g. Closeout Procedures
6. Procedures for maintaining record documents.
7. Use of premises, including:
   a. Office, work, and storage areas.
   b. Owner's requirements.
   c. Safety measures.
   d. Security.
8. Construction facilities, controls, and construction aids.
9. Temporary utilities.
10. Housekeeping procedures.
11. Scheduling.
12. Procedures for testing.
13. Requirements for start-up of equipment.
14. Inspection and acceptance of equipment put into service during construction period.

D. Owner will prepare record minutes and distribute copies within two (2) days after meeting to participants and those affected by decisions made.

1.5 BI-WEEKLY PROGRESS MEETINGS

A. Contractor shall schedule, conduct, and document bi-weekly progress meetings at times mutually agreeable to Owner. Meetings to be onsite at a mutually agreed upon location.

B. Attendance Required: Job Superintendent, Owner, and major suppliers and subcontractors, as appropriate to agenda topics for each meeting.

C. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems impeding planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

D. Contractor will prepare record minutes and distribute copies within two (2) days after meeting to participants and those affected by decisions made.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

A. Not Used.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
1. Submittal procedures.
2. Construction progress schedules.
3. Proposed products list.
4. Product data.
5. Shop drawings.
6. Samples.
7. Design data.
8. Certificates.
9. Manufacturer's instructions.
10. Manufacturer's field reports.
11. Erection drawings.

1.2 SUBMITTAL PROCEDURES

A. The Contractor shall submit a Submittal Schedule to the Owner within fifteen (15) calendar days after the Notice to Proceed. Schedule submittals to expedite Project, and deliver to Owner at 3501 Kishwaukee Street, Rockford, IL. Coordinate submission of related items. The Contractor shall review the Contract Documents and indicate in the schedule only the submittals that are specifically required to be submitted and reviewed. The Owner will review the schedule and inform the Contractor of any required changes prior to any submittal.

B. The Contractor shall submit for approval detailed shop drawings of all equipment indicated in the shop drawing submittal schedule prepared by the Contractor. No material or equipment shall be delivered to the job site or installed until the Contractor has in his possession the approved shop drawings for that particular material or equipment.
1. The shop drawings shall be completed as described in each individual specification Section.
2. Electronic submittals shall be allowed with the requirement that two (2) paper copies and one (1) electronic copy of the final version be submitted before final completion.

C. Transmit each submittal with a letter of transmittal listing the following information in a clear and legible fashion:
1. Project name
2. Date
3. Name and address of Contractor

4. Name and address of supplier, as appropriate
5. Name of manufacturer, as appropriate
6. Number and title of appropriate specification section
7. Drawing number and detail references, as appropriate
8. Similar definitive information as necessary

D. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.

E. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

F. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

G. Prior to delivery of any material to the job site, and sufficiently in advance of requirements to allow Owner ample time for checking, submit for approval detailed, dimensioned drawings or cuts, showing construction, size, arrangement, operating clearances, performance characteristics and capacity. Each item of equipment proposed shall be a standard catalog product of an established manufacturer and of equal quality, finish and durability to that specified.

1. For each submittal for review, allow fifteen (15) calendar days excluding delivery time to and from Contractor.
2. Failure of the Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension of contract time, and no claim for extension by reason of such default will be allowed.

H. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.

I. Allow space on submittals for Contractor and Owner review stamps.

J. When revised for resubmission, identify changes made since previous submission.

K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

L. Submittals not requested will not be recognized or processed.

1.3 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial schedules within fifteen (15) calendar days of receipt of the Notice to Proceed. If re-submittals are necessary, resubmit required revised data within ten (10) calendar days.

B. Submit revised Progress Schedules during progress meetings, as described in Section 01300.

C. Distribute copies of reviewed schedules to Project site file, Pump and VFD Manufacturers, subcontractors, suppliers, and other concerned parties.

D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

E. Submit a schedule detailing each major portion of Work or operation as it pertains to each Phase of Work, identifying first work day of each week.

F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

G. Indicate estimated percentage of completion for each item of Work at each submission.

H. Submit separate schedule of submittal dates for shop drawings, product data, and samples, and dates reviewed submittals will be required from Owner. Indicate decision dates for selection of finishes.

I. Indicate delivery dates for Owner furnished products.

J. Revisions to Schedules:
1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect, including effect of changes on schedules of separate contractors.

1.4 PROPOSED PRODUCTS LIST

A. Within fifteen (15) calendar days of receipt of the Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.5 PRODUCT DATA

A. Product Data: Submit to Owner for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Submit number of copies Contractor requires, plus three (3) copies Owner will retain. Electronic submittals shall be allowed with the requirement that two (2) paper copies and one (1) electronic copy of the final versions be submitted before final completion.

C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

E. All data is due within forty-five (45) calendar days from receipt of the Notice to Proceed.

1.6 SHOP DRAWINGS

A. Shop Drawings: Submit to Owner for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Electronic submittals shall be allowed with the requirement that two (2) paper copies and one (1) electronic copy of the final versions be submitted before final completion.

1.7 DESIGN DATA

A. Submit for Owner's knowledge.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.8 CERTIFICATES

A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Owner, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Owner.

1.9 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.10 MANUFACTURER'S FIELD REPORTS

A. Submit reports for Owner's benefit.

B. Submit report in duplicate within thirty (30) calendar days of observation to Owner for information.

C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.11 ERECTION DRAWINGS

A. Submit drawings for Owner's benefit.

B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

C. Data indicating inappropriate or unacceptable Work may be subject to action by Owner.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

A. Not Used.

END OF SECTION

SECTION 01400

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
1. Quality control and control of installation.
2. Tolerances
3. References.
4. Testing and inspection services.
5. Manufacturers' field services.
6. Examination.
7. Preparation.
8. Cutting and patching.
9. Special procedures.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REFERENCES

A. For products or workmanship specified by association, trades, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

E. Neither contractual relationships, duties, nor responsibilities of parties in Contract, nor those of Engineer, shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.5 MANUFACTURER'S FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Owner fifteen (15) calendar days in advance of required observations.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

D. Refer to Section 01330 – Submittal Procedures: Manufacturer's Field Reports.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Examine and verify specific conditions described in individual specification sections.

C. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 CUTTING AND PATCHING

A. Employ skilled and experienced installer to perform cutting and patching.

B. Submit written request in advance of cutting or altering elements affecting:
1. Structural integrity of element.
2. Integrity of weather-exposed or moisture-resistant elements.
3. Efficiency, maintenance, or safety of element.
4. Visual qualities of sight exposed elements.
5. Work of Owner or separate contractor.

C. Execute cutting, fitting, and patching, including excavation and fill to complete Work, and to:
1. Fit the several parts together, to integrate with other Work.
2. Uncover Work to install or correct ill-timed Work.
3. Remove and replace defective and non-conforming Work.
4. If necessary, provide openings in concrete floor for penetrations of electrical Work.

D. Execute work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.

E. Cut masonry and concrete materials using masonry saw or core drill. Contractor required to scan floors and walls to avoid penetration of concealed conduit and rebar with coring/cutting activities.

F. Restore Work with new products in accordance with requirements of Contract Documents.

G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.

J. Identify hazardous substances or conditions exposed during the Work to Owner for decision or remedy.

3.3 SPECIAL PROCEDURES

A. Materials: As specified in product sections; match existing with new products and salvaged products for patching and extending work.

B. Employ skilled and experienced installer to perform alteration work.

C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

D. Remove debris and abandoned items from area and from concealed spaces.

E. Prepare surface and remove surface finishes to permit installation of new work and finishes.

F. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to original or specified condition.

G. Refinish existing visible surfaces to remain in renovated rooms and spaces, to original or specified condition for each material, with neat transition to adjacent finishes.

H. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.

I. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Owner for review.

J. Where change of plane of ¼-inch or more occurs, submit recommendation for providing smooth transition to Owner for review.

K. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities:
   1. Temporary electricity.
   2. Temporary lighting for construction purposes.
   3. Temporary ventilation.
   4. Temporary water service.
   5. Temporary sanitary facilities.

B. Construction Facilities:
   1. Field offices and sheds.
   2. Vehicular access.
   3. Parking.
   4. Progress cleaning and waste removal.

C. Temporary Controls:
   1. Security.
   2. Dust control.
   3. Pollution control.

D. Removal of utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

A. Miscellaneous power will be made available to the Contractor by Owner at no cost to the Contractor, subject to the following conditions:
   1. Existing lighting systems may be utilized by Contractor to the extent available. Any necessary additional or temporary lighting systems shall be provided by Contractor at no additional cost to Owner.
   2. Power will be available at 120 Volts, 60 Hz, single phase at convenience receptacles. No 480-volt power will be available.
   3. Electrical power shall be used only in such quantities as will not interfere with Owner's requirements, and care shall be taken not to overload the existing facilities. Contractor shall provide any additional or temporary electrical power or power of other voltages it may require for prosecution of the Work.

B. These provisions shall not be construed as a guarantee by Owner of the uninterrupted continuation of power, and interruptions beyond the control of Owner shall not be reason for claims for additional costs nor for extensions of time. Contractor shall provide, at no additional cost to Owner, any necessary power required for prosecution of the Work during such interruptions.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain lighting for construction operations as necessary.

1.4 TEMPORARY VENTILATION

A. Existing ventilation system may be utilized by the Contractor to the extent available. Contractor shall provide individual gas monitoring equipment for use when working in the lower level of the lift station.

B. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases as necessary during construction operations.

C. Contractor to replace existing HVAC filters if Contractor operations create dust in the indoor spaces.

1.5 TEMPORARY WATER SERVICE

A. Owner will pay for the cost of temporary water service. Limited water is available and will be shut off if abused. Contractor shall exercise measures to conserve resources.

B. Utilize Owner's existing water system, extend and supplement with temporary devices as needed to maintain specified conditions for construction operations.

1.6 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization. Provide proper maintenance of facilities.

1.7 FIELD OFFICES AND SHEDS

A. Construction: Provide portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations with steps and landings at entrance doors as necessary during construction operations.

B. Storage Areas and Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01600. District buildings shall not be used for storage unless approved by the District.

1.8 VEHICULAR ACCESS

A. Use existing driveway for construction traffic.

B. Construction vehicles are not permitted on turf areas without prior approval from the District. Contractor shall repair any damage to existing irrigation system caused by construction vehicles.

1.9 PARKING

A. Project site is located in a residential area. Contractor shall not block resident or emergency vehicle access on public roadways.

B. Use of designated areas of existing parking facilities is not permitted by construction personnel, unless approved by Owner.

C. Do not allow heavy vehicles or construction equipment in parking areas.

D. Mud from Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets, when applicable.

1.10 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

C. Collect and remove waste materials, debris, and rubbish from site on a daily basis and dispose off-site.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.11 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials prior to Final Application for Payment inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

A. Not Used.

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
1. Products.
2. Product delivery requirements.
3. Product storage and handling requirements.
4. Product options.
5. Product substitution procedures.

1.2 PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. All materials shall be new rather than stored or reused materials.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

D. Contractor shall not ship any materials directly to the site from outside sources. All required materials shall be shipped and received at the Contractor's shop and brought to the site as needed by the Contractor.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store all products in weather tight, climate controlled, enclosures in an environment favorable to product.

D. For exterior storage of fabricated products, place on sloped supports above ground.

E. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

H. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

A. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

B. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

C. A request constitutes a representation that Contractor:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
2. Shall provide same warranty for Substitution as for specified product.
3. Shall coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.

D. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.

E. Substitution Submittal Procedure After Contract Award:
1. Submit three (3) copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on the proposer.
3. Owner will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

A. Not Used.

END OF SECTION

SECTION 01640

OWNER-FURNISHED EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Summary
1. Equipment items furnished by the Owner
2. Equipment delivery, unloading, and transport
3. Contractor's responsibility for Owner-furnished equipment
4. Storage
5. Installation and Field Tests
6. Insurance, Guarantee, Manufacturer

1.2 RELATED SECTIONS

A. Section 01641 – Owner Furnished Equipment Installation

1.3 SUMMARY

A. The Owner-furnished equipment and accessories will be provided at no cost to the Contractor. Owner-furnished equipment includes:
1. Centrifugal pumps and appurtenances, supplied by Grundfos, referred to herein as the Pump Supplier.
2. Variable frequency Drives (VFD's) and appurtenances, supplied by Gasvoda & Associates (Danfoss Drive), referred to herein as the VFD Supplier.

B. The Contractor shall be responsible for receiving, unloading, transporting, security, storing, maintaining, installing, coordinating testing, and startup of Owner-furnished equipment. In addition, the Contractor shall be responsible for furnishing and installing all additional and compatible or similar materials and specialty items including gaskets, nuts, bolts, etc., and all other appurtenances not specifically mentioned as being furnished by the Owner, but necessary for a complete and operating system.

1.4 EQUIPMENT ITEMS FURNISHED BY THE OWNER

A. The items listed below represent the Owner-furnished equipment and major accessories. The Contractor may be provided with additional Owner-furnished equipment Manufacturer's Instructions for installation recommendations beyond the details in Section 01641. Contractor shall install Owner-furnished equipment according to the Manufacturer's Instructions and the requirements of Section 01641.

B. Equipment associated with the centrifugal pump system include:
1. Two (2) Morris 7100 NC pumps. Each pump will include the pump, 400 hp motor, and support frame.

2. Instrumentation. Instrumentation provided includes: vibration switches and thermistor systems for each pump system.
3. Refer to Appendix A for a detailed submittal of the pumping equipment.

C. Equipment associated with the VFD system includes
1. Two (2) Danfoss Aqua PHD VFD's and enclosures.
2. Refer to Appendix B for the technical specifications of the VFD's and enclosures.

1.5 CONTRACTOR'S RESPONSIBILITY FOR OWNER FURNISHED EQUIPMENT

A. Contractor's responsibility for Owner-furnished pumps, motors, and accessories shall begin upon Contractor loading of the equipment for transport to the job site from the RRWRD Wastewater Treatment Plant at 3333 Kishwaukee St., Rockford IL. Prior to loading the equipment for transport, the Contractor shall examine all material to determine if all necessary components and equipment are present. Unless otherwise authorized by the Owner, the Contractor shall inspect the equipment prior to loading the equipment at the treatment plant for damaged or missing components. After the equipment is loaded, the Contractor shall have waived his right to an inspection and shall accept full responsibility for the condition of the equipment.

B. Contractor's responsibility for Owner-furnished VFD equipment shall begin upon delivery to the Site. Upon delivery, the Contractor shall examine all material to determine if all necessary components and equipment are present. Unless otherwise authorized by the Owner, the Contractor shall have forty-eight (48) hours after receiving the equipment at the jobsite to inspect the equipment for damaged or missing components. After this period, the Contractor shall have waived his right to an inspection and shall accept full responsibility for the condition of the equipment.

C. Any damaged material discovered after its acceptance by the Contractor shall be the Contractor's responsibility, and replacement parts shall be ordered and purchased by the Contractor at no additional cost to the Owner. Delay to the completion of this contract as a result of the late delivery on the replacement parts shall not be a basis for claim for additional cost or Contract time extension.

1.6 STORAGE AND SECURITY

A. Upon taking the delivery of all Owner-furnished equipment, the Contractor shall provide necessary materials, equipment, and labor to store the equipment at least one foot above grade in a dry location where there is no danger of flooding or exposure to dust. Owner-furnished equipment shall be completely covered to prevent exposure to sunlight, rain, and dust. It is anticipated that Pump No. 2, motor, and associated VFD will be able to be installed in their permanent location upon delivery to the Site. Pump No. 3, motor and accessories will remain at the RRWRD Wastewater Treatment Plant until the Contractor is ready to install it. The Owner will allow the VFD for Pump No. 3 to be stored in the lift station garage until Pump No. 2 is operational and Pump No. 3 can be taken out of service.

B. Providing security for onsite storage of Owner-furnished equipment is the Contractor's sole responsibility. The Contractor shall replace, at no additional cost to the Owner, lost, stolen, or damaged equipment and materials.

C. In addition, Contractor shall follow the System Supplier and equipment manufacturer requirements for storing equipment and materials.

1.7 INSTALLATION AND FIELD TESTS

A. The Contractor shall be responsible for proper installation and coordination of field testing of equipment furnished by the Owner. Contractor shall provide all labor, materials, supplies, and utilities as required for start-up, and shall refer to the testing and startup requirements established included in Appendices A and B. The pump manufacturer shall provide three (3) days of startup service and one (1) day of operator training per the Scope of Supply. The VFD Supplier shall provide one (1) day of startup services per VFD. Additional days of service will be provided at no additional cost to the Owner.

B. The Contractor shall furnish and install all the necessary fittings, supports, grouts, epoxy, electrical and plumbing connections, anchor bolts, mounting hardware, and all other miscellaneous equipment, materials, and specialty items required but not furnished by the Owner, as shown on the drawings and/or in the installation instructions; and shall assemble, install, align, adjust, calibrate, check, test, and start all Owner-furnished equipment and accessories under the direction of the Owner and in accordance with the Manufacturer's Instructions. The Contractor shall verify that the pump, motor, piping, etc. has been installed properly and is plumb/level prior to startup of the equipment.

C. The Contractor shall supply and install all electrical power and control wiring and conduit to the Owner furnished equipment plus interconnection between the Owner-furnished field instruments as required including wire, cable, junction boxes, fittings, conduit, etc.

D. The Contractor shall provide (when not provided by Owner), install, and terminate all motor control centers, motor starters, panels, control panels, instrumentation, transformers, and variable frequency drives (VFDs) as required.

E. The Contractor shall install Owner-furnished equipment as directed by the Manufacturer's Instructions. Contractor shall furnish all materials and appurtenances necessary and recommended by the equipment manufacturer for startup, checkout and operation of the equipment and accessories. Specification 01641 provides information on the general installation procedures for Owner-furnished equipment.

F. The Contractor shall assist the Manufacturers with equipment inspections by providing access, operating the equipment, and providing water as directed by the Manufacturers.

G. The Contractor shall provide all chemicals, lubricants, glycol, oils, or grease and other supplies required for equipment start-up or plant operation.

H. Contractor shall provide temporary utilities and installation assistance to the Pump Manufacturer during installation, including:
   1. Coordination of pump and VFD installation activities to avoid conflicting activities occurring at the same time and place.
   2. Operation of pump and VFD equipment as needed by the Manufacturer. Equipment operation shall not include operation of suction or discharge valves.

I. Following installation, all equipment shall be field tested. The Manufacturers shall provide the services of an authorized Manufacturer's representatives to conduct field

tests and to certify proper installation. The Contractor shall be responsible for coordinating these services. Requests to the Manufacturer for a representative shall be made a minimum of fourteen (14) calendar days before a representative is required.

1.8 GUARANTEE

A. The Contractor shall provide labor warranty for all Owner-furnished equipment. The labor warranty shall include the dismantling of any defective part in the equipment. The warranty period shall be two (2) years from the date of successful startup of the system.

1.9 MANUFACTURER

A. The Manufacturer of the Pump Equipment is Grundfos Water Utility, Inc. The Project Manager is Soheb Momin. Contact at (281)994-2731.

B. The Manufacturer of the VFD's is Danfoss. The Project Manager is John Greaney (Gasvoda & Associates). Contact at (708)774-1456.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

A. Not Used.

END OF SECTION

SECTION 01641

OWNER-FURNISHED EQUIPMENT INSTALLATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pump installation

B. Pump piping connections

C. VFD installation

D. VFD electrical connections

1.2 RELATED SECTIONS

A. Section 01640 – Owner-Furnished Equipment

1.3 SUMMARY

A. The Owner-furnished equipment, described in Section 01640, shall be installed by the Contractor according to the Manufacturer's Instructions and the directions herein. The Contractor shall be responsible for receiving, unloading, transporting, security, storing, maintaining, installing, coordination of testing, and startup of Owner-furnished equipment. In addition, the Contractor shall be responsible for furnishing and installing all additional and compatible specialty items including gaskets, nuts, bolts, etc., and all other appurtenances not specifically mentioned as being furnished by the Owner, but necessary for a complete and operating system.

B. This specification is provided for guidance and information purposes in assembling and installing the Owner-Furnished Equipment. It is intended for use during bidding. Means and methods are not dictated to the Contractor building the system.

C. Contractor shall develop a detailed schedule, in accordance with the requirements of Section 01300, that lists the sequence of work and coordination requirements for the System Suppliers and Contractor to accomplish the installation and start-up of the Owner-furnished equipment.

PART 2 EXECUTION

2.1 PUMP INSTALLATION

A. Scope

1. The pumps and appurtenances are scheduled to be delivered prior to the start of this Contract; therefore, the Contractor shall be responsible for loading and transporting the pumps and appurtenances from the RRWRD Wastewater

Treatment Plant at 3333 Kishwaukee St., Rockford, IL, to the jobsite.

2. The VFD and appurtenances are scheduled to be delivered by November 7, 2019. The Contractor shall be responsible for unloading of the VFD's and appurtenances per the VFD Supplier's instructions such as to protect the integrity and the surface finish of the equipment. The Contractor shall be fully responsible to take all the precautions outlined here.

B. Lifting equipment

1. Use of the Owner's hoist/trolley crane system is at the Contractor's option and risk. The safety and functionality of the equipment is not guaranteed. Any damage to the equipment that occurs during Contractor's use shall be repaired immediately at no cost to Owner. The Contractor shall not be allowed contract time extension as a result of owner equipment failure, regardless of the cause of such equipment failure.
2. The Contractor shall utilize services of properly trained and experienced rigging crew as required to off-load the equipment.
3. The Contractor shall review the project drawings to identify the recommended lifting points by the Equipment Suppliers.

C. Transporting to Job Site

1. Painted surfaces must be protected from damage. All loose equipment shall be loaded in such a manner as to avoid damage to painted surfaces. No chains shall be in direct contact with equipment. Padding shall be used.
2. The Contractor and Owner's authorized person at the jobsite shall inspect and supervise the off-loading of the equipment. The Contractor shall check the bill of lading against the equipment received. If damage has occurred during transit, it shall be noted on the delivery receipt prior to signing acceptance. If damage has occurred, a claim should be filed promptly with the delivery carrier. If excessive damage is found, the Contractor:
   a. Shall not unpack or unload the equipment;
   b. Shall document the extent of the damage with photographs;
   c. Shall contact the Equipment Supplier's representative.
3. Inspection Procedure:
   a. All equipment should be visually examined for damage.
   b. Check the equipment for any signs of breakage, abrasion, shifting or rotation that may have resulted in damage to the paint.
   c. Upon discovering minor or major damage, contact the Equipment Supplier's representative.

D. Unloading

1. The Contractor shall unload the equipment and appurtenances as per the Equipment Supplier's instructions.
2. Unloading shall be accomplished in such a manner as to avoid damage to finished surfaces. Adequate padding may be necessary around the lifting point.

E. Installation

1. The Contractor shall follow all the instructions provided by the Equipment Supplier to install the equipment.
2. Set one pump at a time in proper location. Make sure that the pump is set true and level to plan.

3. Align the pump discharge, discharge piping, and rubber expansion joint with the appropriate connections per the Contract Documents and Pump Supplier's recommendation. Bolt-up snug when alignment is satisfactory. Attach all pipe supports as necessary.
4. Align the suction piping and rubber expansion joint piping with the appropriate connections per the Contract Documents and Pump Supplier's recommendation. Bolt-up snug when alignment is satisfactory. Attach all pipe supports as necessary.
5. When it is determined that complete line up is acceptable, finish bolting both suction and discharge lines.
6. Install and wire pump motor including vibration switches, per manufacturer's instructions.
7. Set the second pump into position and line up effluent/influent piping as previously described. When accomplished, finish the bolt-up.
8. When completely satisfied with installation, bolt to foundation using predetermined anchor bolt hardware.
9. Set one VFD at a time in the proper location and make electrical connections per the Contract Documents and VFD Supplier's recommendation.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

A. Not Used.

END OF SECTION

SECTION 03100

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes formwork for cast-in place concrete, with shoring, bracing, and anchorage; openings for other work; form accessories; and form stripping.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 347 - Guide to Formwork for Concrete.
5. ACI 350 – Environmental Engineering Concrete Structures

B. American Forest and Paper Association:
1. AF&PA - National Design Specifications for Wood Construction.

C. The Engineered Wood Association:
1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

D. American Society for Testing and Materials:
1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

E. West Coast Lumber Inspection Bureau:
1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.3 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing to conform to applicable code requirements; resultant concrete to conform to required shape, line and dimension as indicated on the Drawings.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 350, 347, 301, and 318.

B. For wood products furnished for work of this Section, comply with applicable provisions of AF&PA National Design Specifications for Wood Construction.

1.5 QUALIFICATIONS

A. Design formwork under direct supervision of Professional Structural Engineer experienced in design of this Work and licensed in the State of Illinois.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 01 - Product Requirements

B. Deliver void forms and installation instructions in manufacturer's packaging.

C. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.7 COORDINATION

A. Division 01 - Administrative Requirements

B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

C. After formwork is placed, verify that there is sufficient concrete cover over the reinforcement. If there is insufficient concrete cover, request instructions from Owner.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Plywood: Douglas fir or Spruce species; select sheathing, tight face grade; sound undamaged sheets with clean, true edges.

2.2 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

C. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes required.

2.3 FORMWORK ACCESSORIES

A. Form Ties: Snap-off type, fixed length, cone type, with waterproofing washer, 1 inch back break dimension, free of defects capable of leaving holes larger than 1-1/4 inch in concrete surface.

B. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

C. Corners: Fillet or Chamfer, wood strip type; 3/4 inch x 3/4 inch.

D. Flashing Reglets: Rigid PVC, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

E. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.

2.4 COATINGS

A. Coatings for Aluminum:
1. Conlux:
   a. Primer: Bond Plex 46 or 66 (water-borne urethane).
   b. Top Coat: Epolon Multi-Mil 39 (epoxy polyamide).
2. Sherwin Williams: Topcoat of Heavy Duty Epoxy B67-B60B3 (epoxy polyamide). Note: Self-priming.
3. Benjamin Moore:
   a. Primer: Epoxy Rust-Inhibitive Primer (epoxy polyamide).
   b. Top Coat: Epoxy Enamel (epoxy polyamide).

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 01 - Administrative Requirements

B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.

3.2 EARTH FORMS

A. Earth forms are not permitted.

3.3 INSTALLATION

A. Formwork - General:
1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.

4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
5. Complete wedging and bracing before placing concrete.

B. Forms for "Smooth Finish" Concrete:
1. Use steel, plywood or lined board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

C. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

D. Framing, Studding and Bracing:
1. Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood.
2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Construct beam soffits of material minimum of 2 inches thick.
4. Distribute bracing loads over base area on which bracing is erected.
5. When placed on ground, protect against undermining, settlement or accidental impact.

E. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

F. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

G. Obtain Owner's approval before framing openings in structural members that are not indicated on Drawings.

H. Install fillet and chamfer strips on external corners of beams, columns, walls and slabs.

I. Install void forms in accordance with manufacturer's recommendations.

J. Do not reuse wood formwork more than 3 times for concrete surfaces to be exposed to view. Do not patch formwork.

3.4 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Install water stops continuous without displacing reinforcement. Heat seal joints watertight.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

H. Form Ties:
1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from finished surface of concrete.
3. Leave inner rods in concrete when forms are stripped.
4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.

I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

J. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.

3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
4. Arrange joints in continuous line straight, true and sharp.

K. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Securely anchor embedded items in correct location and alignment prior to placing concrete.
4. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318, Section 6.3.

L. Openings for Items Passing Through Concrete:
1. Frame openings in concrete where shown on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

M. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

N. Screed Supports:
1. For concrete over waterproof membranes and vapor barrier membranes, use cradle, pad or base type screed supports which will not puncture membrane.
2. Staking through membrane is not permitted.

O. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris.

3.6 FIELD QUALITY CONTROL

A. Division 01 - Quality Requirements

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Notify Owner after placement of reinforcing steel in forms, but prior to placing concrete.

3.7 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.8 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads. Forming shall remain in place for at least the minimal time recommended by ACI 347R. In addition, forming for horizontal members such as elevated slabs and beams shall remain in place a minimum of 7 days. In no case shall forming of horizontal members be removed before the concrete has reached at least 70% of its specified design strength.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Repair damage to structure caused by early removal of forming and shoring at no additional cost to Owner.

D. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

E. See Section 03300 for additional requirements.

3.9 ERECTION TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

B. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances specified in ACI 117.

C. Camber slabs and beams 1/4 inch per 10 feet in accordance with ACI 301.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes reinforcing steel bars and reinforcement accessories for cast-in-place concrete.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 318 - Building Code Requirements for Structural Concrete.
3. ACI 350 – Environmental Engineering Concrete Structures
4. ACI SP-66 - ACI Detailing Manual.

B. American Society for Testing and Materials:
1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

C. American Welding Society:
1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

D. Concrete Reinforcing Steel Institute:
1. CRSI - Manual of Standard Practice.
2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

A. Division 01 – Submittals

B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.
1. Coordinate bar splicing and placement with Contractor’s concrete placing schedule and joint locations.
2. Submit with construction joint submittals required in Section 03300.

C. Dowel bar splicer system, reinforcing bar splicer laboratory reports and manufacturer’s product data.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI - Manual of Standard Practice.

1.5 QUALIFICATIONS

A. Welders: AWS qualification within previous 12 months.

1.6 COORDINATION

A. Division 01 - Administrative Requirements

B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars, unfinished.
   1. If reinforcement is to be welded, Deformed Reinforcement: ASTM A706/A706M; 60 ksi yield strength, steel bars, unfinished shall be used.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type or patented system.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic-coated steel or Stainless steel type; size and shape as required for Project conditions.

D. Dowel Bar Splicer: ASTM A615, 60 ksi deformed rebar material; the completed splice shall meet 125% specified yield stress. Use “Dowel Bar Splicer (DB-SAE) and Dowel-In (DI) manufactured by Dayton/Richmond or approved equal.

E. Reinforcing Dowel Epoxy: ASTM C881, Two component, high-solids, epoxy-based anchoring adhesive formulated for optimum performance in both cracked and uncracked concrete. Hilti RE500 V3 by Hilti Corporation; SET-3G by Simpson Strong Tie; P110+ by Powers Fasteners; or approved equal.

2.3 FABRICATION

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice.

B. Fabricate column reinforcement with offset bends at reinforcement splices.

C. Locate reinforcement splices not indicated drawings, at point of minimum stress. Review location of splices with Owner.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
   1. Do not weld crossing reinforcement bars for assembly except as permitted by Owner.

B. Do not field bend bars, including bars partially embedded in concrete, unless indicated.

C. Do not place bars having kinks and bands other than shown on the Approved Shop Drawings.

D. Locate reinforcing to avoid interference with items drilled in later, such as concrete anchors.

E. Reinforcement shall be continuous through construction joints
   1. Reinforcement may be spliced at construction joints provided that the entire lap is placed within one concrete pour.

F. Accommodate placement of formed openings.

G. Space reinforcement bars with minimum clear spacing of one bar diameter, but not less than 1 inch.
   1. Where bars are indicated in multiple layers, place upper bars directly above lower bars.

H. Unless otherwise indicated on drawings, conform to ACI 350 for concrete cover over reinforcement.

I. Minimum concrete cover shall be as follows, unless noted otherwise:
   1. Bars adjacent to unformed surfaces and exposed to earth – 3 inches.
   2. Bars adjacent to formed surfaces and exposed to weather – 2 inches.
   3. Bars adjacent to formed surfaces and not exposed to weather – 1 inch.
   4. Bars, ties, stirrups and spirals located in beams or columns – 1 ½” inches

J. Dowel bar splicer systems may be substituted for dowels at Contractor’s option when approved by Owner.

K. Reinforcing bar splicers may be substituted for lapped splices at Contractor’s option when approved by Owner.

L. Drill and epoxy dowels as shown on the plans. Follow epoxy manufacturer’s recommendation for drill hole size, preparation, cleaning, and applying epoxy. Provide embedment depth as shown on drawings, 6” minimum if not indicated otherwise.

3.2 ERECTION TOLERANCES

A. Install reinforcement within the following tolerances for flexural members, walls, and compression members:

Reinforcement Depth	Depth Tolerance	Concrete Cover Tolerance
Greater than 8 inches	plus or minus 3/8 inch	minus 3/8 inch
Less than 8 inches	plus or minus 1/2 inch	minus 1/2 inch

3.3 FIELD QUALITY CONTROL

A. Division 01 – Quality Requirements

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cast-in-place structural concrete.

B. Equipment pads, thrust blocks, and miscellaneous concrete work.

C. Non-shrink grout, and high precision grout.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 305 - Hot Weather Concreting.
4. ACI 306.1 - Standard Specification for Cold Weather Concreting.
5. ACI 318 - Building Code Requirements for Structural Concrete.
6. ACI 350 - Environmental Engineering Concrete Structures.

B. American Society for Testing and Materials:
1. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
5. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
8. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
9. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
10. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
11. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
12. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
13. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
14. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.

15. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
16. ASTM 1077 - Practice for Laboratories Testing Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation.
17. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
18. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
19. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
20. ASTM D2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

1.3 SUBMITTALS

A. Division 01 - Submittal Procedures

B. Product Data: Submit data on attachment accessories, admixtures, non-shrink grout and high precision grout, and accessories.

C. Furnish submittals in accordance with ACI 301 including mill tests for cement, admixture certification (including chloride ion content), aggregate gradation test results and certification, materials and methods for curing, quality-control program of the concrete supplier.

D. Design Data:
1. Submit concrete mix design for each concrete strength to be used on the project. Submit separate mix designs when admixtures are required for the following:
   a. Hot and cold weather concrete work.
   b. Air entrained concrete work.
2. Identify mix ingredients and proportions, including admixtures.
3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

E. Product Data: Submit data on attachment accessories, admixtures, non-shrink grout and high precision grout, and accessories.
1. High Range Water Reducer: Submit intended use area with product data and mix design.

F. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

G. Provide test data on fly ash for each truck load of fly ash delivered for use on this project, conforming to ASTM C618, including the requirements of Tables 1 through 3 and optional requirements.

H. Test Results:
1. Concrete test results.

2. With each load of concrete delivered, provide duplicate delivery tickets, one for CONTRACTOR and one for ENGINEER, with the following information.
   a. Date and serial number of ticket.
   b. Name of ready mixed concrete plant, operator, and job location.
   c. Type of cement, admixtures, if any, and brand name.
   d. Cement content, in bags/cu yd of concrete, and mix design.
   e. Truck number, time loaded, and name of dispatcher.
   f. Amount of concrete in load, cu yds, delivered.
   g. Maximum size aggregate.
   h. Gallons of water added at job, if any, and slump of concrete after water was added.
   i. Temperature of concrete at delivery.
   j. Time unloaded.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Perform Work in accordance with the standards of the State of Illinois.

C. Plant Certification: Plant or concrete supplier shall comply with requirements of National Ready Mixed Concrete Association (NRMCA) certification plan as regards material storage and handling, catching equipment, central mixer, truck mixers with counters, agitators, non-agitating units, and ticketing system.

D. Concrete Testing: Testing shall be provided by Contractor in accordance with Division 01 and this section.
   1. Test concrete and sample material in accordance with applicable ASTM methods listed below.
      a. Slump: ASTM C143.
      b. Air-Entrainment: ASTM C231.
      c. Compressive Strength Test: ASTM C31 (making and cylinder curing) and ASTM C39 (testing)

E. Approved of use of high range water reducer and non-chloride accelerator shall be used in accordance with manufacturer's recommended dosage range.

F. Evaluation and Acceptance of Concrete Strength:
   1. Evaluation and acceptance of concrete shall be according to ACI 318, Chapter 5 and as indicated herein.
   2. Analysis of compression test results shall be performed according to methods in ACI 214. Overall standard deviation of the test results shall not exceed 600 psi.

G. Acceptance of Structure:

1. All concrete which does not meet the requirements, including strength, dimensional tolerances, appearance, durability of ACI 301 and these specifications is subject to removal at no cost to the Owner.
2. Concrete members cast in the wrong location may be rejected.
3. Formed surfaces resulting in concrete outlines that are smaller or larger than permitted by the tolerances of ACI 117 may be rejected.

H. Hot Weather:
1. Comply with ACI 305
2. Concrete temperature shall not exceed 90° F
3. At air temperatures of 80° F or above, keep concrete as cool as possible during placement and curing.
4. When concrete temperatures are expected to exceed 80° F during curing, water reducing, set retarding admixtures shall be used in accordance with manufacturer's recommendations.

I. Cold Weather:
1. Comply with ACI 306.1
2. Temperature of reinforcement, forms, fillers, and other materials in contact with concrete at time of placement shall not be less than 35° F. Preheat if temperature is below 35° F.
3. Maintain air and forms in contact with concrete sections having a minimum dimension of 12 inches or less at temperatures above 50° F for at least the first three days and at a temperature above 32° F for the remainder of specified curing period
4. Maintain air and forms in contact with concrete in more massive sections at temperatures above 40° F for at least the first three days and at temperatures above 32° F for the remainder of specified curing period

1.6 COORDINATION

A. Division 01 - Administrative Requirements

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement for all hydraulic and below grade structures and sewers: ASTM C150, Type I - Portland type with Fly Ash or Slag or Type II - Moderate Sulfate Resistant.

B. Fine and Coarse Aggregates: ASTM C33.

C. Normal Weight Aggregates: ASTM C33.
1. Coarse Aggregate Maximum Size: 1 1/2 inches in accordance with ACI 318.

D. Water: ACI 318; potable, without deleterious amounts of chloride ions.

2.2 ADMIXTURES

A. Air Entrainment: ASTM C260; Daravair by W.R. Grace; MicroAir by Master Builders; Sika AEA-15 by Sika Corp; or approved equal.

B. Chemical: ASTM C494
1. Type A - Water Reducing; WRDA with Hycol or WRDA-82 manufactured by W.R. Grace or approved equal.
2. Type D - Water Reducing and Retarding; Daratard-17 manufactured by W.R. Grace or approved equal.
3. Type F (or G) - Water Reducing, High Range; Daracem-100 manufactured by W.R. Grace; WRDA-19 manufactured by W.R. Grace; or approved equal.

C. Fly Ash: ASTM C618; Class C or Class F providing increased sulfate resistance equivalent to or better than Type II cement.

D. Slag: ASTM C989; Grade 120; ground granulated blast furnace slag.

2.3 ACCESSORIES

A. Epoxy Bonding Agent:
1. Non-sag type: Concressive Paste (SPL or LPL) by Master Builder, Sikadur 32 Hi-Mod Gel Epoxy Adhesive by Sika Corp; or approved equal.
2. Liquid Type: Concressive Liquid (LPL) by Master Builders; Sikadur 32 Hi-Mod Epoxy Adhesive by Sika Corp; or approved equal.

B. Non-Shrink Grout: For steel column base plates and machine bases under 10 hp. ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 3,000 psi in 72 hours and 7,000 psi in 28 days.

C. High Precision Grout: For machine bases over 10 hp. Premixed compound consisting of metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 5,000 psi in 72 hours and 9,000 psi in 28 days; EMBECO 850 Grout manufactured by Master Builders or approved equal.

D. Concrete repair mortars: One component, polymer-modified, cementitious patching material. SikaRepair 222/223 by Sika Corporation; MasterEmaco S440 by BASF Corporation Construction Systems; Planitop 18 by Mapei Corporation, Patchcrete by Lyons Manufacturing, Inc. or approved equal.

E. Surface Applied Corrosion Inhibitor: Surface applied, impregnating coating for steel reinforced hardened concrete. Shall protect both anodic and cathodic parts of the corrosion cell. Sika FerroGard 903 by Sika Corporation; Mapeshield CI 100 by Mapei Corporation or approved equal.

2.4 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94, Option C.

1. Deliver and complete discharge within 1 ½ hours of commencing of mixing or before 300 revolutions of drum or blades, whichever comes first. This includes revolutions required by transit mix trucks. Limitations may be waived by Engineer if the concrete slump is within the allowable range, after the 1 ½ hours or the 300 revolutions limit is reached, and concrete can be placed without addition of water. In hot weather, time and/or revolutions criteria may be reduced by Engineer.
2. Do not add water on-site unless slump and water-cement ratio, after addition of water, are below the maximums allowed. If water is added on-site, mix concrete at site an additional 30 revolutions.
3. Deliver concrete to site having a temperature not less than 50 degrees F nor greater than 90 degrees F.
4. If high range water-reducing admixture is added on-site, mix concrete at site an additional 85 revolutions of drum after the addition of high range water-reducing admixture.

B. Select proportions for normal weight concrete in accordance with ACI 301 trial mixtures.

C. Provide Structural concrete to the following criteria:

Unit	Measurement
Fly Ash Contents	Maximum 25 percent of cement content, Minimum 15 percent of cement content
Slag Cement Contents	Maximum 50 percent of cement content, Minimum 30 percent of cement content
Compressive Strength (7 days)	2,800 psi
Compressive Strength (28 day)	4,000 psi
Water/Cement (fly ash) Ratio (maximum)	0.45 by weight
Cement plus fly ash (minimum)	525 lb/cubic yard
Aggregate Size (maximum)	1 inch
Air Entrained	4 to 6 percent
Admixture	Water reducing type
Slump	2 to 5 inches

D. Miscellaneous concrete and exterior slabs provide concrete to the following criteria:

Unit	Measurement
Fly Ash Contents	Maximum 25 percent of cement content, Minimum 15 percent of cement content
Slag Cement Contents	Maximum 50 percent of cement content, Minimum 30 percent of cement content

Compressive Strength (7 days)	2,000 psi
Compressive Strength (28 day)	3,000 psi
Water/Cement (slag) Ratio (maximum)	0.49 by weight
Cement plus slag (minimum)	475 lb/cubic yard
Aggregate Size (maximum)	1½ inch
Air Entrained	4 to 6 percent
Admixtures	Water reducing type Macro Fiber Reinforcement 4 lbs/c.y.
Slump	3 to 6 inches

E. Use accelerating admixtures in cold weather only when approved. Use of admixtures will not relax cold weather placement requirements.

F. Use calcium chloride only when approved by the Owner.

G. Use set retarding admixtures during hot weather only when approved by the Owner.

H. Add air entraining agent to normal weight concrete exposed to exterior. On surfaces to receive non-metallic hardener limit air content to 3% or less.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Division 1.

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with Manufacturer’s instructions.

B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, clean holes, insert and grout steel dowels using epoxy bonding agent. Prepare holes and use bonding agent in accordance with Manufacturer's instructions.

C. Remove debris and ice from formwork, reinforcement and concrete substrates.

D. Remove standing water, ice, mud and foreign matter before concrete is deposited.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 301, ACI 318, and ACI 304.

B. Notify Owner a minimum 24 hours prior to commencement of concrete placement operations.

C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.
   1. Cast pipe and other embedded items into concrete as placement progresses. Do not provide block outs unless approved by Engineer.

D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Place concrete continuously between predetermined expansion, control, and construction joints.
   1. Place in lifts not exceeding 24 inches and compact with an internal mechanical vibrator
   2. Do not spread concrete with vibrators.

F. Do not interrupt successive placement; do not permit cold joints to occur.

G. The maximum free drop of concrete, where reinforcing will cause segregation of mix, allowed:
   1. Superplasticized Concrete: 10 ft maximum drop
   2. Other concrete 5 ft maximum drop

3.4 CONCRETE FINISHING

A. Rough Form Finish: Finish resulting directly from formwork for surfaces which will be hidden from view by earth, submergence in water, wastewater or subsequent construction.
   1. Patch honeycombing, stone pockets, form ties, spalls and other irregularities as specified in this section and cure.
   2. Where joint marks or fins on submerged surfaces exceed ¼ inch, grind smooth

B. Smooth Form Finish: Interior concrete surfaces permanently exposed to view, interior surface of tanks exposed to view extending 6 inches below liquid level and concrete surfaces scheduled to be painted.
   1. After removal of forms, patch or point up defects as specified and cure
   2. Grind joint marks and fins smooth with adjacent surface. Remove oil stains and rinse surface.
   3. After grinding and cleaning, dampen concrete and paint entire surface with cement grout. Work cement grout into surface with cork or other suitable float. When grout has set to where it will not be pulled out of holes or depressions, brush off surface with dry burlap or carpet.
   4. Prepare surfaces to be painted in accordance with Division 09 and paint manufacturer's requirements.

C. Prepare surfaces which have other materials applied in accordance with requirements specified in other Sections.

3.5 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.6 PATCHING

A. Allow Owner to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Owner upon discovery.

C. Patch imperfections and repair defective areas in accordance with ACI 301. Use a non-shrink nonmetallic grout.

D. Obtain Engineer's approval of proposed repair techniques and mixes.

3.7 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by Owner.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Owner for each individual area.

3.8 FIELD QUALITY CONTROL

A. Obtain samples of concrete in accordance with ASTM C172. Transport cylinders to an on-site location where they can be stored under conditions affecting concrete they represent without being disturbed for first 24 hrs.

B. Make slump tests daily and when requested by Engineer, in accordance with ASTM C143. Make slump tests from same batch from which strength tests are made.

C. When air-entrained concrete is used, make air content tests daily and when requested by Engineer in accordance with ASTM C231.

D. If measured slump or air content falls outside limits-specified, make check test immediately on another portion of same sample. In event of second failure, concrete shall be considered to have failed to meet requirements of Specifications and will be rejected.

E. Strength test for each class of concrete consists of 4 cured standard cylinders made from composite samples secured from single load of concrete in accordance with ASTM C172. Make compressive strength tests on 1 cylinder at 7 days and 2 cylinders at 28 days. Test results at 28 days shall be average strength of specimens as determined in accordance with ASTM C39. If specimen in test shows manifest evidence of improper sampling, molding or testing, it will be disregarded. Test remaining cylinder if needed.

F. Make strength test for each following condition for each class of concrete.
1. Each day's pour.
2. Each change of source.
3. Each 100 cu yds of concrete poured.

G. Strength level of individual class of concrete is considered satisfactory if the following requirements are met.
1. Average of all sets of 3 consecutive strength tests equal or exceed the specified 28 day compressive strength.
2. No individual strength test falls below the specified 28 day compressive strength by more than 500 psi

H. If analysis of strength tests indicates above requirements are not being met, make immediate adjustments to the mix. Also, if likelihood of low strength concrete is confirmed, make additional tests as required by Engineer to determine the strength of the concrete in-place in the portion of the structure identified with the deficient cylinders. If tests and analysis verify Work in-place is not in conformance with Specifications, Engineer will determine whether or not Work in-place is adequate for the intended use the location. If Work is determined inadequate, Contractor shall follow such remedial or replacement measures which Owner may require. Contractor shall bear costs in connection with testing, engineering analysis, remedial work, and replacements required under terms of this paragraph.

END OF SECTION

SECTION 11000

GENERAL PROVISIONS FOR FURNISHING AND INSTALLING EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. The naming of specific manufacturers in the sections of Division 11 is done to establish a standard base for type and quality. Equipment of comparable type and quality produced by others will be considered acceptable, if offered with satisfactory data under similar operating conditions, on the basis as set forth in the General Conditions and bid proposals and approved by the Owner's Representative.

B. This Section specifies the furnishing and installation of equipment which will be part of this contract. All Divisions of the specification will apply as related work to the equipment. Equipment installation shall include, but not be limited to, leveling and grouting of equipment bases, construction of concrete support pads, supporting of equipment, fastening and securing equipment, welding, testing, painting and other requirements to make a complete installation.

C. Manufacturer supplied equipment controls and related electrical equipment shall meet or exceed the provisions and requirements as set forth in Division 11 - Equipment and Division 16 - Electrical specifications. Unless specifically called out otherwise in the specification sections herein, control of the equipment will be per the requirements of the Process Instrumentation section of Division 16 included under the scope of work of the electrical discipline.

1.2 QUALITY ASSURANCE

A. In addition to individual specification requirements, fabrication and assembly of equipment shall meet applicable standards. Materials for which no detailed specifications are given shall:
   1. Meet the particular industry standard for the materials used.
   2. Meet the specifications of ASTM, ANSI or SAE for metals and plastics for the use intended.
   3. Not be used unless it has previously been used for a like purpose for a sufficient length of time in the field or under field simulated laboratory conditions to demonstrate its successful use.

1.3 WARRANTIES

A. Unless indicated otherwise, all equipment furnished under Division 11 specifications shall be provided with a minimum of two (2) year warranty on all parts and labor with the exception of normal maintenance.

B. The two-year warranty shall start at the time when the equipment is in full use for the intended use per the project design. A warranty start date will be designated in writing as

part of the final completion. Warranty dates will be extended if the equipment is not operating properly.

1.4 SUBMITTALS

A. Submit upon request by the Engineer, the following information after the opening of bids, in duplicate.
   1. Complete descriptive literature and general dimensional and performance data as may be required to form an intelligent opinion of the character of equipment and its space requirement.
   2. Time required by Contractor-supplier from date of Notice to Proceed to complete delivery at job site.
   3. Any other product data to be submitted at this time as called for in the specific equipment specification.

B. Unless indicated otherwise in individual Sections, equipment shop drawing and operation manual submittals shall meet requirements of Section 01330 (Submittals).

1.5 JOB CONDITIONS AND DELIVERY

A. The Contractor shall not ship any materials directly to the site from outside sources. All materials shall be shipped and received at the Contractor's shop and brought to the site as needed by the Contractor.

B. Delivered equipment shall be properly crated or packed, and the Contractor/Supplier shall replace any damaged equipment with new identical equipment.

1.6 PAINTING

A. Factory, field, and touch-up painting shall be covered under the provisions of individual specification sections.

1.7 SPARE PARTS

A. The Contractor/Supplier shall make all necessary arrangements for provision, delivery, and storage of spare parts specified for equipment under direction of Division 11 sections. To the greatest extent feasible.
   1. Spare parts shall be furnished at the time of equipment delivery.
   2. Delivery of spare parts shall be properly stored offsite by the Contractor until delivered to the Owner prior to project completion.

B. All costs for provision of spare parts shall be included in the Contract bid price for the equipment. No additional costs to Owner shall be allowed for provision of spare equipment parts as specified.

PART 2 PRODUCTS

A. Not Used.

PART 3 EXECUTION

3.1 DESIGN OF EQUIPMENT

A. All materials shall be designed to withstand stresses and duty encountered in fabrication, erection and operation. All materials shall be provided as corrosion resistant materials or with suitable protection furnished by the Supplier with corrosion resistant industrial coatings as approved by Engineer.

3.2 FACTORY TESTING

A. Factory testing shall be performed by the respective equipment Manufacturers or designated Representative prior to shipment as specified. Factory testing requirements of the Owner-supplied pumps are included in Appendix A. Factory testing requirements of the Owner-supplied VFD's are included in Appendix B.

3.3 ERECTION AND SUPERVISION

A. During erection, provide services of competent erection Engineer to supervise erection by the Erecting Contractor. This supervision may be waived, if in the opinion of the Engineer, the installation is not of such scope as to require this service.

B. Field testing requirements of the Owner-supplied pumps is included in Appendix A.

C. Field testing requirements of the Owner-supplied VFD's is included in Appendix B.

3.4 INTERFACE WITH OTHER PRODUCTS

A. The Contractor shall coordinate the installation of electrical components and controls specified in Division 11 sections, with work covered in Divisions 15 and 16

END OF SECTION

SECTION 15050

PROCESS PIPING

PART 1 GENERAL

1.1 DESCRIPTION

A. The Contractor shall provide all piping, materials and construction specified in this section per the conditions set forth in Division 1 and Specification Section 11000-General Provisions for Furnishing and Installing Equipment.

B. This Section specifies the process piping to be used on the project. This section does not apply to electrical conduit, HVAC or plumbing piping. Piping included in this section includes:

1. Ductile cast iron (DI) pipe
2. Carbon steel (CS) pipe
3. Stainless steel (SS) pipe
4. Copper tubing
5. Joint restraint

1.2 SUBMITTALS

A. The Contractor shall submit shop drawings, installation instructions, operation and maintenance manuals and printed warranties in accordance with specification Section 01330 - Submittals.

B. Upon request of the Owner, the Manufacturer shall provide 3 certified copies of test and inspection reports covering: description, hydrostatic tests, physical properties, chemical lining and coating analysis of materials furnished.

PART 2 PRODUCTS

2.1 PIPE - GENERAL

A. All process piping shall conform to the diameter shown on the Plans and shall be type and quality as specified herein. Contractor shall field verify required lengths and submit a piping layout diagram prior to installation.

2.2 DUCTILE CAST IRON (DI) PIPE

A. Pipe Standards:

1. Pipe to conform to ANSI A21.51 and AWWA C151 standards for minimum working pressure.
2. All fluid carrying ductile iron pipe shall be provided with cement mortar lining. Pipe wall and cement mortar lining thickness shall be in accordance with ANSI A21.4, AWWA C104 and C15 standards.

B. Joint Standards:
1. Flanged joints shall conform to ANSI 21.15 and AWWA C115 standards, with 125-pound flanges conforming to ANSI B16 and supplied with full-face gaskets. Bolts and nuts shall conform to ASTM A307, Grade B standard, except for installations in classified spaces whereas bolts and nuts shall conform to ASTM A193, Grade B8, Class 1 standard for stainless steel fasteners. Classified spaces shall include the interior of sewage wet wells and sewage treatment tanks, and any space rated as Class 1, Division 1 per the NFPA code.
2. Gaskets shall be provided per the following requirements:
   a. Supply neoprene gaskets if the conveyed fluid (liquid or air) is at or below 150°F.

C. Exposed Piping:
1. Class 53 pipe shall be used for all threaded or flanged piping.
2. Unless otherwise indicated, flanged joint fittings shall be used.

D. Acceptable Manufacturers:
1. Non-grooved end pipe shall be as manufactured by US Pipe, American Cast Iron Pipe Company, or District approved equal.

2.3 CARBON STEEL (CS) PIPE

A. Pipe Standards:
1. Pipe shall conform to AWWA C200 and M11 standards.
2. Pipe 6-inches in diameter or greater, shall be welded or seamless, STD (0.375") or SCH XH, ASTM A53 or A120 standard pipe.
3. Piping shall have minimum wall thickness as follows:

Diameter (inches)	Exposed
12" – 30":	STD (0.375")
32" and larger:	XH (0.500")

4. Pipes shall be unlined.

B. Joint Standards:
1. Minimum 275 psi working pressure rating.
2. Butt-welded joints shall be per AWWA C206 standard.
3. Flanged joints shall be per AWWA C207 standard, Class E steel hub type, with ANSI B16.1 standard 125-pound flange pattern.
4. In all instances, ANSI A21.11 and AWWA C111 standard gaskets shall be furnished to provide resistance to degradation in accordance with the chemical, fluid, or air media conveyed:
   a. Provide standard neoprene gaskets, when conveyed media temperature is < 150°F.

C. Fitting Standards:
1. Unless otherwise designated, fittings shall be full radius, non-metered type.
2. Fittings shall conform to AWWA C208 dimensions.

3. Fittings shall be compatible to pipe with regards to linings, joint type, and coatings.

D. Flanges shall be welded to pipe for connection to other fittings, equipment or other pipes with flanged ends.

E. Exposed Piping:
1. Unless otherwise indicated, welded or flanged end joints shall be used.
2. Standard body fittings required.
3. Fluid piping shall be furnished with factory applied primer paint coating.
4. Mechanical joints allowed as required for equipment connection or pipe setting transition.

2.4 STAINLESS STEEL (SS) PIPE

A. Pipe Standards:
1. All material shall be free of dirt, scale and surface defects.
2. Pipe material to be type 304, 304L, 316 or 317 as called for on drawings, schedules or specified elsewhere.
3. When no type is designated, 304 ELC standard pipe shall be used.
4. Material to conform to AISI specifications and manufactured by domestic producers.
5. Maximum yield strength – 42,000 psi.
6. Finish 2D or better through 8 gage and No. 1 finish for 3/16-inch and heavier.

B. Joint Standards:
1. Connections shall be threaded, NPT joints for all pipe 4-inch diameter and smaller.

C. Fitting Standards:
1. All fittings shall conform to AWWA C208 dimensions.
2. Reducing fittings shall conform to the dimensional standard of the largest end.
3. Fittings shall be compatible to pipe with regards to lining, joint type and finish.

2.5 COPPER TUBING

A. Where not specified as ductile iron, water service pipe shall be hard drawn copper tubing designated for use as water service pipe. It shall be type "K" copper tubing conforming to ASTM B-88 standard.

B. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, drawn temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought- copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
4. Copper, Grooved-End Fittings: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.

2.6 EXTERIOR PAINTING AND COATING

A. For exposed ductile iron (DI) and carbon steel (CS) pipe only, primer coat shall be factory applied, modified polyamidoamine epoxy coating system.

B. Finish color selection for painted piping shall be ANSI 70 Grey.

C. Paint exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.

PART 3 EXECUTION

3.1 GENERAL

A. All piping materials specified shall be installed in accordance with approved shop drawings, as shown on the Plans, and per the recommendations of the Manufacturer.

B. The Contractor shall unload and store pipe and fittings so they will not be chipped, cracked or sustain surface coating damaged. Due to space limitations at the job site, the Contractor may be required to store pipe and fittings offsite until needed. Structurally damaged pipe shall be removed from site and the Contractor shall repair damaged coatings to the satisfaction of the Engineer. Unless otherwise instructed, the Contractor shall touch up coating with a suitable asphaltic varnish, or equal (as applies), to the satisfaction of the Engineer.

C. The Contractor shall install pipe as coordinated to avoid interference with other work.

D. The Contractor shall notify Owner when alternate piping grade and alignment is required. Wherever it is necessary to deflect from a straight line, either in a vertical or horizontal plane, the amount of deflection shall not exceed the piping Manufacturer's recommendations for piping supplied. Where an offset is made by means of bends, all bends shall be secured by means of buttresses or thrust blocks, or, where possible in vertical offsets, by means of metal strapping. The finished offset assembly shall be firmly fixed so that no movement is allowed under the most severe operating conditions.

E. The Contractor shall apply lubricant to all joint seals as recommended by Manufacturer.

3.2 INSTALLATION

A. Exposed Piping:
1. Vertical lines shall be plumb unless otherwise noted on Plans.
2. Piping shall be fitted together and matched to form a smooth and uniform invert. Install couplings and other related provisions as required and recommended by Manufacturer to provide for thermal expansion of piping.
3. Where the pipe is embedded in masonry or concrete or in direct contact with adjoining construction, provide a ½-inch expansion joint around the pipe or a pipe sleeve.
4. Where required, pipe insulation shall be installed on all fittings, valves, unions, and flanges in addition to the pipe. Continue insulation and vapor barrier through penetrations. Provide factory fabricated insert, not less than 6-inches long, of same

thickness and contour as adjoining insulation, between support shield and piping, but under the jacketing, to prevent insulation from sagging.

3.3 JOINT INSTALLATION

A. Field Welded Joints:
1. Comply with the provisions of the latest revisions of applicable ASME Boiler Construction Code, ANSI Code for pressure piping, or such State or Local Code requirements that may supersede these codes;
2. Finished welds shall be uniform in thickness and width, free of slag or flux, with a neat and finished appearance.
3. Unless indicated otherwise, provide not less than three passes with each pass chipped and thoroughly cleaned before next pass is made.

B. Unions and Flanged Joints:
1. Install unions or flanged joints where shown or as specified to permit suitable removal of piping sections for equipment service or as may be required for replacement of valves, traps, strainers, etc., whether specifically shown or not.
2. Use joint restraint and pipe support at changes in process piping direction in accordance with live and dead loads.

C. Threaded Joints:
1. Cut pipe threads true, square, clean and sharp, with burrs or beads reamed out, to leave an unrestricted interior passage.
2. Immediately after metallic joints have been fabricated, the exposed threads shall be painted with rust-inhibitor paint.
3. Pipe joint cements and Teflon tapes shall be used sparingly and applied only on male threads.
4. Pipe screwed into threaded fittings shall seat tightly into the shoulder of the fitting. Joint cement shall be applied sparingly and surplus shall be wiped from piping interior when possible.
5. When tight, the joint must not expose more than two threads.

3.4 PAINTING

A. The Contractor shall finish paint all equipment surfaces not provided with a supplied finish coating, and touch-up all finish coated surfaces, which are not adequately covered or damaged.

PART 4 SCHEDULE

4.1 PROCESS PIPING SCHEDULE

Piping System	Process Wastewater	Site Water
Material	DI: CLASS 53	Copper: Type K
	C.S.: STD or XH	(Hard Drawn)
	S.S.: Sch. 80	S.S.: Braided
Joints	DI: Flanged	
	C.S. Welded or Flanged	Copper: Solder or Threaded
	S.S.: NPT Threaded	S.S.: Threaded
Fluid Temp (F)	70ºF	70ºF

Notes:

1. Flanged connectors are required at all exposed disconnect points, including equipment connections, for ductile iron and carbon steel piping.

END OF SECTION

SECTION 15100

PROCESS PIPING ACCESSORIES

PART 1 GENERAL

1.1 DESCRIPTION

A. The Contractor shall provide all piping accessories, materials and construction specified in this section per the conditions set forth in Division 1 and Specification Section 11000-General Provisions for Furnishing and Installing Equipment.

B. This Section describes the process piping accessory materials, tools, equipment, labor and supervision required to provide complete process piping. This section does not apply to electrical conduit or HVAC or plumbing piping. Interior, exterior, buried and exposed pipe setting materials shall be provided fully compatible with piping, and include:
1. Pipe hangers and supports
2. Fixture supports
3. Thrust blocks
4. Couplings and adapters
5. Expansion joints
6. Painting

C. Process piping accessory materials and products shall comply with the current specifications of latest issue for: ANSI, ASTM, AWWA, CS, and applicable standards.

1.2 SUBMITTALS

A. The Contractor shall submit shop drawings, installation instructions, operation and maintenance manuals and printed warranties in accordance with specification Section 01330 - Submittal Procedures.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. General
1. Metallic piping with flanged, threaded or mechanical joints shall be supported per the following schedule:

Pipe Diameter (in)	Max. Spacing (ft)
Less than 1	6
Up to 2½	8
3 to 4	10
6 to 8	12
10 to 12	14
14 to 18	16
More than 18	18

2. Metallic piping with push-on or bell and spigot connections shall be supported at a maximum spacing of one support at each bell or receiving fitting, or per the above schedule, whichever requires the greater quantity of supports.
3. Plastic or polymer piping shall be supported at a maximum spacing of five (5) feet for pipe diameters less than 2 inches, and at a maximum spacing of six (6) feet for pipes 2 inches or larger.
4. Supports for all piping are to be provided at within five feet of each equipment connection; at all branches or risers; at all floor openings; and at each change in direction of the piping run.
5. All anchors, rods, and inserts installed into concrete shall be fabricated from stainless steel material.
6. All threaded rods and u-bolts are to be stainless steel; galvanized; or cadmium plated as required with fabricated threads treated with rust inhibiting coating.
7. All pipe supports and accessories in contact with wastewater; within two feet of the expected high wastewater level; or located in Class 1 Division 1 classified areas are to be fabricated from stainless steel materials.
8. All pipe supports and accessories exposed to outdoor conditions shall be hot-dipped galvanized after fabrication. Fasteners shall be stainless steel.
9. For non-corrosive or non-classified areas, pipe supports may be provided as plain steel fabrication provided they are finish painted prior to installation of the support or piping.
10. All pipe supports for copper or brass piping, or for pipe materials where galvanic action could occur, will be provided with an appropriate coating and shall be sized to fit the contour of the pipe.

B. Pipe Hangers

1. Pipe hangers shall include rod bolts, clamps, straps, locking nuts, and attachment hardware sized to meet the total load and restraint required.
2. For pipe sizes 2 inches and smaller provide band-type, swivel j-hanger, or adjustable clevis hanger. Band straps shall be minimum ¾-inch wide, 18- gauge strap.

3. For pipe sizes 2½ inches and larger provide adjustable, swivel-type clevis hanger, or adjustable yoke pipe roll.
4. For insulated pipe applications adjustable clevis hangers with galvanized sheet metal shields or pipe roll with saddle shall be used.

C. Upper Attachments
1. Beam clamps shall be used where piping is to be suspended from building steel. C-clamps shall have locknuts and cup point set screws. Restraining straps shall be used to maintain the clamp in position where necessary. Center loaded beam clamps shall be used as required.
2. Cast-in-place concrete inserts shall allow for lateral adjustment and have means for attachment to forms. For continuous concrete inserts channels shall be 12-gauge material and be load rated for 2,000 lbs. per foot. Select channel nuts suitable for strut and rod sizes.
3. Ceiling flanges, side beam connectors/clips, or slotted-hole struts are to be used for suspending support rods from beams, ceilings and walls where surface suspension is required. Assemblies are to be rated for the pipe size indicated. Minimum strut requirement is 1½" x 1½", 12 gauge.
4. For precast concrete applications, evaluation must be made to determine if a backer plate located on the exterior surface with bolt connection will be required to provide additional upper support.

D. Wall Supports
1. Wall brackets are to be used for supporting pipes to a vertical surface. Supports are to include the bracket, pipe anchors, guides and clips if required for suspending support rods. Where lateral adjustment is required the bracket shall be fabricated with a channel or strut horizontal support arm.
2. Investigation of the structural integrity of the wall must be made before suspending loads not specifically indicated as being wall mounted.
3. Light weight brackets for supporting loads up to 750 pounds shall have a minimum material thickness of 3/8-inch.
4. Medium weight brackets for supporting loads up to 1,200 pounds shall be constructed of 2" x 2" angle iron shapes with a minimum material thickness of ¼-inch.

E. Floor Supports
1. Pipe supports from the floor are to be cast-in-place concrete or steel pipe type where vertical adjustment is required.
2. Concrete supports shall be constructed of Schedule 40 PVC pipe forms sized 2 inches larger than the supported pipe; two No. 5 reinforcing bars embedded a minimum of 4 inches into the floor and extending up through the form; 3,000 psi concrete fill; and a shaped concrete top saddle to form to the supported pipe.
3. Steel pipe supports shall consist of base stand; pipe adjuster; and top saddle or anchor. Minimum pipe diameter for base stand shall be 1½-inch and minimum base plate size shall be 8-inch square x ¼-inch thickness; however, both shall be sized based on pipe size to be supported. The pipe adjuster shall provide up to 4½-inch of vertical adjustment. A pipe slide shall be provided where horizontal movement must be accommodated.

F. Pipe Clamps

1. Riser clamps are to be used for supporting and stabilizing vertical pipe runs under a coupling or shear lugs. Steel and bolt sizing is to be based on supported weight conditions.

2.2 FIXTURE SUPPORTS

A. Wall hung fixtures, hanger plates, support arms, or mounting lugs shall be fastened to the wall by full penetration bolts where appearance of the bolts is not objectionable. Exposed hardware shall be chromium plated or finish painted in finished areas.

2.3 THRUST BLOCKS

A. Interior thrust blocks shall be provided as shown on Plans or as to substitute for other support specified as approved. Approval of substitute shall be contingent upon compatibility with structural provisions and suitable equipment access.

2.4 COUPLINGS AND ADAPTORS

A. Unless otherwise indicated, mechanical couplings shall be carefully installed and provide suitable restraint to prevent movement. Unless otherwise required, pipe shall be cut clean with smooth ends such that a space is left between pipe ends of not less than ¼-inch or more than 1-inch. The connected pipe shall be furnished with plain ends smooth and round for a distance of at least 10-inch from each end.

B. Couplings:

1. Provide material and construction to be dielectric compatible.
2. Mechanical joint to join plain end pipe of same outside diameter as Dresser Style 38, Rockwell Type 411, 441, or District approved equal.
3. Mechanical joint to join steel or ductile iron pipe of different outside diameters up to ¾-inch difference as Dresser Style 162, Rockwell Type 413, or District approved equal.
4. Mechanical joint for steel or ductile iron pipe of different outside diameters larger than ¾-inch difference by reducing coupling as Dresser Style 62, Rockwell style 415, or District approved equal.
5. Flanged coupling adaptors shall be used for joining plain end pipe to flanged valves and fittings for steel or cast iron pipe shall be Dresser Style 128, Rockwell Type 913, or District approved equal.
6. Compression couplings shall be allowed to join small diameter pipe, less than 4-inch diameter, as Dresser Style 68, Rockwell type 521, or District approved equal.
7. The expansion couplings used to absorb concentrated pipe movement shall be furnished as required for steel and cast iron pipe as Dresser Style 63, Rockwell Type 611, or District approved equal.

2.5 EXPANSION JOINTS

A. Unless otherwise indicated, flexible connections shall be installed at building expansion joints as required and at connection to all pumps, blowers, and other equipment items which may induce vibration to the piping system. The expansion joints shall allow a minimum of 0.625 inches expansion and 0.25 inches compression.

B. Expansion joints shall be constructed with a filled arch, to eliminate sedimentation of solids in the arch area, and restraint. Tie rod restraint shall be provided with sufficient rod number and strength to restrain the connection at test pressure as required. Unless load requires additional restraint, use a minimum of two (2) 5/8-inch diameter threaded tie rods. Apply rust-inhibitor paint primer as required. The flexible connections furnished shall be manufactured by General Rubber, Proco Products, Metroflex, or District approved equal.

2.6 PAINTING

A. Process pipe accessories shall be supplied cleaned, primed, and finish coated in accordance with the Manufacturer's standard production procedures.

B. The accessory Manufacturer shall clearly identify in shop drawings additional finish coatings to be applied in the field for complete installation.

PART 3 EXECUTION

3.1 GENERAL

A. All piping accessories and materials specified shall be installed in accordance with approved shop drawings, as shown on the Plans, and per the recommendations of the Manufacturer. Unless otherwise noted, the delivery, storage, and erection of equipment shall be done in accordance with Specification Section 11000.

3.2 INSTALLATION

A. Location of inserts, hangers and supports shall be coordinated with the structural work to assure that the structural members will support the intended load. In lieu of separate hangers or supports, the Contractor shall submit for approval a detailed drawing of the type of hanger or support proposed to support multiple pipes.

B. Dielectric unions shall be installed at the junction of all dissimilar piping. Gasket material shall be suitable for the pressure, temperature, and the fluid contained in the piping.

C. Installed piping accessories shall not interfere with the operation or accessibility of doors or windows, shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of any equipment.

D. The weight of the piping shall be supported independently of connected equipment.

3.3 PAINTING

A. The Contractor shall finish paint all equipment surfaces not provided with a Manufacturer supplied finish coating, and touch-up all finish coated surfaces which are not adequately covered or damaged.

B. Accessories to be painted in the field shall be finish coated before installation; and the touch up painted as required.

END OF SECTION

SECTION 15150

VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Valve operators.

B. Chain wheels and guides.

C. Valve tagging requirements.

D. Gate Valves.

E. Ball Valves.

F. Plug Valves.

G. Check Valves.

H. Knife Gate Valves.

I. Special Valves.

1.2 SUBMITTALS

A. Submit shop drawings under the provisions of Section 01330 – Submittals:
1. Identify all submittal data with specified valve type number.
2. Submit a valve schedule, identifying all valves by type number, pipeline, location, joint type, manufacturer, and model or catalog number.
3. Include all valves in a single submittal package. Partial or incomplete submittals will not be reviewed.

PART 2 PRODUCTS

2.1 GENERAL

A. Like items of equipment shall be the end product of one (1) manufacturer.

B. All valves shall be complete with all necessary operating hand wheels, chain wheels, extension stems, worm and gear operators, operating nuts, chains, wrenches, and other accessories that are required for the proper completion of the work included under this section.

C. Valves shall be suitable for the intended service. Renewable parts including discs, packing, and seats shall be of types recommended by valve manufacturer for intended service.

D. Unless otherwise shown, valves shall be the same size as the adjoining pipe.

E. All units shall have the name of the manufacturer and the size of the valve cast on the body or bonnet or shown on a permanently attached plate in raised letters.

F. For the purpose of designating the type and grade of valve desired, a manufacturer's name and list or figure number is given in the following specifications.

2.2 DESIGN FEATURES

A. Brass and Bronze Components:
1. Brass and bronze components of valves and appurtenances that have surfaces in contact with the water shall be alloys containing less than 16 percent zinc and 2 percent aluminum. Approved alloys are of the following ASTM designations: B61, B62, B98 (Alloy A, B, or D), B139 (Alloy A), B143 (Alloy 1-B), B164, B194, B292 (Alloy A), B127, and B584 (Alloy 844).
2. Stainless steel Alloy 18-8 may be substituted for bronze at the option of the manufacturer and with the approval of the Engineer.
3. All gland bolts on iron body valves shall be bronze and shall be fitted with brass nuts.

2.3 VALVE OPERATORS

A. Equip all valves with handwheel operators, which open by turning counter-clockwise, unless otherwise shown or specified.

B. Proportion valve operator as to permit operation of the valve under full operating head with a maximum pull of 80 pounds on the handwheel or crank.

C. Worm and Gear Operators for Manually Operated Valves:
1. Provide a totally enclosed design.
2. Provide a self-locking type to prevent the disc or plug from creeping.
3. Self-locking Worm Gears: One (1)-piece design of AWWA gear bronze material, accurately machine cut.
4. Provide a hardened alloy steel worm, with thread ground and polished.
5. Provide proper lubricant for the reduction gearing.
6. Provide with position indicators to show the position of the valve disc or plug.
7. Paint the hand wheels the same color as the valve and associated pipeline.

2.4 CHAIN WHEELS AND GUIDES

A. Provide Walworth Company, Figure 804; Clow Valve Company, Figure F-5680; DeZurik corporation, Series W or LWG; or District approved equal.

B. Paint chain wheels and guides.

C. Size chains as recommended by the valve manufacturer and to extend within 4 feet of the operating floor.

D. Provide plated chains of the single loop coil or babbitt type.

E. Where chains hang in normally traveled areas, provide appropriate "L" type tie back anchors and locate as directed by the Engineer.

2.5 VALVE TAGGING REQUIREMENT

A. Provide a valve tag for each power or air operated valve.

B. Construction: Fiberglass with embedded lettering.

C. Overall Tag Size: 2-1/2 inch by 4 inch with area to provide two (2) rows of eight (8) ¾-inch high black characters.

D. Tag Color: White and have no border.

E. Valve Character Designations: Provide during shop drawing review.

F. Provide Type 1-39 valve tags as manufactured by W.H. Brady Co.; Allen Systems Inc.; or District approved equal.

G. Attach tags to the operator with self-locking nylon ties such that tie and tag cannot be removed.

2.6 GATE VALVES

A. Gate valves 1-1/2-inches and larger for water service shall be iron body, bronze mounted valves with flanged ends, double disc gate, rising or nonrising bronze stem conforming to AWWA C500. Valves shall be rated 150-pound WOG minimum, and shall be American Darling Valve Company; Ludlow-Rensselaer Valves by Patterson Pump, Inc.; or District approved equal.

2.7 BALL VALVES

A. Ball valves 2 inches and smaller, for general water and air service, shall be bronze, end entry type, one piece with screwed ends, reduced bore ports, Teflon seats, and hand lever operators, rated 150 SWP, 600 CWP. Valves shall be Crane Co. Capri, Cat. No. 9302; NIBCO Figure T-585-70; Stockham Figure No. S-206- BR-R-T; or District approved equal.

B. Ball valves for gas service, shall be bronze, end entry, one piece, rated 150 SWP/600 CWP, with screwed ends, hand lever operators, PTFE seats. Valves shall be AGA certified to 5 psi. Valves 3/4 inch and smaller shall be Nibco GB-1, or equal. Valves 2 inch through 1 inch shall be Nibco T-FP600, or District approved equal.

2.8 PLUG VALVES

A. Plug-type pump check valves shall be furnished complete with operating mechanisms, controls, and accessories for a complete system as specified. Valves shall be of the non-lubricated eccentric type with resilient faced plugs and shall be furnished with end connections as shown on the plans. Flanged valves shall be faced and drilled to the ANSI 125/150 lb. standard.

B. Bodies shall be constructed of ASTM A126 Class B cast iron. Seats shall be a 1/8" welded overlay of not less than 90% nickel. Seat area shall be raised with raised surface

completely covered with weld to ensure that the plug face contacts only pure nickel.

C. Plugs shall be constructed of ASTM A126 Class B cast iron. The plug shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interference between the plug face and body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure. Plug shall be Chloroprene (CR) or resilient facing suitable for the application.

D. Bearings shall have sleeve type metal bearings and shall be of sintered, oil impregnated, type 316 ASTM A743 Grade CF8M. Install 1/8" zerk grease fittings in the upper bonnet and lower body journals.

E. Shaft seals shall be of the multiple V-ring type and shall be externally adjustable and re-packable without removing the actuator or bonnet from the valve while under pressure.

F. Valves shall be rated for 175 psi for sizes from ½-inch to 12-inch and 150 psi for sizes from 14-inch to 72-inch diameter.

G. Cylinder operators shall be of the rack and gear type and shall be enclosed in a cast iron housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the pinion quadrant shall be supported on permanently lubricated bronze bearings.

H. Cylinder tubes shall be fiberglass with molybdenum di-sulfide lining. Interior shall be glass smooth. Piston, cylinder heads and caps shall be cast iron.

I. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque and to provide adjustment to compensate for change in pressure differential or flow direction change. All exposed nuts, bolts, and washers shall be stainless steel.

J. Cylinder actuators shall be sized to operate with 100 psi cylinder pressure at a maximum valve shutoff pressure of 90 psi.

K. Pump check controls shall include the following:

1. Pneumatic 4-way 120 VAC solenoid valve used in automatic open/close operation and shall be of sufficient size to allow fast operation of the pump check valve.
2. Adjustable open and close speed controls capable of matching the pump check valve operation speeds to the requirements of the pump system.
3. Four (4) SPDT proximity switches for open, closed, and intermediate position indication. The intermediate position can be adjusted and can interface with the pump motor controls allowing coordination between the pump shut down sequence and valve closure.
4. Two-way 120 VAC solenoid, fail open, for rapid closure in the event of pumping system failure.
5. Pump check valves shall be as manufactured by DeZurik PEC or District approved equal.

L. Drain cocks, 1-inch and smaller, shall be 125-pound bronze body square- head type with screwed ends and stop, Central United Corp., Milwaukee, WI, Figure 150; or District approved equal.

M. Gauge cocks shall be ¼-inch bronze body valves, hexagon end pattern with tee head and male and female ends, rated for 125-pound SWP. Cocks shall be Lunkeheimer Figure 1180; Crane No. 744; or District approved equal.

PART 3 EXECUTION

3.1 GENERAL

A. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run. Before installing flanged valves, the flange faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseat or replace the gasket, retighten and/or reinstall the nuts and bolts, and retest the joints. Joints shall be watertight at test pressures before acceptance. Thoroughly clean threads of screwed joints by wire brushing, swabbing, or other approved methods. Apply approved joint compound to threads before making joints. Joints shall be watertight at test pressures before acceptance.

3.2 PLACING

A. Where centerline of manually operated valves are over 5.5 feet above the floor line, chain wheel and guide assemblies or chain lever assemblies shall be furnished and installed for operation of the valves, unless otherwise directed by the Engineer.

B. Generally, unless otherwise indicated on the Drawings, all valves installed in horizontal runs of pipe having centerline elevations 4.5 feet or less above the finish floor shall be installed with their operating stems vertical. Valves installed in horizontal runs of pipe having centerline elevations between 4.5 feet and 5.5 feet above the finish floor shall be installed with their operating stems horizontal. If adjacent piping prohibits this, the stems and operating handwheel shall be installed above the valve horizontal centerline as close to horizontal as possible. Valves installed in vertical runs of pipe shall have their operating stems orientated to facilitate the most practicable operation.

3.3 TESTING

A. Valves shall be tested at the same time that the adjacent pipeline is tested. Joints shall show no visible leakage under test. Repair joints that show signs of leakage before final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. Correct any damage caused by the testing.

B. If requested by the Engineer, the valve manufacturer shall furnish an affidavit stating the materials options furnished and/or that he has complied with these and other referenced specifications.

3.4 MANUFACTURERS SERVICES FOR CYLINDER OPERATED VALVES

A. Provide manufacturer's services as follows:
   1. Installation: As required for proper installation.
   2. Operator Training: One (1) full day on site.
   3. Service to Repair Defective Work: Provide during two (2)-year warranty period under the provisions of General Conditions.

END OF SECTION

SECTION 16010

GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 1 shall govern Work under this Section.

1.2 DEFINITIONS

A. The Owner: Rock River Water Reclamation District (RRWRD).

B. The Engineer: Applied Technologies, Inc., Brookfield, Wisconsin.

C. Provide: Furnish, install and wire complete and ready for service.

D. Exposed: Exposed to view in any room, corridor or stairway.

E. Code: National, State and Local Electrical codes including OSHA requirements.

F. NEC: National Electrical Code

G. NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities

H. Signal Voltage: NEC class 1, 2, or 3 remote control, signaling, or power limited circuits.

I. Low Voltage: 50 to 600 volts

J. Medium Voltage: 601 to 35,000 volts

K. High Voltage: 35,001 volts and greater

1.3 STANDARDS AND CODES

A. All work shall be installed in accordance with National, State, and Local codes, ordinances, laws, and regulations. National Codes include, but are not limited to, the NEC and NFPA 820. Comply with all applicable OSHA regulations.

B. All materials shall have a UL or ETL label where a UL or ETL Standard and/or test exists.

1.4 DIMENSIONS AND DEFINITE LOCATIONS

A. The drawings depicting electric work are diagrammatic and show, in their approximate location, symbols representing electrical equipment and devices. The exact location of

such equipment and devices shall be established in the field in accordance with instructions from the Engineer and/or as established by manufacturer's installation drawings and details.

B. The Contractor shall refer to Owner-furnished equipment shop drawings and submittal drawings for all equipment requiring electrical connections to verify rough-in and connection locations.

C. Unless specifically stated to the contrary, no measurement of an electric drawing derived by scaling shall be used as a dimension to work by. Dimensions noted on the electric drawings are subject to measurements of adjacent and previously completed work. All measurements shall be performed prior to the actual installation of equipment.

1.5 DRAWINGS

A. The Contractor shall keep a detailed up-to-date record, of the manner and location in which all installations are actually made, indexing each feeder, pull box and protective device.

B. As Built Drawings - See General Requirements - Division 1.

C. In the event of a conflict between the drawings and specifications, Contractor shall base their bid on the greater quantity, cost or quality of the item in question, unless such conflict is resolved by an addendum.

1.6 SHOP DRAWINGS AND EQUIPMENT BROCHURES

A. Submit to Engineer for review, the manufacturer's shop drawings and/or equipment brochures in accordance with Division 1 for the following:
1. Section 16111 - Conduit
2. Section 16112 - Conduit Fittings
3. Section 16170 - Motor and Circuit Disconnects (Include disconnect overcurrent devices with this submittal)
4. Section 16425 - Low Voltage Switchboard Overcurrent Devices

B. Shop drawings shall be submitted in advance of construction and installation so as to not cause delay in other Contractor's work.

1.7 TESTS AND ACCEPTANCE

A. The operation of the equipment and electrical systems does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.

B. After the work is completed and prior to acceptance, the Contractor shall conduct the following tests, tabulate data, date, sign and submit to the Engineer:
1. Standard megger insulation test on each feeder that was added or modified.

C. Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction. The Contractor shall demonstrate that all work is complete and in perfect operating condition, with race way and conduit system properly grounded, all wiring free from grounds, shorts, and that the entire installation is free from any physical defects.

D. In the presence of the Engineer and the Owner, the Contractor shall demonstrate the proper operation of all miscellaneous systems.

E. Perform other tests as specifically directed in other sections of the specification for specific equipment.

1.8 IDENTIFICATION

A. All switchboards, panelboards and 480V control panels, shall include a warning label indicating the risk of Arc Flash. The warning label shall comply with N.E.C. article 110.16 and O.S.H.A. 29.

B. New junction and pull boxes shall be stenciled as follows:
1. Lighting and power feeders and branch circuits - 120, 208, 240, 277, and 480V.
2. Instrumentation & Control - I&C

C. Branch wiring shall be color coded per industry standards. Where wires of different systems junction in a common box each cable shall be grouped with its own system and identified using tags or identification strips.

D. On all 3 phase systems, each phase shall be identified at all terminals using code marker.

E. All cover plates for control stations controlling remote equipment shall be engraved to identify the device being controlled.

F. All motor starters, remote control stations, etc., shall be identified with engraved lamecoid nameplates fastened to the equipment with escutcheon pins. Nameplates shall be 1/8" 5 ply lamecoid with 1/2" black letters on a white background. Adhesive cloth labels, similar to those manufactured by Brady Label Co., may be used on motor switches and controls only, indicating the number, designation, size and usage of the motor.

G. Refer to individual specification sections for more specific or additional identification requirements.

1.9 HAZARDOUS AREAS

A. NFPA 820 identified NEC-Area Electrical classifications. The Contractor shall provide material and installation in compliance with this national standard.

B. All sanitary sumps and wastewater wet wells have a CLASS 1, DIVISION 1 area rating. Contractor shall provide material and installation labor accordingly.

1.10 FIRESTOPPING

A. Openings in fire rated construction and annular spaces around conduits, cable trays, and other penetrating items shall be protected in accordance with NEC article 300-21 and in accordance with the Wisconsin Administrative Code, Department of Commerce Chapter 51.049. The fire rating of the protective seal shall be at least that of the floor or wall into which it is installed, so that the original fire rating of the construction is maintained.

B. Firestopping materials shall include, but not be limited to, mortars, sealants and caulks, putties, collars, intumescent wrap strips mastics, and firestop pillows. All materials and methods used shall be recognized by an independent testing agency and shall have flame and temperature ratings assigned by that agency.

C. Materials using solvents or those requiring hazardous waste disposal shall not be used.

D. All wall or floor penetrations openings shall be as small as possible.

E. All openings and annular spaces required by code to be protected, shall be protected whether specifically indicated on the plans or not.

F. The firestop assemblies shall meet ASTM E-814 and all of the fire test and hose stream test requirements of an independent testing agency.

G. Installation of materials and assemblies shall be in strict accordance with the manufacturer's instructions.

H. Acceptable Manufacturers
   1. 3M Corporation.
   2. Nelson Firestop Products
   3. Rectorseal Corporation

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

A. Not used.

END OF SECTION

SECTION 16040

ELECTRICAL DEMOLITION AND ALTERATIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work in this Section.

1.2 JOB CONDITIONS

A. The existing pump station shall remain in service during construction. Power outages and interruptions in building systems shall be held to a minimum and shall be done at a time convenient to and agreed to by the Owner. The time of all outages shall be scheduled with the Owner and all other trades affected by the outage at least ten (10) working days in advance. All demolition work shall be scheduled at periods and times acceptable to the Owner.

B. Prior to demolition or alteration of structures, the following shall be accomplished:
   1. Owner release of such structure.
   2. Disconnection of electrical power to equipment and circuits removed or affected by demolition work.
   3. Electrical services rerouted or shut off outside area of demolition.
   4. Coordinate sequencing with Owner and other Contractors.
   5. Survey and record condition of existing facilities to remain in place that may be affected by demolition operations. After demolition operations are completed, survey conditions again and restore existing facilities to their pre-demolition condition.

C. Contractor shall properly dispose of all obsolete material.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 MODIFICATIONS

A. Feeders, branch circuits, and other system wiring which are to remain in service but which are presently routed through areas being demolished shall be rerouted around demolition area.

B. Wall penetrations, which served conduits being removed, shall be patched to match existing finish.

3.2 REMOVAL

A. Electrical equipment in conflict with construction shall be removed or relocated as indicated on drawings, as directed, or required.

B. Remove or relocate: Conduit, wire, boxes, fixtures that are in the way of construction.

C. Reconnect circuits and equipment to be continued in service.

D. Provide temporary wiring to any equipment that is to remain in operation during demolition and whose power would be interrupted as a result of demolition.

E. Remove electrical equipment released from service as a result of construction or as indicated on drawings.

F. Do not reuse removed electrical equipment except as specifically directed on the drawings.

G. Where the plans require existing equipment to be removed or relocated, removal shall include all equipment associated with the device. Associated equipment shall include but not be limited to coverplates, backboxes, conduit, fittings, de-energized conductors, etc. In instances where a device is removed but active conductors remain in the backbox and the box is mounted in a wall which is remaining, the backbox may remain and a blank coverplate provided. If removal of the box is specifically indicated on the plans the active conductors shall be intercepted at convenient, accessible locations and rerouted to allow existing box to be removed. When boxes are removed from existing walls which will remain, it shall be the Contractor's responsibility to fill in openings, sand as required flush with adjacent surfaces, and paint to match existing. The Contractor shall be responsible for final finish work unless specifically indicated otherwise on the plans.

3.3 DISPOSAL

A. Dispose of equipment that is removed unless specifically indicated on the drawings.

B. Raceway, conductors, boxes, cabinets and supporting devices shall become the property of the Contractor and shall be removed from the site and disposed of by the Contractor.

C. The Contractor shall tour demolition areas with the Owner to determine the status of all other equipment to be removed during demolition. All equipment that is to be salvaged for reuse by the Owner shall be removed by the Contractor and transported to an Owner designated onsite storage area. The Owner shall be responsible for removal of salvaged equipment from the storage area.

3.4 ALTERATIONS

A. The Contractor shall be responsible for work of other trades to facilitate installation of electrical work in the existing building.

B. Work required by Electrical Contractor which is normally performed by other trades shall be done under direction and at the expense of Electrical Contractor.

END OF SECTION

SECTION 16111

CONDUITS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide conduit systems for all power, control, and communications systems wiring as specified. Flexible, modular wiring systems shall not be used unless expressly accepted by the Engineer.

1.3 QUALITY ASSURANCE

A. National Electrical Contractor's Association (NECA) Standard of Installation.

B. National Electrical Code (NEC) Including State of Illinois and local supplements.

PART 2 PRODUCTS

2.1 GALVANIZED RIGID CONDUIT (GRC)

A. Manufactured lengths, full weight, heavy wall, rigid steel conduit, protected inside and out by hot-dipped galvanized or electro-galvanized coating.

B. Minimum conduit size shall be 3/4 inch.

2.2 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Galvanized spiral strip flexible steel.

B. Standard conduit sizes.

C. Heavy wall sunlight resistant PVC jacket.

D. Minimum size 3/4 inch.

2.3 GENERAL

A. Interior conduits for wiring systems rated 50 to 600 volts shall be galvanized rigid conduit (GRC). Exceptions to the requirements stated above are as follows:
1. Conduits for feeder conductors shall be GRC regardless of conduit size.
2. Flexible conduit where required by other paragraphs in this section.

2.4 PROCEDURES AND PRACTICES

A. Where allowed, the general installation requirements are as follows.
   1. Raceways shall be routed horizontally along the corners of walls and ceilings, directly above edges of base molding at floors, or along the tops of window and door frames.
   2. Raceways shall be routed vertically along corners of adjacent walls and along the edges of window and door frames.
   3. Raceways shall not be routed down or across open wall surfaces except in portions of runs not exceeding 12" in length.
   4. Raceways shall be painted to match wall finishes, in finished spaces.
   5. Fittings and boxes used with raceways shall be specifically designed and approved for use with the raceways.
   6. Raceways may not be routed on or across finished floors.

B. All conduit in unfinished spaces shall be surface mounted (conduit routed in block or poured walls is not permitted). For general installation requirements, refer to item numbers 1 through 6 directly above.

C. Cut joints shall be square, reamed smooth, and drawn up tight.

D. Keep conduit plugged, clean, and dry during construction.

E. Install No. 12 pull wire in empty conduit.

F. Cap spare conduits.

G. Provide riser clamps around all conduits 1-1/4" or larger that are routed between floors.

H. Provide a watertight conduit system where installed in wet locations such as outdoors, underground, in wash-down areas, or where embedded in concrete.

I. For interior overhead conduit runs, the conduit shall be attached directly to the ceiling (conduit shall not be suspended from the ceiling at a lower elevation).

J. Conduits may be routed exposed.

K. Make bends and offsets without kinking or destroying smooth bore of conduit. Arrange bends and offsets in parallel conduits to present a neat symmetrical appearance.

L. The use of perforated strapping as a conduit hanging method is not approved.

M. Conduit runs that extend through areas of different temperature or atmospheric conditions shall be sealed using approved seal off devices, drained, and installed in a manner that will prevent drainage of moisture or gas migration into cabinets, and equipment enclosures.

N. Connections to Motors and Equipment Subject to Vibration:
   1. Flexible steel conduit not over 3 ft. long for connection to motorized equipment.

2. Liquid-tight flexible conduit not over 3 ft. long where exposed to moisture, dirt, fumes, oil, corrosive atmosphere, with connectors to assure a liquid-tight, permanently grounded connection. Locate so it is least subject to physical abuse. Corrosive areas are identified on the floor plans.
3. Use double locknuts and insulated bushings with threads fully engaged.

O. Install bushings with ground lugs and integral plastic linings at equipment with open-bottom conduit entrances.

P. Install conduit expansion fittings where conduits cross expansion joints.

2.5 FIRESTOPPING

A. Provide firestopping at conduit penetrations through fire rated construction in accordance with section 16010.

2.6 CUTTING AND PATCHING

A. Provisions for openings, holes, and clearances through walls, floors, ceilings, and partitions shall be made in advance of construction.

B. Provide cutting, patching and painting necessary for the installation of electrical systems.

C. Where conduits need to penetrate concrete or masonry construction the contractor shall install 22 gauge galvanized steel pipe sleeves, 1 in. larger in diameter than the conduit being installed. Sleeves shall extend 2" above and below the floor slab or wall penetrated. Install sleeves before walls and/or slabs are poured or constructed.

D. The contractor shall prepare drawings indicating size and location of all anticipated floor sleeves for the installation of electrical conduits. Such drawings shall be made available 10 days prior to any scheduled concrete work.

2.7 RESTRICTIONS

A. Conduits routed parallel to steam lines, hot water pipes, flues, high temperature piping or ducts shall be routed at least 12" from such and shall be a minimum 12" clear when crossing same.

B. Do not route conduit over boiler, incinerator, or other high temperature equipment.

C. Where conduits must cross or follow the same path as water, steam or other fluid piping, run electrical conduits above such piping wherever possible.

2.8 ADJUSTMENT AND CLEANING

A. Pull cleaning plug through conduits to clear of dirt, oil, and moisture.

2.9 CONDUIT SYSTEMS

A. Separate raceways shall be provided for each wiring category as follows;

1. 120/208 volt or 120/240 volt normal power wiring systems.
2. 480 volt normal power wiring systems.
3. I&C: analog (twisted-shielded pair or triad)
4. I&C: 120VAC control
5. I&C: 24VAC control
6. I&C: pulsed frequency (twisted-shielded pair)
7. I&C: field instrument signal

Exceptions: Circuits consisting of twisted-shielded pair cable may share conduits with 120V power circuits. They may also share conduits containing 120V (or lower) control circuits. Circuits consisting of twisted-shielded triad cable may share conduits with 120V power circuits. They may also share conduits containing 120V (or lower) control circuits.

END OF SECTION

SECTION 16112

CONDUIT FITTINGS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide conduit fittings to form a complete raceway system as specified herein.

1.3 QUALITY ASSURANCE

A. Reference National Electrical Contractors Association (NECA) - Standard of Installation

PART 2 PRODUCTS

2.1 MATERIAL

A. Fittings shall be steel or malleable iron and shall be zinc galvanized, or cadmium plated.

B. Do not use running threads.

C. Do not use set screw or indentor type fittings.

2.2 CONNECTORS AND COUPLINGS

A. Galvanized Rigid Conduit and Intermediate Metal Conduit
   1. Threaded.
   2. Liquid tight.
   3. Insulated throat.

B. Liquidtight Flexible Metal Conduit
   1. Liquid tight.
   2. Suitable for grounding.
   3. Suitable for wet locations.
   4. Tapered threaded hub.
   5. Non-metallic materials.

2.3 EXPANSION FITTINGS

A. Expansion fittings: Copper bonding jumper, Crouse Hinds Type XJ.

B. Expansion/deflection fittings: Copper bonding jumper, Crouse-Hinds Type XD.

2.4 CONDUIT BODIES

A. Galvanized or cadmium plated.

B. Threaded hubs.

C. Removable cover, with gasket.

D. Corrosion-resistant screws.

2.5 SEALS

A. Wall entrance seals. Link Seal type as manufactured by Thunderline Corporation.

B. Explosion-proof seals. Appleton type EYS, SFM, or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install electrical fittings in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that fittings serve intended purposes.

B. Rigidly secure connectors at cabinets and boxes with galvanized lock nut and bushing. Use appropriate connectors on NEMA 3R (weatherproof) and NEMA 4 (spraytight) enclosures to maintain their ratings. NOTE: Conduit penetrations to NEMA 3R and NEMA 4 enclosures shall be made on the bottom (or the sides, if the bottom access is insufficient) – do not penetrate the top of the enclosure.

C. Seal conduits that run through different temperature or atmospheric conditions to prevent moisture or gases from entering electrical equipment and devices.

D. Install wall entrance seal where conduits or direct burial conductors pass through foundation walls below grade.

E. Install conduit expansion fittings complete with bonding jumper in following locations:
1. Conduit runs which cross a structural expansion joint.
2. Conduit runs where movement perpendicular to axis of conduit may be encountered.

F. Locate conduit bodies so as to assure accessibility of electrical wiring.

G. Install fittings designed for use with flexible liquid-tight conduit to ensure continuity of ground throughout the fittings and conduit and prevent entrance of moisture.

END OF SECTION

SECTION 16120

LOW VOLTAGE WIRES, CABLES AND CONNECTORS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Application provisions of Division 1 shall govern work under this Section.

1.2 SCOPE

A. Provide wires, cables and connectors as specified herein.

1.3 QUALITY ASSURANCE

A. Reference Standards of the following associations.
1. National Electrical Contractor's Association (NECA) - Standard of Installation
2. Insulated Cable Engineers Association (ICEA)

PART 2 PRODUCTS

2.1 WIRE CONDUCTORS

A. Copper Conductor only.

B. Insulated with 600 volt insulation and color code conductors for low voltage (secondary feeders and branch circuits) as required by code.

C. Type THHN solid or stranded: Single conductor No. 10 AWG and smaller for general use wiring. No. 12 AWG minimum size.

D. Type THW or THHN Stranded: Single conductor No. 8 AWG and larger for general use wiring. Conductor triple rated for use as types THHN, THWN and MTW is approved.

E. Conductors installed in wet locations and areas with high humidity shall be type THW or XHHW. Wet locations shall include, but not be limited to, conduits installed in direct contact with the earth and underground electrical ductbanks.

F. Conductors shall not be installed at temperatures below the manufacturer’s minimum installation temperature.

2.2 INSTRUMENTATION WIRING & CABLES

A. Refer to INSTRUMENTATION WIRING LEGEND on drawing 10-E-1 for abbreviations and other requirements.

2.3 JOINTS, TAPS AND SPLICES

A. Conductors No. 10 AWG and Smaller: 3M Scotch-lok compression type solderless connectors with plastic cover. Wire nuts are not acceptable.

B. Joints, Taps, and Splices in Conductors No. 8 AWG and Larger: Solderless compression type connectors, tool and die applied, of a type that will not loosen under vibration or normal strains. Burndy "Hy-Dent" type or equivalent.

PART 3 EXECUTION

3.1 INSTALLATION

A. Run wire and cable in conduit, unless otherwise indicated on drawings.

3.2 JOINTS, TAPS AND SPLICES

A. Each tap, joint, or splice in conductors No. 8 AWG and larger shall be taped with two half-lap layers of vinyl plastic electrical tape and a finish wrap of color coding tape, where required by code. Electrical tape shall be 3M Scotch brand.

B. Cable splices shall be made only in distribution and junction boxes.

3.3 WIRE AND CABLE IDENTIFICATION

A. Install label tags on wire and cable in junction boxes, pullboxes, wireways, and wiring gutters of panels. Tags identify wire or cable number and/or equipment served as shown on drawings.

B. Different conductor insulation colors and electrical tape colors shall be used to identify the different conductors in a given circuit. Code requirements shall always be followed where applicable. In general, colors shall be as follows;
1. 120/208 volt systems neutral conductor - solid white. Provide additional markings for neutral conductors in the same raceway as required by code.
2. 480/277 volt systems neutral conductor - solid gray. Provide additional markings for neutral conductors in the same raceway as required by code.
3. Ground Conductors - solid green. Provide additional markings for ground conductors in the same raceway as required by code.

C. For additions to existing buildings, existing conductor color coding schemes shall be followed unless in conflict with the codes. If no logical color coding scheme exists, color coding indicated above shall be followed.

3.4 TAGS AND LABELS

A. Provide metal or flame-resistant adhesive label tags and identify the cable source, use and destination.

B. Line voltage conductors shall be identified by circuit number using sleeve type adhesive markers.

END OF SECTION

SECTION 16122

BRANCH CIRCUITS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide a branch wiring system to serve lighting, receptacle, instrument, motor and equipment loads as indicated on the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. Reference Standards of the National Electrical Contractors Association (NECA), Standard of Installation.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 GENERAL

A. Conductors shall be size 12 AWG minimum (unless otherwise noted) for branch circuit wiring, including motor circuits.

B. Size 120V branch circuits for length of run on following basis:
1. 0 to 75 ft run from panelboard to first outlet: No. 12 AWG minimum.
2. 75 to 125 ft run: increase one wire size, i.e., No. 12 AWG becomes No. 10 AWG.
3. 126 to 200 ft run: increase two wire sizes, i.e., No. 12 AWG becomes No. 8 AWG.
4. 201 and above: wiring to be sized for 3% maximum voltage drop.

C. Voltage drop for branch circuits and feeder circuit combined shall not exceed requirements of NEC Article 220.

D. Route branch circuits and switch legs as dictated by construction, these specifications, or instruction from Engineer.

E. Size conduit, outlet boxes, and other raceway system components in accordance with NEC requirements as minimum.

3.2 MOTOR AND EQUIPMENT WIRING

A. Furnish and install motor circuits in accordance with any schedules on drawings and code requirements, from source of supply to associated motor starter, and from starter to motor terminal box, including necessary and required intermediate connections.

B. Conductor and conduit size for motor branch circuits, if shown on drawings, are sized for motor requirement only.

C. Motors shall have proper feeders as per NEC and nameplate ratings. Contractor is responsible for verification of ratings of motors and installing proper branch circuits.

D. Obtain manufacturer's wiring diagrams and shop drawings for equipment requiring electrical connections.

E. Check drawings and specifications of other divisions of work for equipment and work which shall be included in order to provide a complete electrical installation.

F. Motor connections shall be made by compression type connectors using proper tools and fittings to assure good electrical continuity and low resistance joint.

3.3 INSPECTION

A. Examine areas and conditions under which branch circuits are to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

3.4 INSTALLATION

A. Install in accordance with manufacturer's written instructions and in accordance with recognized industry practices

B. Install branch circuit and control wiring system as indicated in drawings.

C. Use color-coding to identify conductors as indicated in Section 16120.

END OF SECTION

SECTION 16130

ELECTRICAL BOXES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable requirements of Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide electrical boxes in accordance with these specifications.

1.3 QUALITY ASSURANCE

A. Reference Standards of the National Electrical Contractors Association (NECA), Standard of Installation.

PART 2 PRODUCTS

2.1 INTERIOR WALL OUTLET AND SWITCH BOXES - SURFACE MOUNTED - DRY LOCATIONS ONLY

A. Stamped steel, four inch square, 2-1/8" deep, with round corners. Provide rounded corner raised box covers with openings as required for devices being installed. Refer to section 16111 for restrictions on exposed conduit systems.

2.2 INTERIOR WALL OUTLET AND SWITCH BOXES - SURFACE MOUNTED - DAMP OR WET LOCATION (includes areas with floor drains)

A. Single or two gang as indicated on the plans. Cast malleable iron with threaded conduit hubs. Two inches deep minimum. Internal mounting ears. Boxes shall be coated with electroplated zinc, a dichromate coating, and an aluminum polymer enamel finish. Refer to section 16111 for restrictions on exposed conduit systems.

2.3 CEILING BOXES - SURFACE MOUNTED – DAMP AND WET AREAS

A. Single or two gang as indicated on the plans. Cast malleable iron with threaded conduit hubs. Two inches deep minimum. Internal mounting ears. Boxes shall be coated with electroplated zinc, a dichromate coating, and an aluminum polymer enamel finish. Refer to section 16111 for restrictions on exposed conduit systems.

2.4 SPECIAL BOXES

A. Provide special boxes fabricated by the manufacturer of fixtures and other devices where standard outlets are not applicable.

2.5 GENERAL PURPOSE JUNCTION AND PULL BOXES (FOR DRY INTERIOR AREAS ONLY)

A. Fabricate from code gauge galvanized steel, with covers held in place by corrosion resistant machine screws

B. Size as required by code for number of conduits and conductors entering and leaving box.

C. Provide with welded seams, where applicable, and equip with corrosion-resistant nuts, bolts, screws, and washers.

2.6 ACCESS PANELS

A. Furnish type necessary for the particular wall or ceiling construction in which they occur.

B. Panels to be complete with screwdriver cam locking device.

2.7 WEATHERPROOF JUNCTION AND PULL BOXES (DAMP/WET INTERIOR AREAS)

A. Stainless steel or cadmium plated malleable iron cast type with threaded hubs, cast cover, and neoprene gasket.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install electrical boxes as indicated, in compliance with NEC requirements, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that the boxes serve the intended purposes.

B. Seal conduit at entrance to weatherproof boxes for interior and exterior locations exposed to weather or moisture.

C. Install knockout closures to cap unused knockout holes where blanks have been removed

D. Locate boxes so as to assure accessibility of electrical wiring. Relocate boxes rendered inaccessible by the installation of work by other trades.

E. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry. Do not support from conduit.

F. Set boxes, in concealed conduit runs, flush with wall surfaces, with or without covers, as required.

G. Do not install boxes back to back or through wall. Offset outlet boxes on opposite sides of wall a minimum 12 inches.

H. Set outlet boxes parallel to construction, securely mounted and adjusted to set true and flush with the finished surface.

I. Do not burn conduit holes, use knock-out punches, or hole saws.

J. Use "no-bolt" studs where required.

K. Use handy boxes only where specifically detailed on the drawings.

L. Boxes shall be sized per code to accommodate the number and size of conduit entrances to the box and to accommodate the number of conductors, splices, fittings, etc. within the box. Do not use box extensions to create additional volume to meet NEC requirements for the number of conductors contained in a box.

3.2 EXPOSED OUTLET AND JUNCTION BOXES

A. Install weatherproof outlet and junction boxes in any area where drawings show weatherproof (WP) wiring devices.

3.3 INTERIOR OUTLET BOX ACCESSORIES

A. Provide outlet box accessories as required for each installation, such as mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes, compatible with outlet boxes being used and meeting requirements of individual wiring situations.

3.4 OUTLET BOX LOCATIONS

A. Location of outlets and equipment as shown on drawings is approximate, and exact location is to be verified and shall be determined by:

B. Construction or code requirements.

C. Conflict with equipment of other trades.

D. Equipment manufacturer's drawings.

E. Where receptacles and communications outlets are shown grouped next to each other on the drawings, the boxes for these outlets shall be mounted next to each other and shall not be located according to stud spacing. The Contractor shall utilize between stud box supports to assist in mounting boxes proximal to one another on a consistent spacing between wall studs.

F. Minor modification in the location of outlets and equipment is considered incidental up to a distance of 10 feet, provided the change in location is requested prior to rough in.

G. Mounting heights for devices and equipment to be measured from finished floor to centerline of device.

END OF SECTION

SECTION 16450

GROUNDING

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 1 shall govern work in this Section.

1.2 SCOPE

A. Provide all material, labor and incidentals necessary for the completion of this section of the work.

1.3 QUALITY ASSURANCE

A. Follow the requirements of the following regulatory agencies;
   1. National Fire Protection Association (NFPA), NFPA-70 - National Electrical Code (NEC).
   2. Local Codes and Ordinances

1.4 REFERENCE STANDARDS

A. Conform to the standards of the National Electrical Contractors Association (NECA), Standard of Installation.

PART 2 PRODUCTS

2.1 GROUND WIRES

A. Copper only

B. Size as shown on drawings, or as required by NEC

PART 3 EXECUTION

3.1 GENERAL

A. Ground electrical systems and equipment as required by code, utility, local ordinances, and to requirements herein.

B. Install separate code rated grounding conductors to special equipment and activity areas as required by code.

C. Bond all metallic piping systems and service equipment as required by NEC.

3.2 EQUIPMENT GROUND

A. Bond metallic conduits, supports, cabinets, and other equipment so ground will be electrically continuous from service to outlet boxes.

B. Install grounding conductor in nonmetallic and flexible conduit to complete equipment ground continuity. Ground wire shall be bonded at equipment and at first junction box of conduit system on line side of flexible conduit to the system.

C. Install grounding conductors to permit shortest and most direct path from equipment to ground. When grounding conductor runs through metallic conduit, bond to conduit at entrance and exit with a bolted clamp.

D. Install a separate equipment grounding conductor in each conduit containing feeder conductors.

E. Green ground bar in panels: shall be similar to neutral bar, except tinted green and bonded to panel tub.

F. Connections shall be accessible for inspection and checking. No insulation shall be installed over ground connections.

G. Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.

END OF SECTION

SECTION 16960

TESTING ELECTRICAL SYSTEM

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Applicable provisions of Division 1 shall govern work under this Section.

1.2 SCOPE

A. Assure that electrical equipment is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.

1.3 ITEMS TO BE TESTED

A. Switchboard Circuit Breakers

B. Grounding Integrity

C. Remote instruments/sensors

D. Motors

E. Feeder Circuits

1.4 QUALITY ASSURANCE

A. Comply with the requirements of the following regulatory agencies;
1. National Fire Protection Association (NFPA), chapter 70 National Electrical Code (NEC).
2. Underwriters' Laboratories, Inc. (UL).
3. O.S.H.A.

B. Conform to the standards of the following agencies;
1. National Electrical Manufacturer's Association (NEMA)
2. American Society for Testing and Materials (ASTM)
3. Institute of Electrical and Electronic Engineers (IEEE)
4. National Electrical Testing Association (NETA)
5. Insulated Power Cable Engineers Association (IPCEA)

C. Inspections and tests shall utilize the following references:
1. Project design specifications.
2. Project design drawings.
3. Manufacturer's instruction manuals applicable to each particular apparatus.

1.5 TEST REPORT SUBMITTALS

A. Seven copies of complete testing report.

B. Submit report no later than 30-days after completion of testing.

PART 2 PRODUCTS

A. Not used.

PART 3 EXECUTION

3.1 GENERAL

A. Test work and equipment installed to ensure its proper and safe operation in accordance with intent of drawings and specifications.

B. Check interlocking and automatic control sequences and test operation of safety and protective devices.

C. Correct defects.

3.2 CIRCUIT BREAKERS - LOW VOLTAGE - (MOUNTED IN SERVICE ENTRANCE SWITCHBOARD)

A. Visual and Mechanical Inspection
1. Circuit breaker shall be checked for proper mounting, conductor size and feeder designation.
2. Operate circuit breaker to ensure smooth operation.
3. Inspect case for cracks or other defects.
4. Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.

B. Electrical Tests
1. Measure contact resistance.
2. Insulation resistance shall be determined phase to phase and phase to ground. Test voltage shall be 1,000-VDC.

C. Test Values
1. Contact resistance shall be compared to adjacent poles and similar breaker. Deviations of more than 50% shall be investigated and corrected.
2. Insulation resistance shall not be less than 50 megohms.

3.3 MOTORS

A. Inspect for physical damage, proper anchorage and grounding.

B. Compare equipment nameplate data with design drawings or starter schedule.

Cherry Valley Lift Station
Pump 2 and Pump 3 Replacement
Capital Project No. 1911

3.4 FEEDERS

A. Each new or modified feeder shall be megger tested for insulation resistance.

B. Submit test results on the appropriate sheet found at the end of this section.

END OF SECTION

Cherry Valley Lift Station
Pump 2 and Pump 3 Replacement
Capital Project No. 1911

FEEDER FROM _____ TO _____

Phase conductor size _____

Applied Voltage _____

Resistance Reading _____

Tested By _____

Date Tested _____

Time of Day _____

Cherry Valley Lift Station
Pump 2 and Pump 3 Replacement
Capital Project No. 1911

FEEDER FROM _____ TO _____

LOAD IN AMPS

Phase A _____

Phase B _____

Phase C _____

Phase conductor size _____

Tested By _____

Date Tested _____

Time of Day _____

Was Balancing Required? _____ Yes _____ No

Cherry Valley Lift Station
Pump 2 and Pump 3 Replacement
Capital Project No. 1911

ELECT MOTOR TAG # _____

HORSEPOWER _____

NAMEPLATE DATA:

Overload Relay Type _____

Protective Relay Setting _____

Voltage Readings (Motor Operating)

A-Phase _____

B-Phase _____

C-Phase _____

Current Readings (Motor Operating)

A-Phase _____

B-Phase _____

C-Phase _____

Direction of rotation (clockwise)(counterclockwise)

END OF SECTION

Section II

Contract Forms

Proposal

Project: **Cherry Valley Lift Station – Pump 2 and Pump 3 Replacement, Capital Project No. 1911**

Location: Cherry Valley Lift Station
4020 Barley Ridge Trail
Cherry Valley, IL 61016

Completion Date: 120 Days from Receipt of the Notice to Proceed

Liquidated Damages: $300/calendar day beyond completion date deadline

To: Board of Trustees
Rock River Water Reclamation District
3501 Kishwaukee Street
Rockford, IL 61109

From: _____
(Individual, Partnership or Corporation, as case may be)

_____

(Address of Individual, Partnership or Corporation)

Gentlemen:

I (We), the undersigned, hereby propose to furnish all materials, equipment, tools, services, labor, and whatever else may be required to construct and place in service the above subject Sanitary Sewer for the Rock River Water Reclamation District all in accordance with the plans and specifications, provided by the Rock River Water Reclamation District. The undersigned also affirms and declares:

1. That I (we), have, examined and am (are) familiar with all the related contract documents and found that they are accurate and complete and are approved by the undersigned.
2. That I (we), have carefully examined the site of the work, and that, from my (our) investigation, has satisfied myself (ourselves) as to the nature and location of the work, the character, quality, and quantity of materials and the kind and extent of equipment and other facilities needed for the performance of the work, the general and local conditions and all difficulties to be encountered, and all other items which may, in any way, effect the work or its performance.
3. That this bid is made without any understanding, agreement or connection with any other person, firm, or corporation making a bid for the same purposes, and is in all respects fair

and without collusion or fraud; and that I (we) are not barred from bidding as a result of a bid-rigging or bid-rotating conviction.

4. That accompanying the Proposal is a Bidder's Bond in the amount specified in Article 1, Notice to Bidders, payable to the Board of Trustees of the Rock River Water Reclamation District, which it is agreed, shall be retained as liquidated damages by said Rock River Water Reclamation District if the undersigned fails to execute the Contract in conformity with the contract documents incorporated in the contract documents and furnish bond as specified, within ten (10) days after notification of the award of the contract to the undersigned.

5. The Bidder is of lawful age and that no other person, firm or corporation has any interest in this Proposal or in the Contract proposed to be entered into.

6. The Bidder is not in arrears to the Rock River Water Reclamation District, upon debt or contract, and is not a defaulter, as surety or otherwise, upon any obligation to the Rock River Water Reclamation District.

7. No officer or employee or person whose salary is payable in whole or in part by the District is, shall be or become interested, directly or indirectly as a contracting party, partner, stockholder, surety of otherwise, in this Proposal, or in the performance of the Contract, or in the work to which it is relates, or in any portion of the profits thereof.

8. The Bidder which I represent complies with all applicable requirements of the Americans with Disabilities Act (ADA) and the Occupational Safety and Health Act (OSHA) and that if said bidder is awarded a contract, it will complete all OSHA-required or ADA-required employee and customer training, will make available all required information, and will hold harmless and indemnify the District and the District's representatives.

   In regard to participation in an approved Apprenticeship program, upon request, Contractor will be required to provide written proof of participation.

9. The undersigned, as Bidder, declares that he has adopted and promulgated written sexual harassment policies in accordance with Public Act 99-093 and will make this information available upon request.

10. The undersigned, as Bidder, declares he will comply with prevailing wages in accordance with the Illinois Department of Labor Standards. The State of Illinois requires contractors and subcontractors on public works projects (including the Rock River Water Reclamation District) to submit certified payroll records on a monthly basis, along with a statement affirming that such records are true and accurate, that the wages paid to each worker are not less than the required prevailing rate and that the contractor is aware that filing false records is a Class B Misdemeanor. The successful Bidder shall be responsible for verifying the prevailing wages each month and notifying all subcontractors of the appropriate monthly rates. Prevailing wage rates may be found on the Illinois Department of Labor website at www.illinois.gov/idol/Laws-Rules/CONMED/Pages/Rates.aspx .

    The certified payroll records must include the name, address, telephone number, social security number, job classification, hourly wages paid in each pay period, the number of hours worked each day, and the starting and ending time of work each day, for every worker employed on the project. Any contractor who fails to submit a certified payroll or knowingly files a false certified payroll is guilty of a Class B Misdemeanor. Certified

payroll reports shall be submitted on industry standard forms such as IDOT Statement of Compliance (SBE 348) or other approved equal.

11. The undersigned, as Bidder, declares he will comply with the Federal Drug Free Workplace Act.

12. The undersigned, as Bidder, declares he will comply with Public Act 83-1030 entitled "Steel Products Procurement Act".

13. The undersigned, as Bidder, declares he will comply with Public Act 96-929 (30 ILCS 570) regarding Illinois residents' employment.

14. The undersigned, as Bidder, declares he will comply with non-discrimination in employment in accordance with the Illinois Fair Employment Practices Commissions Rules & Regulations.

15. The undersigned, as Bidder, declares that he currently participates in an apprenticeship or training program that is registered with the United States Department of Labor's Bureau of Apprenticeship and Training or other acceptable State of Illinois Department of Labor monitored program.

In submitting this bid, it is understood that the right is reserved by the Rock River Water Reclamation District to reject any and all bids. It is agreed that this bid may not be withdrawn for a period of sixty (60) days from the opening thereof.

The undersigned further declares that he (they) has (have) carefully examined the following items of work and that the cost of all the work to complete this project is given in this Proposal.

Lump Sum Bid Amount

Total Amount of Lump Sum Bid, expressed in figures, for providing all materials, equipment, warranty, and labor to complete this project in conformity with all specifications in this Invitation to Bid.

$_____

The undersigned acknowledges that he has received Addendum numbers _____, _____ _____, _____, and realizes that all Addenda are considered part of the Contract.

Date: _____

Bidder: _____ By: _____
(Printed Name of Firm) (Authorized Rep's Signature)

_____ By: _____
(Printed Street Address) (Printed Authorized Rep's Name)

_____ By: _____
(Printed City, State, Zip) (Printed Authorized Rep's Title)

_____ By: _____
(Area Code and Phone Number) (Fax Number)

_____
(Authorized Rep's Email Address)

Fair Employment Practices Affidavit of Compliance

PROJECT: Cherry Valley Lift Station – Pump 2 and Pump 3 Replacement, Capital Project No. 1911

NOTE: THE BIDDER MUST EXECUTE THIS AFFIDAVIT AND SUBMIT IT WITH ITS SIGNED BID. THE ROCK RIVER WATER RECLAMATION DISTRICT CANNOT ACCEPT ANY BID WHICH DOES NOT CONTAIN THIS AFFIDAVIT

_____, being first duly sworn, deposes and says that:
(Name of person making affidavit)

They are: _____ of _____
(Officer's Title) (Company Name)

that said company is and "Equal Opportunity Employer" as defined by Section 2000(e) of Chapter 21, Title 42 of the United States Code annotated and Federal Executive Orders #11375 which are incorporated herein by reference;

and that said company will comply with any and all requirements of Title 44 Admin. Code 750. APPENDIX A – Equal Opportunity Clause, Rules and Regulations, Illinois Department of Human Rights, which read as follows:

"In the event of the contractor's non-compliance with the provisions of this Equal Employment Opportunity Clause, the Illinois Human Rights Act or the Rules and Regulations of the Illinois Department of Human Rights ("Department"), the contractor may be declared ineligible for future contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations, and the contract may be cancelled or voided in whole or in part, and such other sanctions or penalties may be imposed or remedies invoked as provided by statute or regulation. During the performance to this contract, the contractor agrees as follows:

1. That it will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, marital status, national origin or ancestry, citizen status, age, physical or mental handicap unrelated to ability, sexual orientation, military status or an unfavorable discharge from military service; and further that it will examine all job classifications to determine if minority persons or women are underutilized and will take appropriate affirmative action to rectify any such underutilization.
2. That, if he or she hires additional employees in order to perform this contract or any portion of this contract, he or she will determine the availability (in accordance with the Department's Rules and Regulations) of minorities and women in the areas from which he or she may reasonably recruit and he or she will hire for each job classification for which employees are hired in a way that minorities and women are not underutilized.
3. That, in all solicitations or advertisements for employees placed by him or her or on his or her behalf, he or she will state that all applicants will be afforded equal opportunity without discrimination because of race, color, religion, sex, sexual orientation, marital status, national origin or ancestry, citizenship status, age, physical or mental handicap unrelated to ability, sexual orientation, military status or an unfavorable discharge from military service.
4. That he or she will send to each labor organization or representative of workers with which he or she has or is bound by a collective bargaining or other agreement or understanding, a notice advising such labor organization or representative of the contractor's obligations under the Illinois Human Rights Act and the Department's Rules and Regulations. If any labor organization or representative fails or refuses to cooperate with the contractor in his or her efforts to comply with such Act and Rules and Regulations, the contractor will promptly so notify the Department and the contracting agency and will recruit employees from other sources when necessary to fulfill its obligations under the contract.
5. That he or she will submit reports as required by the Department's Rules and Regulations, furnish all relevant information as may from time to time be requested by the Department or the contracting agency, and in all respects comply with the Illinois Human Rights Act and the Departments Rules and Regulations.
6. That he or she will permit access to all relevant books, records, accounts and work sites by personnel of the contracting agency and the Department for purposes of investigation to ascertain compliance with the Illinois Human Rights Act and the Department's Rules and Regulations.
7. That he or she will include verbatim or by reference the provisions of this clause in every subcontract awarded under which any portion of the contract obligations are undertaken or assumed, so that the provisions will be binding upon the subcontractor. In the same manner as with other provisions of this contract, the contractor will be liable for compliance with applicable provisions of this clause by such subcontractors; and further it will promptly notify the contracting agency and the Department in the event any subcontractor fails or refuses to comply with the provisions. In addition, the contractor will not utilize any subcontractor declared by the Illinois Human Rights Commission to be ineligible for contacts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations.

(Source: Amended at 32 I11. Reg. 16484, effective September 23, 2008)"

IL Dept of Human Rights Registration No.: _____ Expiration Date: _____

_____
Signature

Subscribed and sworn to before me this _____ day of _____, 20_____.

_____
Notary Public

Bid Bond

KNOW ALL MEN BY THESE PRESENTS, that we:

_____ (hereinafter called the Principal) and

_____ (hereinafter called the Surety)

a Corporation chartered and existing under the laws of the State of _____ with its principal offices in the City of _____ and authorized to do business in the State of Illinois are held and firmly bound onto the Rock River Water Reclamation District of Winnebago County, Illinois (District), in the full and just sum of: TEN PERCENT (10%) OF THE TOTAL BID PRICE good lawful money of the United States of America, to be paid upon demand of the District, to which payment will and truly to be made we bind ourselves, our heirs, executors, administrators, and assigns, jointly and severally and firmly by these presents.

WHEREAS, the Principal is about to submit, or has submitted to the District, a proposal for constructing Sanitary Sewers and Appurtenances.

WHEREAS, the Principal desires to file this bond, in accordance with law, to accompany this Proposal.

NOW THEREFORE, The conditions of this obligation are such that if the Proposal be accepted, the Principal shall, within ten days after the date of receipt of a written notice of award of Contract, execute a Contract in accordance with the Proposal and upon the terms, conditions, and prices set forth therein, in the form and manner required by the District, and execute a sufficient and satisfactory Contract Performance Bond payable to said District in an amount of one hundred percent (100%) of the Contract price (including alternates) in form and with security satisfactory to said District, then this obligation to be void, otherwise to be and remain in full force and virtue in law; and the Surety shall, upon failure of the Principal to comply with any or all of the foregoing requirements within the time specified above, immediately pay to the aforesaid District, upon demand, the amount hereof in good and lawful money of the United States of America, not as a penalty, but as liquidated damages.

IN TESTIMONY THEREOF, the Principal and Surety have caused these presents to be duly signed and sealed this _____ day of _____, 20_____.

_____

Principal

(Seal)

By _____

Name: _____

Title: _____

Date: _____

Attest:

_____

Secretary

_____

Surety

(Seal)

By _____

Name: _____

Title: _____

Date: _____

Agreement

1. General

THIS AGREEMENT, made and concluded this ___ day of _____, 2019, between the Rock River Water Reclamation District, Rockford, Illinois (District), acting by and through the Board of Trustees, and **_____,** his/their executors, administrators, successors or assigns:

2. Scope of Work

WITNESSETH: That for and in consideration of the payments and agreements made in the Proposal attached hereto, to be made and performed by the District and according to the terms expressed in the Bond referring to these presents, the Contractor agrees with the District at his/their own proper cost and expense to do all the work, furnish all equipment, materials and all labor necessary to complete the work in accordance with the plans and specifications hereinafter described, and in full compliance with all of the terms of this agreement and the requirements of the District and its representative.

And it is also understood and agreed that the Bidding Requirements, Detailed Specifications, Contract Forms, General Conditions, General Requirements, Technical Specifications, Plans, Addenda, and provisions required by law are all essential documents of the contract, and are a part hereof, as if herein set out verbatim or as if attached, except for titles, subtitles, headings, table of contents and portions specifically excluded.

3. Contract Price

The District shall pay to the Contractor, and the Contractor shall accept, in full payment for the performance of this Contract, subject to any additions or deductions provided for hereby, in current funds, the Total Contract Price of _____ and 00/100 ($_____).

Payments are to be made to the Contractor in accordance with and subject to the provisions of Section 7 of this Agreement, which is a part of this Contract.

4. Bond

The Contractor has entered into and herewith tenders a bond of even date herewith, in the penal sum of _____ and 00/100 ($_____) to insure the faithful performance of this Contract, which said bond is hereby made a part of this Contract by reference.

5. Maintenance and Guarantee

The Contractor shall promptly repair, replace, restore or rebuild any imperfections that may arise and shall maintain satisfactory to the District all work for a period three years from the date of final acceptance of the Contract for trench settlement and for a period of two years all other work, except where periods of maintenance and guarantee are provided for. The Contractor shall, for this period, indemnify and save harmless the District, its officers and agents from any injury done to

property or persons as a direct or alleged result of imperfections in the Contractors' work, and shall immediately assume and take charge of the defense of such action or suits in like manner and to all intents and purposes as if said actions and suits had been brought directly against the Contractor.

If the Contractor shall fail to repair, replace, rebuild or restore such defective or damaged work promptly after receiving notice given by the District, the District shall have the right to have the work done by others and to call on the Contractor and his bondsman to pay the costs thereof.

6. Contract Execution

IT IS EXPRESSLY UNDERSTOOD AND AGREED that the entire improvement shall be done in a thorough and workmanlike manner, under the direction and to the satisfaction of the District and in full compliance with all the requirements of its representative under them. All loss or damage arising out of the nature of the work to be done, or from any detention of unforeseen obstruction or difficulty which may be encountered in the prosecution of the work, or from the action of the elements, shall be sustained by the Contractor.

The Contractor will be held responsible for all accidents, and hereby agrees to indemnify and protect the District from all suits, claims, and actions brought against it, and all cost, and damages which the District may be put to by reason of an injury or alleged injury, to the person or property of another in the execution of this contract, or the performance of the work, or in guarding the same, or for any material used in its prosecution or in its construction.

Any person employed on the work who shall refuse or neglect to obey the directions of the District or its representative, or who shall be deemed by the District to be incompetent, or who shall be guilty of any disorderly conduct, or who shall commit any trespass on any public or private property in the vicinity of the work, shall at once be removed from the work by the Contractor when so requested by the District.

Any request to extend the contract completion date must be considered by the Board at the Board meeting prior to the then-existing contract termination date. Any deviation from this action will result in the liquidated damage clause in the contract to be exercised.

7. Payments to Contractor

The District hereby covenants and agrees, in consideration of the covenants and agreements in this Contract, specified to be kept and performed by the Contractor and subject to the conditions herein contained, and if the District receives an acceptable invoice prior to the tenth day of the month and receives approval of the work by the District Engineering Manager, the District shall issue payment before the fifth day of the succeeding month. If the District receives an acceptable invoice on or after the tenth day of the month, the District shall issue payment before the fifth day of the second succeeding month.

The District reserves the right at all times to refuse to issue payment in case the Contractor has neglected or failed to pay any subcontractors, workmen or employee on the work.

8. Subcontracts

No part of the work herein provided for shall be sublet or subcontracted without the express consent of the District, to be entered in the records, and in no case shall consent relieve the Contractor from the obligation herein entered into, or change the terms of this Agreement.

9. Contractor's Responsibility

This Contract shall extend to and be binding upon the successors and assigns, and upon the heirs, administrators, executors, and legal representatives of the Contractor.

In consideration of and to induce the award of this Contract to him, the Contractor represents and warrants: that he is not in arrears to the District upon debt of the Contract and that he is not a defaulter, as surety, contractor or otherwise; that he is financially solvent and sufficiently experienced and competent to perform the work; that the work can be performed as called for by the Contract; that the facts stated in his proposal and the information given by him is true and correct in all respects, and that he is fully informed regarding all the conditions affecting the work to be done and labor and materials to be furnished for the completion of this Contract and that his information was secured by personal investigation and research.

The Contractor shall pay not less than the prevailing wage rate as determined by the Department of Labor, to all laborers, workmen and mechanics performing work under this Contract. Contractor shall comply with current revisions of the wage standards; as required by law. The Contractor shall be responsible for verifying the prevailing wages each month and notifying all subcontractors of the appropriate monthly rates. Certified payroll reports shall be submitted on industry standard forms such as IDOT Statement of Compliance (Form SBE 348).

In regard to nondiscrimination in employment, Contractor will be required to comply with the Illinois Fair Employment Practices Commission's Rules and Regulations as provided herein.

The Contractor shall comply with the American Disabilities Act of 1990 (ADA). The Contractor will hold harmless and indemnify the District and their representatives from all:

(a) suits, claims, or actions;
(b) costs, either for defense (including but not limited to reasonable attorney's fees and expert witness fees) or for settlement, and;
(c) damages of any kind (including but not limited to actual, punitive, and compensatory damages)

relating in any way to or arising out of the ADA, to which said firm is exposed or which it incurs in the execution of the contract.

Contractor shall also comply with Public Act 99-0933, which requires any party to a contract to adopt and enforce a written policy regarding sexual harassment that includes, as a minimum, the following information:

(a) the illegality of sexual harassment
(b) the definition of sexual harassment under Illinois State law;
(c) a description of sexual harassment, utilizing examples;
(d) my (our) organization's internal complaint process including penalties;
(e) through the Illinois Department of Human Rights and the Illinois Human Rights Commission;

(f) directions on how to contact the Department and the Commission; and
(g) protection against retaliation as provided by Section 6-101 of the Illinois Human Rights Act.

Upon request this information will be provided to the Illinois Department of Human Rights. Upon District award of a contract, the District will be provided this information described no more than ten working days after the District issues its award notification.

The Contractor shall comply with Article 2 of Public Act 83-1472 which provides that Illinois residents be employed on Illinois public works projects, provided there has been a period of excessive unemployment (5%) in the State of Illinois as defined in the Act; and further, that Illinois workers are available and capable of performing the particular type work involved.

The Contractor shall comply with all rules and regulations of OSHA during the execution of this Contract.

The Contractor shall comply with the Federal Drug Free Workplace Act.

The Steel Products Procurement Act, Illinois Public Act 83-1030, requires that steel products used or supplied in performance of this Contract or subcontract shall be manufactured or produced in the United States with three exceptions, as explained in the Instructions to Bidders.

The Contractor shall comply with Public Act 96-1416 regarding the disposal of CCDD and uncontaminated soil at CCDD fill sites as explained in the Instructions to Bidders.

10. Time

Work under this Agreement shall be commenced upon issuance of a written Notice to Proceed. The completion date for this project shall be 120 days from receipt of the Notice to Proceed.

11. Liquidated Damages

The amount of liquidated damages shall be $300.00 per calendar day.

12. Counterparts

This Agreement may be executed and recorded in counterparts, each of which shall be deemed an original and all of which, when taken together, shall constitute one and the same instrument. The Parties hereby acknowledge and agree that facsimile signatures or signatures transmitted by electronic mail in so-called “pdf” format shall be legal and binding and shall have the same full force and effect as if an original of this Agreement had been delivered. Each of the parties (a) intend to be bound by the signatures on any document sent by facsimile or electronic mail, (b) are aware that the other party will rely on such signatures, and (c) hereby waive any defenses to the enforcement of the terms of this Agreement based on the foregoing forms of signature.

13. Seals

IN WITNESS WHEREOF, the parties have hereunto set their hands and seals, and such of them as are corporations have caused these presents to be signed by their duly authorized officers.

Rock River Water Reclamation District
Winnebago County, Illinois

(Seal)

By _____
President, Board of Trustees

ATTEST: _____
Clerk of the Board

Contractor

By _____
Contractor's Officer

(Corporate Seal)

Name: _____

Title: _____

Date: _____

ATTEST: _____

Performance Bond

KNOW ALL MEN BY THESE PRESENTS, that WHEREAS, the Rock River Water Reclamation District has awarded to: _____
hereinafter designated as the "Principal", a contract, dated, _____, for the Rock River Water Reclamation District.

WHEREAS, said Principal is required under the terms of said Contract to furnish a bond for the faithful performance of said Contract (the "Bond");

NOW, THEREFORE, we the Principal and _____,
as Surety, are firmly bound unto the Rock River Water Reclamation District in the penal sum of _____ Dollars ($_____) lawful money of the United States for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally firmly by these presents for a performance bond. The conditions of this obligation is such that if the said Principal does well and faithfully performs all the conditions and covenants of said Contract, according to the true intent and meaning thereof, upon its part to be kept and performed, then the above obligation is to be null and void, otherwise to remain in full force and effect.

THE CONDITION OF THIS OBLIGATION IS SUCH, that if the above bounden Principal, its heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions and agreements in the said Contract, including the provisions for liquidated damages in the said Contract, any changes, additions or alterations thereof made as therein provided, on its part, to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify and save harmless the Rock River Water Reclamation District, its officers and agents, as therein stipulated, then this obligation shall become null and void; otherwise it shall be and remain in full force and effect. And 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 the work to be performed thereunder or the specifications accompanying the same and no inadvertent overpayment of progress payments shall in any way affect its obligations 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 work or to the specifications or of any inadvertent overpayment of progress payments. The Rock River Water Reclamation District shall be named as beneficiary on this Performance Bond.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their seal this _____day of _____, 20_____, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

CONTRACTOR **SURETY**

Contractor Firm Name:

By: _____ By: _____ Signature

Attorney-in-Fact

_____ _____

Title

Resident Agent

ATTEST:

_____

Corporate Secretary (Corporations only)

Labor & Material Payment Bond

TO: _____Contractor Name

_____Contractor City, State

KNOW ALL MEN BY THESE PRESENTS

That _____(Contractor)

as Principal, and _____

a corporation of the State of _____ as Surety, are held and firmly bound unto the Rock River Water Reclamation District, as Obligee, for the use and benefit of claimants as hereinafter defined in the amount of

_____Dollars ($_____), for the payment where of Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has by written agreement dated _____20__ Entered into a Contract with Obligee for _____ in accordance with contract documents prepared by the Rock River Water Reclamation District which Contract is by reference made a part hereof, and is hereinafter referred to as "the Contract".

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if Principal shall promptly pay for all laborers, workers and mechanics engaged in the work under the Contract, and not less than the general prevailing rate of hourly wages of a similar character in the locality in which the work is performed, as determined by the State of Illinois Department of Labor pursuant to the Illinois Compiled Statutes 280 ILCS 130 / 1-12 et.seq. and for all material used or reasonably required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect.

1. A claimant is deemed as any person, firm, or corporation having contracts with the Principal or with any of Principal's subcontractors for labor or materials furnished in the performance of the Contract on account of which this Bond is given.
2. Nothing in this Bond contained shall be taken to make the Obligee liable to any subcontractor, material man or laborer, or to any other person to any greater extent than it would have been liable prior to the enactment of The Public Construction Bond Act, approved June 20, 1931, as amended; provided further, that any person having a claim for labor and materials furnished in the performance of the Contract shall have no right of action unless he shall have filed a verified notice of such claim with the Obligee within 180 days after the date of the last item of work or the furnishing of the last item of materials, which claim shall have been verified and shall contain the name and address of the claimant, the business address of the claimant within the State of Illinois, if any, or if the claimant be a foreign corporation having no place of business within the State the principal place of business of the corporation, and in all cases

of partnership the names and residences of each of the partners, the name of the Contractor for the Obligee, the name of the person, firm or corporation by whom the claimant was employed or to whom such claimant furnished materials, the amount of the claim and a brief description of the public improvement for the construction or installation of which the contract is to be performed. No defect in the notice herein provided for shall deprive the claimant of its right of action under the terms and provisions of this Bond unless it shall affirmatively appear that such defect has prejudiced the rights of an interested party asserting the same.

3. No action shall be brought on this Bond until the expiration of 120 days after the date of the last item of work or of the furnishing of the last item of material except in cases where the final settlement between Obligee and the Contractor shall have been made prior to the expiration of the 120 day period, in which case action may be taken immediately following such final settlement; nor shall any action of any kind be brought later than 6 months after the acceptance by the Obligee of the work. Such suit shall be brought only in the circuit court of this State in the judicial district in which the Contract is to be performed.
4. Surety hereby waives notice of any changes in the Contract, including extensions of time for the performance thereof.
5. The amount of this Bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder.
6. The Principal and Surety shall be liable for any attorneys fees, engineering costs, or court costs incurred by the Obligee relative to claims made against this Bond.

Signed and Sealed this _____day of _____, 2019.

CONTRACTOR
Contractor Firm Name

By: _____
Signature

_____
Title

ATTEST:

_____
Corporate Secretary (Corporations only)

SURETY

By:_____
Attorney-in-Fact

Resident Agent

Section III

General Provisions & Technical Specifications for Sanitary Sewer Construction

(Separate document incorporated by reference)

Appendix A

District Provided Pump Information

(Equipment Procurement for Cherry Valley Lift Station Pump Replacement - Capital Project No. 1911)

Section 43 21 13

Centrifugal Liquid Pumps

Part 1 General

1.1 Section Includes

A. Furnish two (2) dry pit, vertical, direct coupled centrifugal pumps specifically designed to pump raw sewage containing solids and/or rags and other fibrous materials without clogging.

B. The pumps shall be constructed to operate with variable frequency drives (VFD) that will be similar to the existing VFD's. The existing VFD's are 200 hp Danfoss VLT AQUA Drive FC202. New VFD's will be provided by others under a separate contract.

1.2 Related Sections

A. Section 40 05 00 Equipment General Provisions

B. Section 43 05 13 Common Motor Requirements for Liquid Pumps

C. Section 43 21 00 Pumps, General

1.3 Quality Assurance

A. All pumping equipment furnished under this section shall be of a design and manufacture that has been used in similar applications, and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that Manufacturer specifically named herein. Manufacturers shall provide evidence of at least five (5) installations in which similar sized equipment has provided satisfactory performance for a minimum of five (5) years in a similar application. No consideration will be given to an individually sized pump that has not been commercially available for five (5) years.

B. To insure a consistent high standard of quality, the Manufacturer of this pumping equipment shall comply with the requirements of the ISO 9001 quality system, and such compliance shall be verified by an independent certification agency approved by the international organization for standardization. Documentation shall be submitted for approval showing compliance with this requirement, and the equipment will not be released for shipment until approved.

C. Centrifugal pump, complete with motor, coupling, baseplate, necessary guards, and all other specified accessories and appurtenances shall be furnished by the pump Manufacturer to insure compatibility and integrity of the individual components, and

provide the specified warranty for all components. The pump Manufacturer shall accept unit responsibility for each pump complete assembly.

D. The centrifugal pumps specified in this Section shall be furnished by and be the product of one Manufacturer.

E. Manufacturers: The equipment specified in this Section shall be manufactured by Morris Pump or District-approved equal.

1.4 Reference Standards

A. The work in this Section is subject to the requirements of applicable portions of the following standards:

1. Hydraulic Institute Standards
2. IEEE Standards
3. NEMA Standards
4. OSHA Rules and Regulations

1.5 Submittals

A. Shop Drawings and Product Data: The Contractor shall furnish complete shop drawings for all equipment specified in the various Sections, together with piping valves and controls for review by the Engineer, including the following information:

1. Pump name and identification number
2. Pump performance curve, pump outline dimension drawing indicating support frame, elbow and anchor bolt locations, electric motor data, parts list, warranty, installation guide, certified factory performance tests witnessed by Owner, quality assurance record, and Manufacturer's start-up report form. Pump performance curves shall indicated head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The equipment Manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions. A family of performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be provided.
3. The Manufacturer shall indicated the limits of the performance curves recommended for stable operation without surge, cavitation, or excessive vibration. The stable operating range shall be as wide as possible based on actual hydraulic and mechanical tests.
4. Provide certification that the motor is inverter duty rated and meets the requirements of NEMA MG-1, Part 31. The submittal information shall also include bearing calculations at the duty point as well as at the maximum and

minimum operating heads shown in the specification. These calculations shall verify the specified minimum bearing life shown elsewhere in this specification.

5. The supplier shall also demonstrate that they have a service facility located within one hundred (100) miles of the facility that has a minimum of three (3) trained service technicians certified to work on these pumps as well as the hoisting capabilities in the shop to work on the specified pumps.

6. Data, in accordance with Section 43 05 13 for the electric motor proposed for each pump.

7. Assembly and installation drawings include seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

B. Electrical Shop Drawing and Product Data:

1. The pump Manufacturer shall submit a motor chart for the motors to be supplied. The motor chart shall include amp draw, power consumed, and output power versus speed for induction motor.

2. Submit catalog data for each motor furnished. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

3. Indicate procedures and results for specified factory and field testing and inspection.

C. Operating Instructions: Three (3) copies of an operating and maintenance manual for the pump and motor shall be furnished as per the specifications. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

D. The submittal data shall be prepared, in its entirety, by the equipment Manufacturer. Shop drawings prepared by the Manufacturer's sales representative, fabrication shop, and other than the listed Manufacturer shall not be acceptable. No additions or modifications to the Manufacturer's submittal shall be accepted, with the sole exception of a cover letter provided by the Manufacturer's local Representative.

E. A service representative who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the Owner on proper operation and maintenance. If there are difficulties in operation of the equipment, due to the Manufacturer's design or fabrication, additional service shall be provided at no cost to the Owner.

F. Spare Parts List: A Spare Parts List shall contain the required information for each piece of equipment. Contractor shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

G. Tools: The Contractor shall supply one (1) complete set of proprietary wrenches and other proprietary tools necessary for the assembly, adjustment, and dismantling of the equipment. All tools shall be of best quality hardened steel forgings with bright, finish wrench heads shall have work faces dressed to fit nuts. All tools shall be suitable for professional work and manufactured by a recognized supplier of professional tools such as Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled tool box of suitable design provided with a hinged cover.

H. Vibration Analysis: In his bid price, the Contractor shall include at least two (2) site visits of the service representative, during construction and testing of the equipment, to analyze and measure the amount of equipment vibration and make his written recommendation for keeping the vibration at a safe limit.

I. Certifications:

1. Manufacturer's certification of proper installation. (Field Services/Start-up)
2. Manufacturer's certification of factory tests. (Factory Witnessed)
3. Manufacturer's certification of satisfactory field testing. (Field Services/Start-up)
4. Manufacturer's certification of vibration analysis indicating vibration is within acceptable limits. (Field Services/Start-up)

Part 2 Products

2.1 Performance

A. The pumps shall be designed for continuous operation and will be operated continuously under normal service. To minimize operation power costs, the hydraulic efficiencies listed for each pump are the minimum acceptable, and must be guaranteed by the Manufacturer.

2.2 Design

A. The overall pump design shall combine high efficiency, low required NPSH, a large solid passage, clog-free, and the ability to handle rags or other fibrous material without plugging.

1. Minimum non-compressible solids passage shall be 3-inch diameter.

B. Suction and discharge flanges shall be drilled to meet ANSI 125 lb. bolting.

2.3 Operating Conditions

A. The following are the operating conditions for the lift station pump and motor:

		Design Conditions
1.	Design Flow, per pump (GPM)	7,500
2.	Design Head (FT)	151
3.	Minimum Flow (GPM)	1,588 @ 121 ft
4.	Operating Range (FT)	7.5 – 13.5
5.	Horsepower	400
6.	Efficiency, minimum (%)	85
7.	Maximum NPSH required (FT)	18.8
8.	Speed, maximum (RPM)	1200
9.	Discharge Size (IN)	12
10.	Suction Size (IN)	12

2.4 Materials of Construction

A. Pump Component Standard Material
Casing Cast Iron (ASTM A48, Class 35)
Impeller Cast Iron (ASTM A48, Class 35)
Wear Rings 420SS Castings (ASTM A743, CA-40, 12 Min. 450 Brinell)
Suction / Stuffing Cast Iron (ASTM A48, Class 35) Box Covers
Shaft SAE 1045 Steel (AISI 1045 H.R.)
Shaft Sleeve 420SS Castings (ASTM A743, CA-40, 9, 10 Min. 450 Brinell)
Bearing Frame Cast Iron (ASTM A48, Class 25)
Gland Bronze - 40 (ASTM B854 C83600)
Lantern Ring Bronze – 40 (ASTM B85 C83600)

B. Casing Construction
The pump casing shall be designed for the type service herein specified and shall be of sufficient strength and metal thickness to insure long life, accurate alignment and reliable operation. T he volute of the pump casing shall have smooth fluid passages large enough at all points to pass any size solid which can pass through the impeller and provide smooth unobstructed flow. The casing shall have a separate and removable suction cover and seal chamber cover.

The casing shall be designed to permit rear pump rotating assembly removal without disturbing either the suction or discharge piping. The casing shall have connections for vents and drains, and gauges.

A handhole shall be provided in the casing to give convenient access to the impeller and interior parts of the pump. The inner contours of the handhole cover shall match the contours of the casing.

The discharge flange shall conform to ANSI B 16.1, Class 125 lb., flat face, of standard size with drilled holes. The discharge flange shall be drilled and tapped for gauge connections.

No stationary guides will be permitted on either the suction or discharge sides of the casing.

C. Impeller Construction

The pump impeller shall be of the single suction enclosed type of the non- clogging design. The impeller shall be designed with smooth water passages to prevent clogging by large chunks, splinters or fibrous material and shall be capable of passing solids having a maximum sphere size as specified herein.

The impeller shall be dynamically balanced to ISO standards G6.2 to insure that the specified vibration limits are met.

The impeller shall be taper bored and keyed and securely held in place to the shaft by a locking plate and secured to the shaft by no less than three (3) high-strength socket head cap screws threaded into the pump shaft. This arrangement shall provide positive locking of the impeller to the shaft, so that the impeller cannot be loosened by torque from either forward or reverse rotation.

D. Wear Rings

A replaceable suction cover wear ring providing 1/8" minimum wear shall be installed with its wear surface parallel to the suction end of the pump impeller. The wear ring shall be installed with recessed stainless steel screws for attachment to the suction cover.

A replaceable impeller wear ring providing 1/8" minimum wear shall be mounted on the impeller to provide a renewable surface opposite the suction cover wear ring. The wear ring shall be secured to the impeller with recessed stainless steel screws.

E. Suction/Seal Chamber Covers

The pump casing shall be provided with suction and seal chamber covers of the same material as the material used in the casing, cast separately from the casing and shall be built to allow for complete removal of the pump rotating assembly by unbolting the seal chamber cover. The suction cover and the seal chamber back plate shall be machined register fit to the casing to assure accurate alignment.

The suction cover flange shall conform to ANSI B16.1, Class 125 lb., flat face, of standard size with drilled holes and shall be designed to assure equal distribution of

the liquid to all parts of the impeller suction eye. Drilled gauge connection shall be provided.

F. Bearing Frame

The pump bearing frame shall be a one-piece rigid cast iron construction, providing a self-centering and self-indexing fit with the seal chamber cover of the pump to assure proper alignment. The bearing frame shall be provided with retainer covers for the outboard and inboard ends of the housing. Both of the retainer covers shall be equipped with lip-type grease seals and deflectors to prevent the entrance of contaminants. The bearing assembly shall be designed to allow the removal of the complete rotating assembly from the casing without disconnecting suction or discharge piping.

The pump bearing frame shall be equipped with a three (3) bearing system designed to provide a separate bearing for the thrust load imposed by the pump impeller and two (2) separate bearings to accept the radial load. The radical bearing shall be of the roller or spherical roller type suitable for all loads encountered in the specified service conditions. The thrust bearings shall be angular contact ball or spherical roller type suitable for all thrust loads. All bearings shall be designed for a minimum of 100,000 hours B-10 life for any point within the pump operating range specified. Certified calculations shall be provided to demonstrate compliance.

All bearings shall be able to be relubricated while the pump is in operation. The bearings shall be grease lubricated. Greased bearings shall be provided with a pressure relief system so that excessive temperature and/or pressure will not damage the bearings.

The bearing frame assembly shall be designed to withstand the loads from frequent running against a closed control valve on the pump discharge for minimum periods of three (3) minutes during pump start-up and stop cycles.

The bearing frame shall have provisions for adjustment of the axial clearance between the impeller wear ring and the suction cover wear ring. This adjustment shall be accomplished through the sue of metal shims placed between the mounting flange of the bearing frame and the mounting flange on the seal chamber cover. A cylindrical sliding fit between the bearing frame and seal chamber cover shall assure positive bearing alignment.

Grease lubricated bearings shall be properly hand packed at the factory prior to shipment.

G. Seal Chamber

The seal chamber shall be an integral part of the seal chamber cover and shall be designed to collect the leakage from the seal chamber. It shall have a minimum (3/4” – 14 NPT) drain connection at its lowest point.

The seal chamber shall be designed to allow for installation of a split mechanical seal produced by John Crane model 3740 or District approved equal. The mechanical seal faces shall be a combination of carbon, tungsten carbide or silicon carbide as appropriate for the application.

The gland follower bolts and nuts shall be of stainless steel construction. A conveniently located sealing water connection to the seal chamber shall be drilled and tapped to feed water directly to the seal cage.

H. Suction Elbow

Each pump shall be provided with a reducing, long radius type, cast iron suction elbow bolted directly to the pump suction flange.

I. Coupling

The coupling between the pump and the drive system shall be a vertical type unit providing a flexible connection between the pump and the drive.

The selection of the size of the coupling required shall be on the basis of the maximum horsepower of the drive system including the service factor and any other special conditions outlined in this hydraulic specification.

In addition to the torque requirements of the drive system, the selection of the coupling size shall be verified through the pump Manufacturer calculating and submitting to the Engineer for approval the torsional analysis of the complete pump/driver system. There shall be no torsional critical speed within 15% above or below the specified speed range. The number of vanes times the RPM are part of the speed range.

J. Pump and Drive Support System

The pump shall be supported by rigid concrete piers, which shall be provided by the Installing Contractor. The Manufacturer shall determine the size and placement of anchor bolts. This information shall be used to design the concrete support piers. Anchor bolts shall be supplied by the Installing Contractor prior to concrete placement for pump support, drive support, and bearing support.

The drive system shall be supported by a high ring base of sufficient height to provide access for mounting and servicing the connecting shaft. The high ring base shall be designed to accommodate the specified 400 hp motors as well as future upgrades to 700 hp motors.

K. Painting, Coating, and Surface Preparation

1. Surface Preparation

(a) Solvent Cleaning: Remove all oil, grease, dirt, and other contaminates by solvent cleaning with Varsol, Acetone, or equivalent.

(b) Hand and Power Tool Cleaning: Remove all loose rust, scale, metal chips, weld splatter, and other foreign material by one or more of the following methods:

(1) Power tools

(2) Hand chipping

(3) Scraping

(4) Wire brushing

(5) Blast cleaning to SSPC-SP6

(6) Surface Irregularities: Small surface pits or irregularities are smoothed using Devcon A plastic steel or equivalent.

2. Paint Application

(a) Paint shall be applied using standard spraying equipment or brushing as necessary.

(b) Air temperature and equipment temperature shall be at least 50° F prior to paint application.

(c) Color shall be ANSI 70 Grey.

3. Procedures

(a) Primer coat using medium oil alkyd red oxide primer dry film thicknerr 1.5 to 2.0 mils per coat. The finish coat shall be a synthetic alkyd enamel, ANSI 70 Grey, dry film thickness will be 1.5 to 2.0 mils per coat. Allow a minimum of two (2) hours drying time prior to handling.

L. The pump Manufacturer shall specially handle all painted components and complete assembled pumps to insure that the applied surfaces are not damaged prior to shipment. The preparation for shipment of all applied surfaces shall be taken into consideration when units are skidded for shipping, making all efforts to protect the surfaces from damage.

Part 3 Execution

3.1 Services of Manufacturer

A. Inspection, Start up, and Field Adjustment: Where required by the individual pump Sections, an authorized service representative of the Manufacturer shall visit the site for the number of days indicated in those Sections to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation. Any additional time required to correct Manufacturer-related deficiencies shall not be included in the days indicated.

1. Installation of the equipment

2. Inspection, checking, and adjusting the equipment
3. Startup and field testing for proper operation
4. Performing field adjustments to ensure that the equipment installation and operation comply with the specified requirements.

3.2 Start-up Service

A. Pump start-up will be organized by the installing Contractor. The pump Manufacturer may be required to assist in pump startup services. A typical startup checklist and typical startup procedure will be required of the installing Contractor. See Project Specification Section III. The equipment Manufacturer is responsible to assist the installing Contractor in performing these checklists and startup procedures for the pump start up services.

B. The Manufacturer shall furnish the services of a qualified factory trained field service Engineering for three (3) 8-hour working days at the site o inspect and certify in writing that the equipment has been properly installed, aligned, lubricated, adjusted and readied for operation. After the pumps have been completely installed and wired, the Manufacturer shall do the following:

1. Check seal lubrication
2. Check for proper rotation
3. Check power supply voltage
4. Measure motor operating load and no load current
5. Field test to demonstrate satisfactory pump performance. Obtain flow rate and head for individual pumps and pumps in combination at full and reduced speeds.

3.3 Field Tests

A. Each pump system shall be field tested after installation to demonstrated satisfactory operation without excessive noise, vibration, cavitation, or overheating of bearings. The Manufacturer shall be required to assist with field testing.

B. The following field tests shall be conducted:

1. Startup, check, and operate the pump system over its entire speed range. Vibration shall be within the amplitude limits recommended by the Hydraulic Institute Standards at a minimum of four (4) pumping conditions defined by the Engineer.
2. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least four (4) pumping conditions at each pump rotational speed. Check each power lead to the motor for proper current balance.

3. Determine bearing temperatures by infrared thermometer. A run time of at least twenty (20) minutes shall precede this test, unless insufficient liquid volume is available.

4. Electrical and instrumentation tests shall conform to the requirements of the Sections under which the equipment is specified.

C. Field testing will be witnessed by the Engineer. The installing Contractor shall furnish seven (7) days advance notice of field testing.

D. In the event any pumping system fails to meet the test requirements, it shall be modified and retested as above until it satisfies the requirements.

E. After each pumping system has satisfied the requirements, the Installing Contractor shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data. The Manufacturer shall certify in writing successful completion of the field tests.

F. The Installing Contractor shall bear all costs of field tests, except for power and water which the Owner will bear. If available, the Owner's operating personnel may provide assistance in field testing. No additional compensation will be provided for the Manufacturer's personnel during start up.

3.4 Instruction of Owner's Personnel

A. During the initial start-up inspection, the Manufacturer's service representative shall also provide one (1) 8-hour working day to review recommended operation and maintenance procedures specific to the models of equipment provided including step-by-step troubleshooting with necessary test equipment with the Owner's personnel. The representative shall have a minimum of two (2) years of experience in training.

B. A resume for the representative shall be submitted.

C. Training shall be scheduled a minimum of three (3) weeks in advance of the first session.

D. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.

E. The training materials shall remain with the trainees.

F. The Owner may videotape the training for later use with Owner's personnel.

3.5 Factory Testing

A. Testing performed upon each pump shall include the following inspections:

1. Impeller, motor rating, and electrical connections shall be checked for compliance with this specification.
2. Prior to operating, each pump shall be run dry to establish correct rotation.
3. All motors shall be assembled, test, and certified at the motor factory and the working clearances checked to insure that all parts are properly fitted. The tests shall be in accordance with ANSI/IEEE 112 – Test Procedures for Polyphase Induction Motors and Generators, and ANSI/IEEE 115 – Test Procedures for Synchronous Machines, including heat run and efficiency tests. All computations shall be recorded, certified, dated, and submitted to the District.

B. A written quality assurance record confirming the above testing/inspections shall be supplied with each pump at the time of shipment.

C. Motors: All motors of sizes 100 hp and larger shall be assembled, tested, and certified at the motor factory and the working clearances checked to insure that all parts are properly fitted. The tests shall be in accordance with ANSI/IEE 112 - Test Procedures for Polyphase Induction Motors and Generators, and ANSI/IEEE 115 – Test Procedures for Synchronous Machines, including heat run and efficiency tests. All computations shall be recorded and certified and dated copies of the test results shall be furnished.

D. Pump Systems: All centrifugal pump systems 10 hp and larger shall be successfully tested under simulated field conditions at the pump factory in accordance with the Test Code for Centrifugal Pumps of the Standards of the Hydraulic Institute, Inc. Tests shall be performed using the complete pump system to be furnished, including the motor. Testing of prototype models will not be acceptable. The following minimum test data shall be submitted:
   1. Hydrostatic test data
   2. A minimum of five (5) hydraulic test readings between shutoff head and 25” beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.
   3. Pump curves showing head, flow, bhp, efficiency, and NPSH requirements.
   4. Certification that the pump horsepower demand did not exceed the rated motor hp beyond the 1.15 service rating at any point on the curve.

E. Factory Witnessed Tests: All pumps and motors, 150 hp and larger shall be factory-tested as complete assembled systems with Owner motor and shall be witnessed by the Owner. The Contractor shall give the Owner a minimum of two (2) weeks notification prior to the test. The Manufacturer shall pay the travel expenses, including airfare, lodging, and meals, for one (1) person from the Owner if the testing facility is more than 300 miles from the Owner. Test results shall be submitted to the Engineer and no equipment shall be shipped until the test data has been approved by the Engineer.

F. Acceptance: In the event of failure of any pump to meet any of the specified requirements, the Contractor shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be re-tested at no additional cost to the Owner until found satisfactory.

3.6 Equipment Supplier

A. The equipment shall be supplied by a local representative of the Manufacturer. The local representative must offer in-house service capabilities as a normal scope of his business. As a minimum, the representative must have at his local facility a complete equipment service shop arranged and equipped to provide in-house factory authorized service for any equipment supplied. The representative must offer twenty-four (24) hour emergency field service capabilities year round by factory trained and authorized technicians.

End of Section

Equipment Procurement for Cherry Valley Lift Station Pump Replacement
Capital Project No. 1911

The following checklist is designed to assist the Contractor in the pre-startup process.

I. Pre-Startup Checklist

A. Prior to the day of the official Engineer-witnessed startup, the Contractor shall verify that all of the following items have been completed:

1.	The pump is connected to the force main and not to another temporary discharge.	
2.	All valves in the lift station are functioning properly and set correctly for the start of testing.	
3.	Force main is full; all air has been bled out.	
4.	Pressure pipe has been tested for leaks.	
5.	Pump vendor has checked and approved the pumps for all items listed under 43 21 13, Section 3.	
6.	Contractor has confirmed that the pump vendor will be present again at the Engineer-witnessed startup to provide technical support as needed.	
7.	Control system representative has fully programmed systems and performed troubleshooting.	
8.	All equipment that requires startup testing shall be installed, programmed, and operating as specified.	
Notes:		

B. The Engineer-witnessed startup will only be performed once the Contractor is confident that the pump is fully installed, programmed, and operating. The Engineer will not operate the system, coordinate start-up problems of troubleshoot with the Contractor.

II. Start-up Procedure

A. The Engineer-witnessed start-up will only be performed once all items in the Pre-Startup Checklist have been completed.

B. The following functions should be witnessed during start-up:

1.	Obtain flow rate, head (discharge pressure and wet well level) for the pumps at full and reduced speeds. Compare results to certified factory performance curves.
2.	Pump motor running currents at VFD.
3.	Pump motor voltages.
4.	Pump Sequence:
	a. Normal pump control (transducer)
	b. Redundant pump control, if applicable
5.	Alarm Notifications:
	a. High level
	b. Pump Seal Fail
	c. Pump over Temp
	d. Transducer Failure
6.	Check for proper operation of check valves.

Notes:

Morris Pumps
P.O. Box 6620
3905 Enterprise Court
Aurora, IL 60598-0620

(630) 236-6900
Fax (630) 236-6932

SUBMITTAL DATA

Issue # 2 – May, 2019

PROJECT NAME

CHERRY VALLEY LIFT STATION PUMP REPLACEMENT CAPITAL PROJECT NO. 1911
Rockford, IL

SUBMITTED DATA

Specification Section 43 21 13
Centrifugal Liquid Pumps

MORRIS PUMPS ORDER NUMBER

PS-005496

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Rock River Cherry Valley Lift Station
Morris SO PS-005496

SECTION 1

MORRIS EQUIPMENT PACKAGE
Type 7100, Heavy-Duty Non-Clog Pumps

PROJECT DESCRIPTION

Job Name:	**Rock River Cherry Valley Lift Station**
Location:	Rockford, IL
Description:	Raw Wastewater Pumps
Specifications:	Section 43 21 13 – Centrifugal Liquid Pumps
Morris Order No:	PS-005496

PUMP(S) & ACCESSORIES

Type:	Morris Pumps, Series 7100, Vertical, Non-Clog Pump
Model / Size:	(2) NC 12 x 12-25 3V, 12" Suction, 12" Discharge, 3.0" Max. Sphere
Rated Point:	7,500 GPM @ 151' TDH

Accessories/Features:

- Cast Iron Construction
- Mechanical Seal w/ Throat Bushing
- 420 SS Wear Rings
- 4150 Steel Shaft
- 420 SS Shaft Sleeve
- Soleplates
- Motor Supports
- 12"X14"LR Reducing Suction Elbow
- Pump Bearing Vibration Switches
- John Crane 3740 seal

Finish: SSPC-SP5 Surface Prep.
(1) Coat Tnemec 69 Epoxy Primer 4-6 mils min. DFT - Gray

MORRIS EQUIPMENT PACKAGE
Type 7100, Heavy-Duty Non-Clog Pumps

MOTOR & ACCESSORIES

Manufacturer: Nidec

Description: (2) 400 HP, 1180 RPM, 3 phase, 480 volt, 60 Hz, Inverter Duty

Configuration: Vertical, TEFC

Accessories/Features:
- Thermasentry Thermistors
- Motor Bearing Vibration Switches (Provided and Installed by Morris)

SPARE PARTS

- NONE

SOURCE QUALITY CONTROL

Factory Tests will conform to the Hydraulic Institute Standard and in accordance with the specification, as described below.

- Balancing – Balance in accordance with ISO 1940 G6.2.
- Hydrostatic Test – Non-witnessed, in accordance with the Hydraulic Institute Standards
- Pump Performance Testing – Witnessed, in accordance with the Hydraulic Institute Standards and Specification 43 21 13.
- Motor Factory Testing – Non-witnessed, complete initial test in accordance with NEMA MG1 and Specification 43 05 13.
- Lateral & Torsional Analysis
- 2 Year Warranty from Startup, not to exceed 30 months from Shipment.

FIELD SERVICE

Installation Inspection, Start-up & Testing Supervision, and Training to be provided by Morris Pumps and/or their sub-contractor's technicians, in accordance with Specifications. A Certificate of Proper Installation will be provided upon the completion of the Installation Inspection, and the satisfactory demonstration thereof. Morris Pumps will utilize our leveling, alignment, vibration, and temperature devices to conduct inspection, startup, and testing. Other instrumentation, such as gauges, torque wrench, and flow meters, are to be provided by others.

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3905 Enterprise Court
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Fax (630) 236-5511

Certificate of Equipment Warranty

CHERRY VALLEY LIFT STATION PUMP REPLACEMENT

Morris Pump Order Number PS-005496

For a period of two (2) years from the date of startup and Owner acceptance, Morris Pumps warrants that the equipment covered by this order shall be free of defects in material and workmanship under normal use and service and when properly installed. Morris Pumps agrees to repair or replace F.O.B. point of shipment, such equipment, or any part thereof, previously furnished by Morris Pumps as actually found by Morris Pumps after inspection as defective, provided: (a) said equipment has been properly installed, operated and maintained by Buyer in accordance with Morris Pumps' recommendations and specifications, and (b) Buyer notifies Morris Pumps, Aurora, Illinois in writing as soon as any such defect becomes apparent. Any claim by Buyer with reference to the equipment sold hereunder for any cause shall be deemed waived by Buyer unless submitted to Morris Pumps in writing within thirty (30) days from the date the Buyer discovered, or should have discovered, any claimed breach. Unless agreed to the contrary by Morris Pumps in writing, any work done, material furnished, repairs or designs made by others, shall void the warranty.

Equipment not manufactured by Morris Pump, but covered under this order, such as the motors and intermediate shafting, will carry the same two (2) year warranty, and will be administered with the equipment manufacturer by Morris Pumps.

Morris Pumps shall not be liable for incidental or consequential losses, damages or expenses directly or indirectly arising from the sale, handling or use of the equipment, or from any other cause relating thereto, and Morris Pumps' liability hereunder in any case is expressly limited to the replacement (in the form originally shipped) of equipment or any part thereof, not complying with this order, or, at Morris Pumps' election, to the repayment of, or crediting Buyer with an amount equal to the purchase price of such equipment, whether such claims are for breach of warranty or negligence.

THIS WARRANTY IS EXPRESSLY MADE IN LIEU OF ANY AND ALL OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS.

MORRIS PUMPS

SECTION 2

Morris Pump
P.O. Box 6620
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SPECIFICATION - COMMENTS & CLARIFICATIONS (Technical)
CHERRY VALLEY LIFT STATION PUMP REPLACEMENT
CAPITAL PROJECT NO. 1911
Rockford, IL

April 2019

GENERAL
The following are Morris Pumps' comments and clarifications to the technical aspects of the Contract Documents. Morris Pumps will provide our scope of supply in accordance with these comments, unless otherwise indicated by the Reviewer, and clearly referenced in this submittal.

Morris Pumps utilizes the Shop Drawings, as a means to communicate our Scope of Supply and understanding of the Contract Documents. Similarly, the Shop Drawings are to be utilized by the Reviewer as a means to confirm and communicate any and all dimensional corrections and/or scope-related issues, prior to our manufacturing of the equipment.

SECTION 43 05 13 – COMMON MOTOR REQUIREMENTS FOR LIQUID PUMPS

1) Item 2.1.A.11 – Vibration Switches: Morris Pumps will provide the specified vibration switches for all pumps and motors. Nidec will provide the mounting provisions only for the switches. One switch will be installed at the top bearing of each pump and motor.

SECTION 43 21 13 – CENTRIFUGAL LIQUID PUMPS

2) Item 1.5 – Submittals: For clarification, Morris Pumps has provided in this submittal a list of those items that will be submitted later at the appropriate stages of the project.
3) Item 1.5.A.3 – Recommended Limits: The AOR (allowable operating region) designation on the predicted performance curve indicates our recommendation for stable operation of the pump.
4) Item 1.5.A.5 – Service Facility: While our local manufacturer's representative has their own in-house service capabilities, we suggest using Morris Pumps service facility located in our manufacturing plant, which is located closer to the Rock River facility. Our factory service facility is located in Aurora, IL at 3905 Enterprise Court. We employ four service technicians, plus two pump assemblers in our manufacturing department. Our overhead crane is rated at 20,000 LBS.
5) Item 1.5.A.7 – Shipping Weights: Uncrated weights of major components are shown on our submittal installation drawings. Crated weights are typically 5-10% greater.
6) Item 1.5.F – Spare Parts: No spare parts were proposed.
7) Item 1.5.I – Certifications: Certifications will be provided when the respective tasks are complete.
8) Item 2.4.A – Shaft: Shaft material will be AISI 4150 alloy steel.
9) Item 3.1.A.1 – Installation Supervision: Morris Pumps will provide installation assistance as required via customary communication methods and site visits if necessary, but it should be understood that we cannot station someone onsite for the duration of the installation. We assume that the installation is to be performed by knowledgeable personnel using accepted best practices, and we will provide the project-specific O&M Manual containing detailed installation guidelines prior to installation.

ADDENDUM – Addendum No.1 is acknowledged.

Morris Pumps
3905 Enterprise Court
Aurora, IL 60504

(630) 236-5500
Direct (630) 499-6917
Fax (559) 346-6820

Vertical Pump Installations

White Clay Creek P.S.
New Castle Public Works
New Castle, DE
Regis Yurcich
(302) 322-9813
(5) NC 20x20-41 3V
400 hp, 500 rpm
2005

Lake Rhodhiss WWTP
Division of Water Quality
Valdese, NC
Greg Padgett
(828) 879-2131
(2) NC 16 x16-33 2V
200 hp, 590 rpm
2003

Riverside Road P.S.
Fulton County Dept. of Public Works
O. P. Shukla
(404) 612-0225
(6) NC 16x16-33 2V
900 hp, 880 rpm
2009

Scanlon Station
Western Lake Superior S.D.
Duluth, MN
Jim Benning
(218) 730-5105
(3) NC 16x16-33 2V
600 hp, 880 rpm
(3) NC 20x20-41 3V
500 hp, 500 rpm
2006

Morris Pumps
3905 Enterprise Court
Aurora, IL 60504

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Vertical Pump Installations

9th Street P.S.
Miami-Dade County Water & Sewer
Miami, FL
John Renfrow
(786) 552-8970
(5) NC 16x16-33 3V
350 hp, 700 rpm
1996

Patapsco S.P.S.
Baltimore County Public Works
Halethorpe, MD
Edward Adams
(410) 887-3300
(4) NC 20x24-41 3V
1000 hp, 700 rpm
2009

ABS Quality Evaluations

Certificate Of Conformance

This is to certify that the Quality Management System of:

Grundfos Water Utility, Inc.

3905 Enterprise Court
Aurora, IL 60504
U.S.A.

has been assessed by ABS Quality Evaluations, Inc. and found to be in conformance with the requirements set forth by:

ISO 9001:2015

The Quality Management System is applicable to:

DESIGN AND MANUFACTURE OF NON-CLOG CENTRIFUGAL PUMPS, GRINDERS, SUBMERSIBLE MOTORS, AND RELATED WASTEWATER EQUIPMENT

This certificate may be found on the ABS QE Website (www.abs-qe.com). For certificates issued in the People's Republic of China information may also be verified on the CNCA website (www.cnca.gov.cn).

Certificate No:	33849
Certification Date:	22 December 1998
Effective Date:	10 August 2018
Expiration Date:	13 December 2019
Issue Date:	10 August 2018

Alex Weisselberg, President

Validity of this certificate is based on the successful completion of the periodic surveillance audits of the management system defined by the above scope and is contingent upon prompt,written notification to ABS Quality Evaluations, Inc. of significant changes to the management system or components thereof.

Morris Pumps
P.O. Box 6620
3905 Enterprise Court
Aurora, IL 60598-0620

(630) 236-6900
Direct (630) 499-6926
Fax (630) 236-6932

CHERRY VALLEY LIFT STATION PUMP REPLACEMENT

CAPITAL PROJECT NO. 1911

Morris SO PS-005496

LIST OF SUBMITTAL ITEMS TO FOLLOW

Lateral & Torsional Analysis

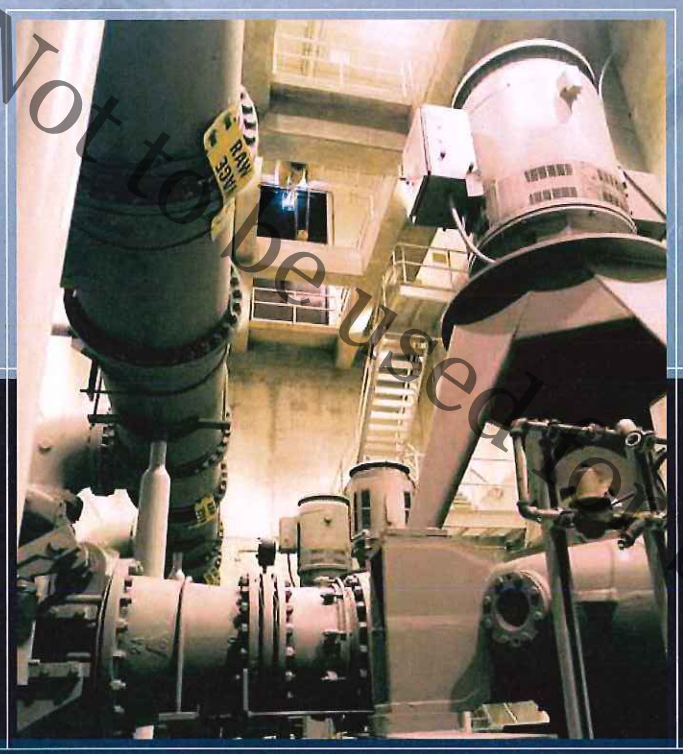
Factory Test Results for Pumps & Motors (Under a separate cover)

Operation & Maintenance Manual (Under a separate cover)

Field Inspection, Startup, & Testing Reports (Under a separate cover)

SECTION 3

SERIES 7100
TYPE NC/EC/MF



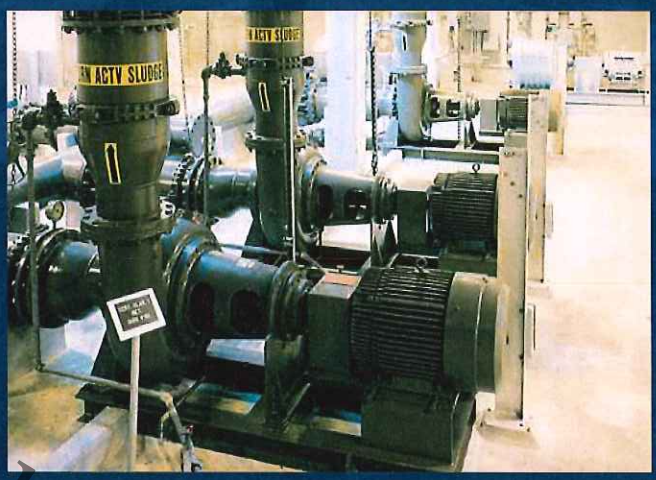
HEAVY-DUTY WASTEWATER PUMPS

MORRIS

BUILT FOR SUPERIOR PERFORMANCE

7100 SERIES / TYPE NC/EC/MF

HIGH-EFFICIENCY, SOLIDS-HANDLING PUMPS



The Morris 7100 is a series of large dry-pit solids-handling pumps for sewage, wastewater, raw water and light slurry applications. Robust materials, thick castings and customized design assure long service life and efficient operation. The impeller and casing design ensures smooth vibration-free pumping.

Each pump application is configured by Morris engineers to meet specific project requirements and operating conditions. The 7100 Series offers a wide hydraulic application range supplemented, when appropriate, by adjustable speed drives to provide solutions that operate within the preferred operating region. Impeller profiles are designed for lowest NPSH requirements, further extending the practical operating range of the pump.

Maintenance and reassembly is simplified by features such as back pull-out design, generous inspection ports, simplified impeller clearance adjustments and self-centering/self-indexing components. The bearing frame designs allow maximum interchangeability across the product range to minimize spare part inventory.

To assure proper system design integration, Morris Pumps takes single-source responsibility for the complete pumping system, including motors, adjustable speed drives, controls, accessories and components as required for the project.

- High efficiency
- Easier maintenance
- Longer life
- Vibration-free pumping

TYPICAL APPLICATIONS

For both wastewater and clean water applications in municipal and industrial processes.

WASTEWATER PUMPING STATIONS

The high flow conditions at end-of-the-line pumping stations and combined sewer/storm systems are the natural home for the Morris 7100. The same applies to controlling equalization basins/tunnel systems to eliminate disruptive surges that could overwhelm the wastewater treatment processes.

RAW WATER INTAKE

The high flow and resistance to abrasion make the Morris 7100 well suited to feeding raw surface water to potable water treatment plants. A minimized footprint reduces the space and construction costs associated with the intake structure.

INDUSTRIAL PROCESSES

Customized solutions can be engineered for water intensive processes such as make-up water in power generation, metal and steel production or wash-down applications. High temperatures, aggressive pumpage or stringy materials are similar typical applications.

CUSTOM SYSTEMS ARE THE STANDARD

JOB MATCHED TO YOUR NEEDS

The flexibility of Morris Series 7100 pumps is based on three hydraulic designs as well as a wide choice of sizes, configurations and materials. Based on your specifications, a Morris engineer will select and specify the right solution in terms of pump speed, efficiency, specific speed, driver size, wear, equipment life or cost. The system is factory assembled and tested prior to shipment to further ensure you get a cost-effective solution that delivers long-term reliability.

The standard material selection for wastewater is cast gray iron due to its low cost and characteristic strength and durability. If mild corrosion or abrasion protection is required, a 3% nickel iron is suggested due to the wear resistance and uniformity of castings. For high head/high pressure or heavy shock load applications Morris offers optional ductile iron construction for increased strength and overall toughness.

Various grades of stainless steel and special metallurgies are available, for example CD4MCu (duplex stainless steel), high-chrome iron, Ni-Hard, bronze, or other unique metals to meet the most demanding corrosive or abrasive applications.

Morris utilizes standard and modified Francis Vane or mixed flow impeller designs. Most pump models are available in either 2 or 3 vane impellers (some with 4 or 5 vane impellers) to suit the specific conditions.

A variety of mechanical shaft seals and packing solutions are available as appropriate to the application.

SPECIFICATIONS

- Capacities to 150,000 GPM (34,000 m3/h)
- Heads to 260 ft (79 m)
- Temperatures to 250° F (120° C)
- Pressures to 110 PSIG (758 kPa)
- Discharge sizes from 4" to 54 " (100 – 135 mm)
- Solids to 9 ¾" (388 mm)

7100 SERIES / TYPE NC/EC/MF

ENSURING LONGER LIFE AND EASIER MAINTENANCE

SEAL WATER DRAIN

A tapped drain at the lowest point on the stuffing box cover permits continuous drainage of all leakage from the stuffing box.

PUMP SUPPORT FEET

Vertical configured pumps (VPM and VOS) are designed for three-point mounting at the pump casing. When the driver is to be coupled directly to the pump (VPM), Morris' exclusive fabricated pedestal is mounted directly on the pump feet. This places the motor's weight on the support piers. No stress is "passed through" the pump casing. (Smaller motors may also be pedestal mounted directly on the bearing frame.)

INSPECTION PORTS

A generous and smooth internally contoured inspection plate is provided on the casing. Inspection ports may be optionally furnished in suction elbow or suction spool piece.

FLUSH WATER RINGS (OPTIONAL)

A series of holes in the suction cover wear ring allows water to be continuously injected during pump operation. This water injection flushes away abrasives and fibrous material, thus extending the wear life of the wet-end components.

TEMPERATURE AND VIBRATION MONITORING (OPTIONAL)

A wide variety of temperature and vibration monitoring devices are available. A conveniently located pump-mounted junction box can be supplied to terminate the sensor conductors and facilitate connections to customer's instrumentation system.

BEARINGS

Engineered for a minimum B-10 life of 100,000 hours. Grease lubricated bearings are standard on most pumps with oil lubricated bearings optional on most.

IMPELLER ADJUSTMENTS

Shims between the upper face of the casing cover and bearing frame allow a simple but effective method of maintaining impeller clearances. Wear ring and pump life is enhanced when impeller clearance is optimized.

STUFFING BOX

The easily accessible stuffing box and split gland make adjustment or repacking a simple procedure. The proper box proportions and seal cage design help ensure low temperatures and extended packing life. Standard stuffing box dimensions allow the use of a variety of optional mechanical seals.

SHAFT AND SHAFT SEAL

The alloy steel pump shaft is protected from abrasion in the stuffing box area by a hardened stainless steel shaft sleeve. The sleeve design effectively seals the shaft from the pumped liquid.

IMPELLER

The impeller is designed for optimum balance between efficiency, solids handling and abrasion resistance. Multiple vane impellers are available for each pump model.

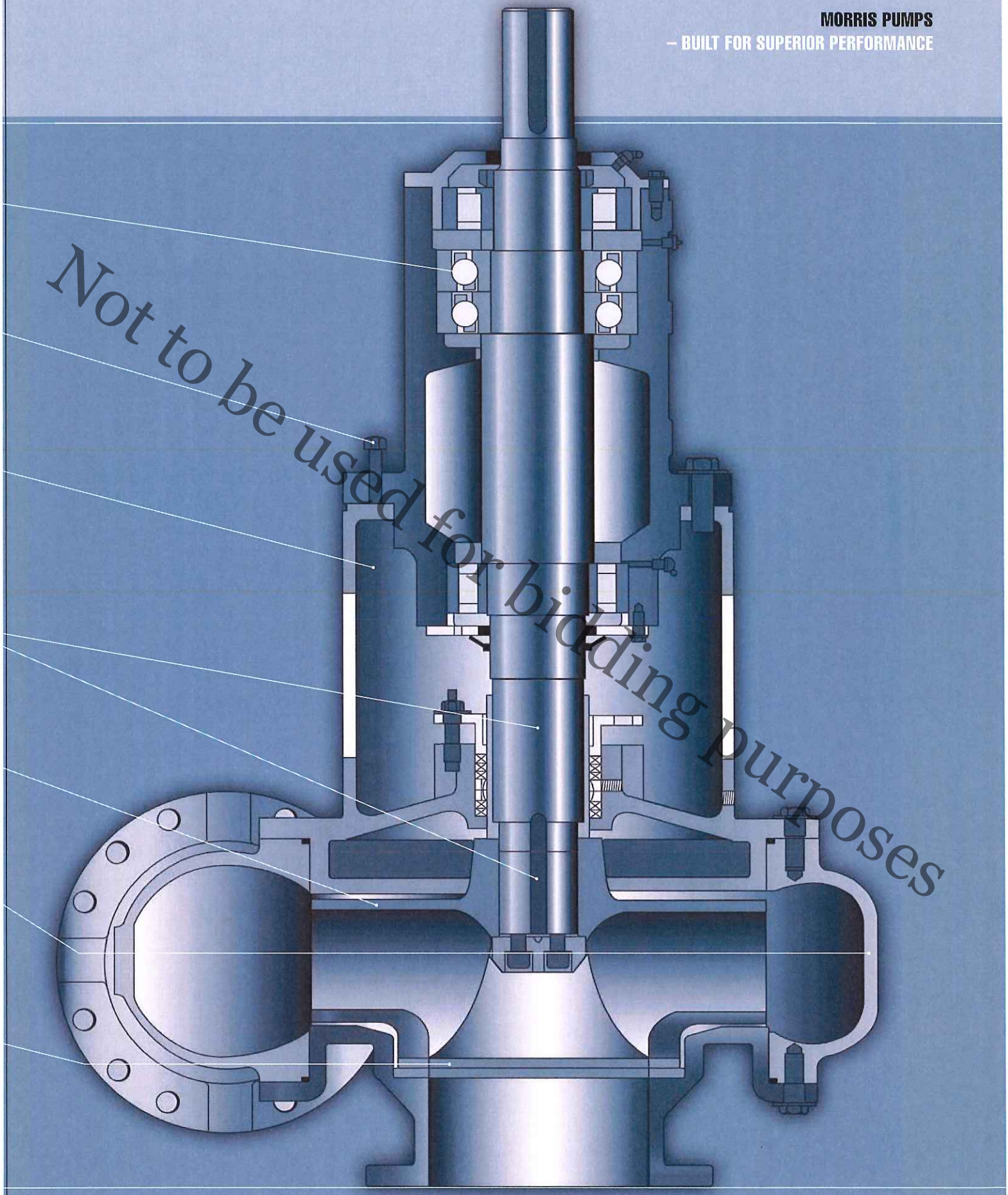
PUMP CASING

The casing is a one-piece design for smooth hydraulic flow and maximum solids passage. Extra thick casting walls provide extended protection against abrasion and corrosion. Back pull-out design allows removal of the impeller and bearing frame without disturbing existing piping.

WEAR RINGS

Replaceable hardened stainless steel rings protect the impeller and suction cover from wear. Axial sealing permits impeller adjustment to maintain proper clearance. Wear rings available in optional materials and hardness ratings.

MORRIS PUMPS
– BUILT FOR SUPERIOR PERFORMANCE



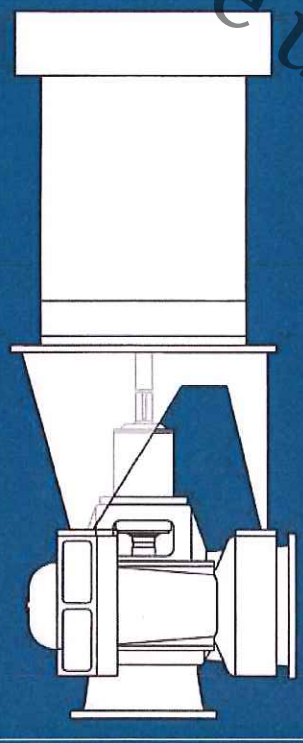
7100 SERIES
FLEXIBLE INSTALLATION

Morris 7100 Series is available in mounting configurations to meet your installation needs. Morris applications engineers will select or fabricate the best configuration to meet the unique requirements of each installation.

Vertical mounting is available in both pier-mount or pedestal-mount on most models.

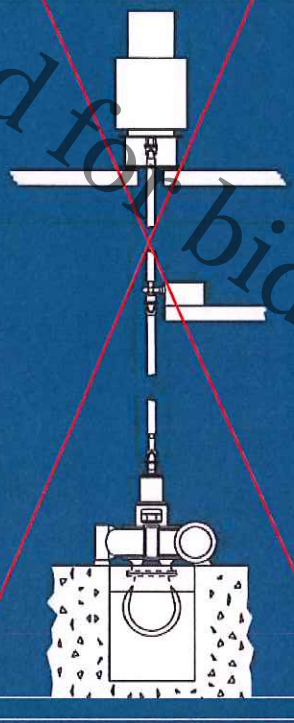
VERTICAL PEDESTAL MOUNTED

The motor is directly mounted and connected to the pump assembly.



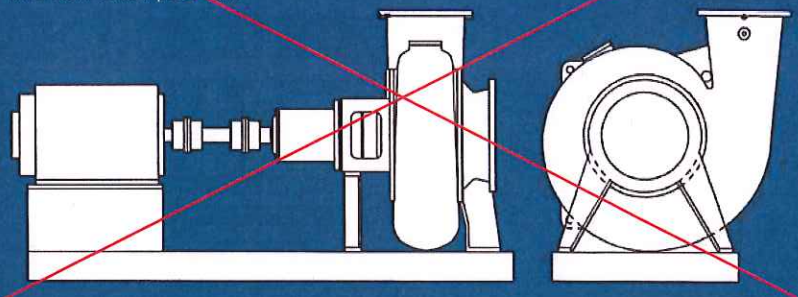
VERTICAL OPEN SHAFT

A common configuration when motor location requires remote mounting at higher elevation due to flooding or space requirements.



HORIZONTAL BALL BEARING

A fabricated steel base supports both the pump and driver in a horizontal position.



BEST EFFICIENCY BY FULL HYDRAULIC COVERAGE

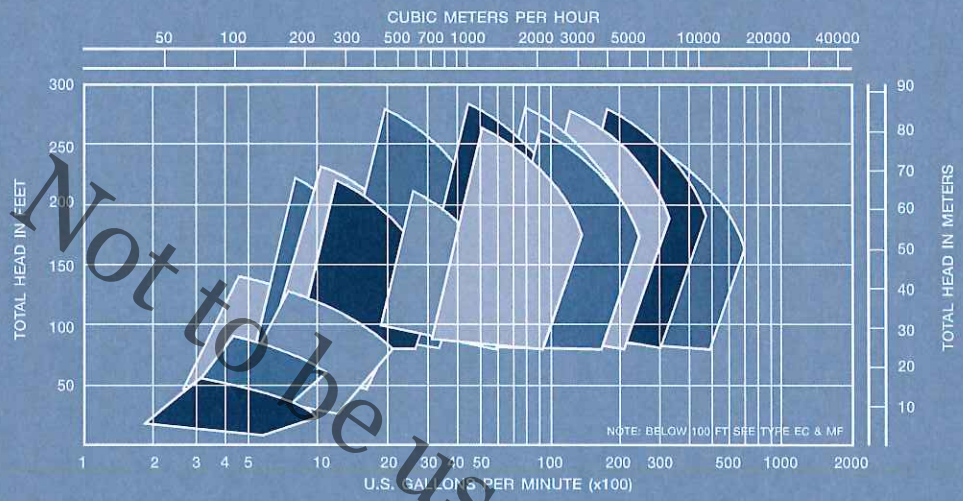
Morris pumps cover the complete range of flow and head requirements encountered in municipal and industrial solids handling applications. Shown to the right are the three distinct hydraulic designs that provide the highest practical pump speed for a given head in combination with low NPSH requirements.

This job-matched approach maximizes operation and performance efficiencies while minimizing the physical size of the pump and the power requirements.

On the basis of the operating conditions identified by the specifier, Morris consultants select a pump to achieve the appropriate specific speed. Specific speed is a correlation of pump capacity, head and speed at the best efficiency point (BEP) and is indicative of the shape, hydraulic geometry and characteristics of an impeller and casing. These design considerations enable the pump system designer to predict pump suction requirements and to verify pump and station intake design limitations.

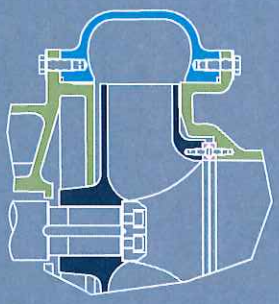
7100 SERIES / TYPE NC/EC/MF

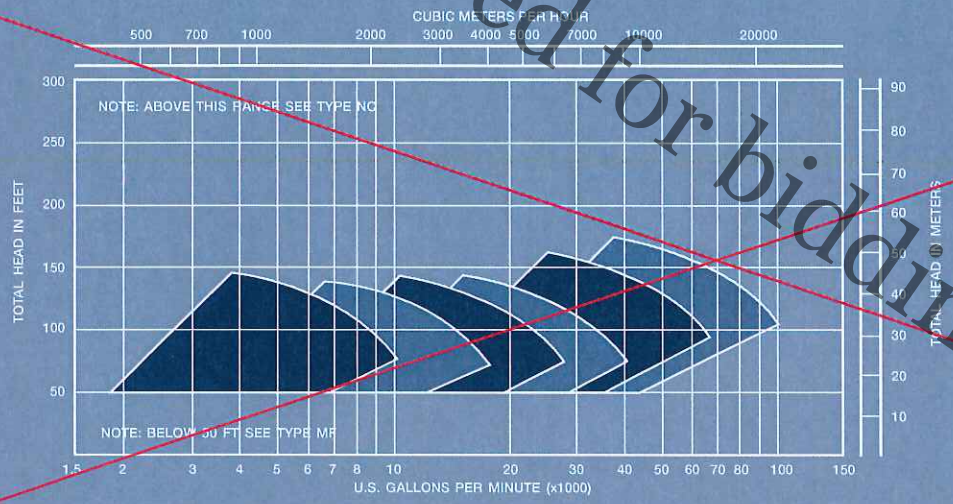
BEST EFFICIENCY BY FULL HYDRAULIC COVERAGE



NON CLOG IMPELLER (NC)

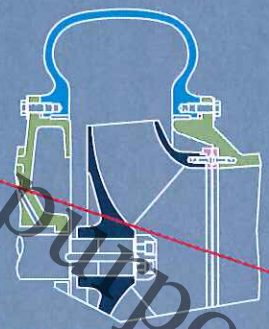
- Head Range: High (275' TDH max.; BEP TDH's ~200')
- Capacity Range: Up to 75,000 USGPM
- Impeller Type: Francis Vane
- Specific Speed Range: 1,800 ~ 2,700

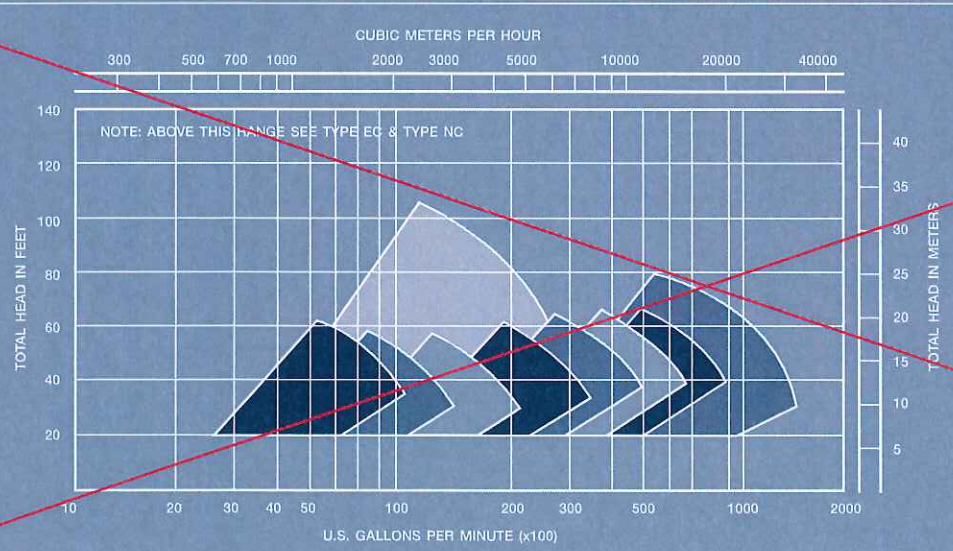




EXTRA CAPACITY IMPELLER (EC)

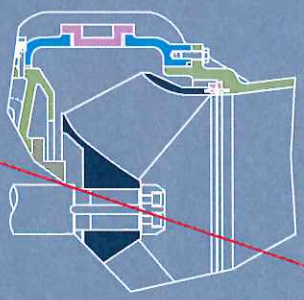
- Head Range: (175' TDH max.; BEP TDH's ~100')
- Capacity Range: Up to 100,000 USGPM
- Impeller Type: Modified Francis Vane
- Specific Speed Range: 2,700 ~ 3,700





MIXED FLOW IMPELLER (MF)

- Head Range: Low (100' TDH max.; BEP TDH's ~50')
- Capacity Range: Up to 150,000 USGPM
- Impeller Type: Mixed Flow
- Specific Speed Range: 4,700 ~ 5,800



WHEN OTHER PUMPS CAN'T TAKE IT

The Morris 7100 is a series of large dry-pit pumps that can handle large and abrasive solids.

For over 150 years, Morris pumps have been built using proven design and manufacturing methods. This rich history combines with an effective utilization of today's engineering methods and technologies to bring a pumping solution built for superior performance .

We work hand-in-hand with pumping system designers and consultants. We pride ourselves in bringing the end-user a reliable, trouble-free system that exceeds expectations.

Morris Pumps stands for tough, heavy-duty wastewater pumps manufactured by Yeomans Chicago Corporation.

MORRIS 7100 WASTEWATER PUMPS ARE BUILT FOR SUPERIOR PERFORMANCE

MORRIS PUMPS

3905 Enterprise Court
P.O. Box 6620
Aurora, IL 60598-0620
Phone 630-236-6900
Fax 630-236-6932

www.morrispumps.com

GRUNDFOS

Water Utility Inc.

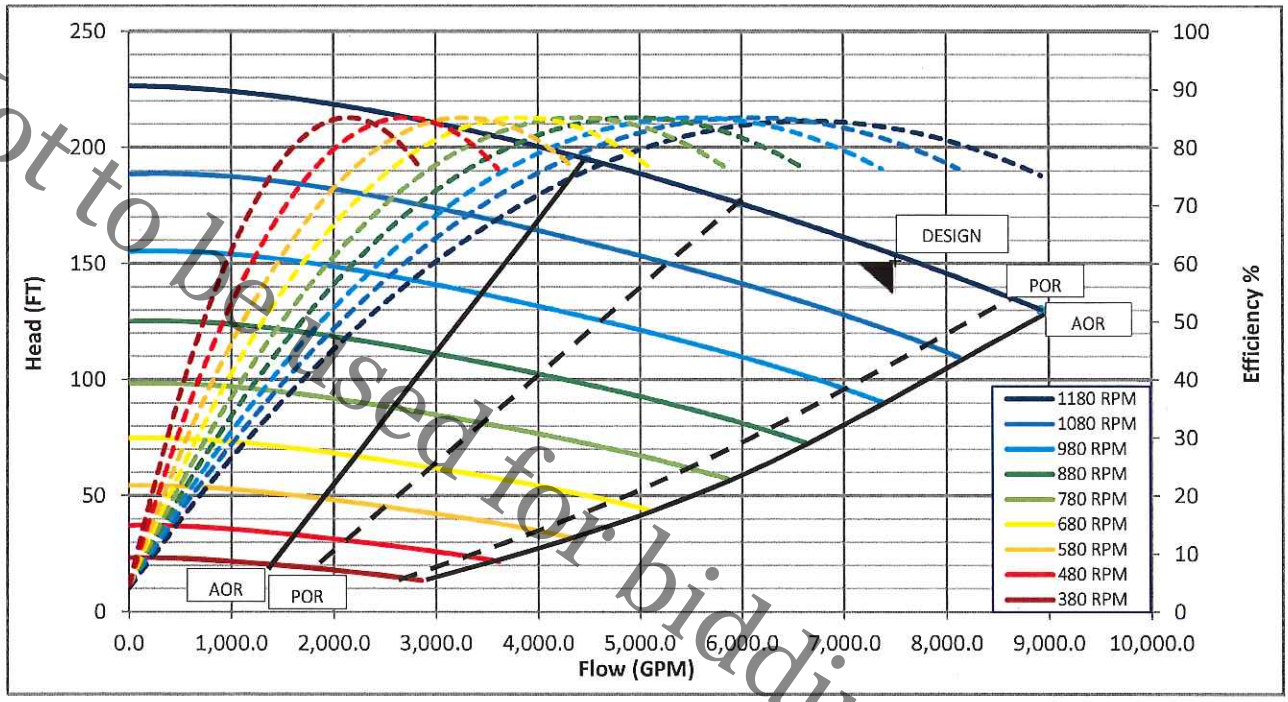
Aurora, IL

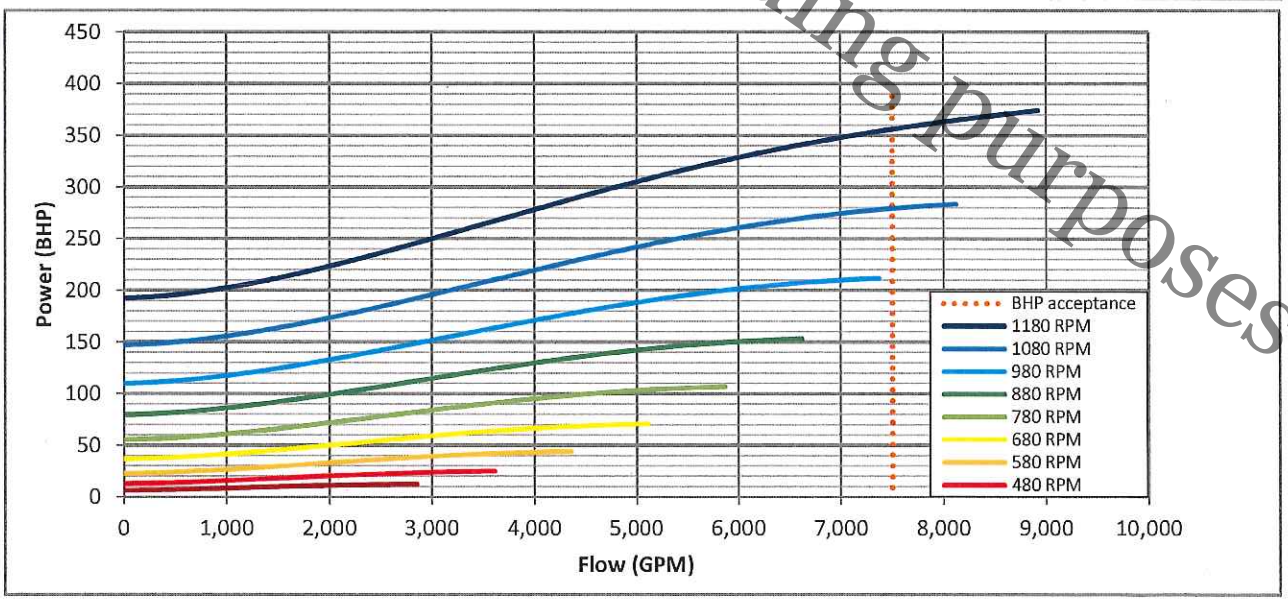
Job Reference: Rock River Cherry Valley

Quote number/Sales Order: PS-005496

PREDICTED PERFORMANCE CURVE

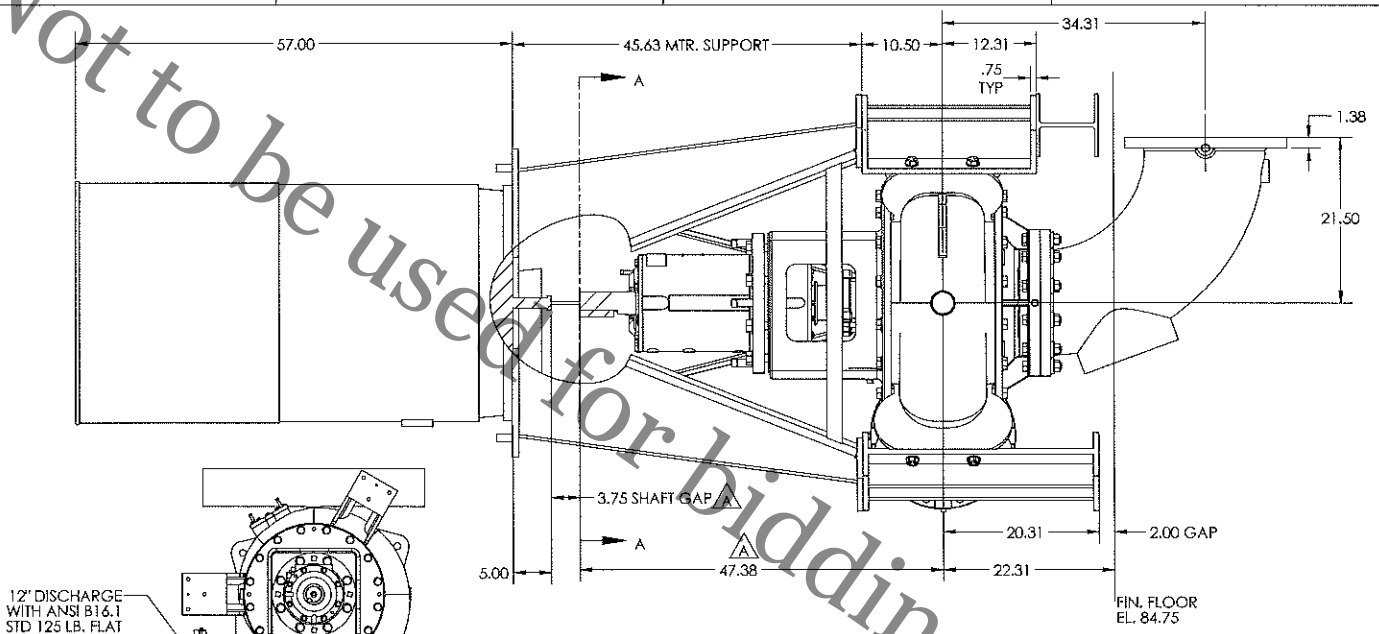
TRIM:	21.375	*DATE:*	March 29, 2019	*PUMP:*	Morris 7100 NC12X12-253V
RPM:	1180	*FLOW:*	7,500 gpm	*HEAD:*	151 feet

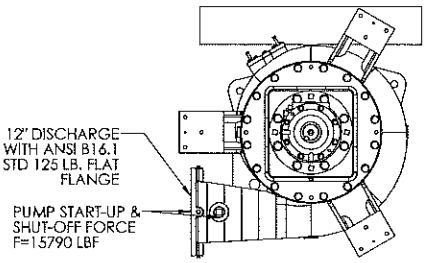




Curves and Data for Both Efficiency and Power are for **Reference Only** and are **NOT Guaranteed**

Impeller Casting:	C5072500AA	**Solid Size:**	3





SECTION A-A
SCALE 1 : 20

APPROXIMATE WEIGHT (LB)

PUMP	3,200
MOTOR	4,700
MOTOR SUPPORT	1,020
SUCTION ELBOW	442
TOTAL	9,362

NOTES:
1. CONTRACTOR TO CONFIRM ALL ELEVATIONS.
2. MINIMUM 1.00 IN. NON-SHRINK GROUT UNDER EQUIPMENT SUPPORTS.
3. ALL CONCRETE EQUIPMENT SUPPORTS (I.E. PADS, PIERS, ETC.) AND ANCHORS PROXIMITY TO EDGE TO BE DETERMINED BY OTHERS.
4. F max=((DISCHARGE DIA^2*PI)/4)*HEAD@SHUT-OFF/2.31]*(SAFETY FACTOR=1.5).
5. BOTH SUCTION AND DISCHARGE PIPES SHOULD BE SUPPORTED INDEPENDENTLY, NEAR THE PUMP, SO THAT WHEN THE FLANGE BOLTS ARE TIGHTENED, NO STRAIN WILL BE TRANSMITTED TO THE PUMP CASING.

REV.	DATE	ECN	ECN NO. / DESCRIPTION	BY	CKD
A	5/22/2019	A3, 2-A, 2-B	MOTOR SUPPORT DESIGN CHANGED FOR FUTURE 700 HP MOTOR OPTION	MJ	MK

THIRD ANGLE PROJECTION

STANDARD MACHINE TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS IN INCHES

// .005 TIR	±.02 TWO PLACE DECIMAL
⊥ .005 TIR	±.005 THREE PLACE DECIMAL
◎ .005 TIR	BREAK OUTSIDE EDGES .005-.035
∕ .005 TIR	INSIDE CORNER R .035 MAX
∠ ±.5°	ALL DRILL & TAP DEPTHS ± .06
√ 125 RMS	

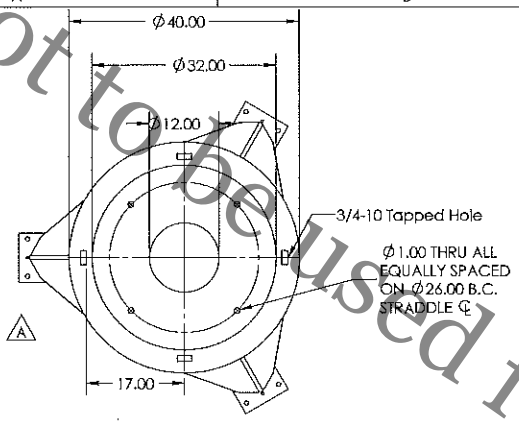
DO NOT SCALE DRAWING
WEIGHT: Weight
SCALE: 1:12
ORDER NO.

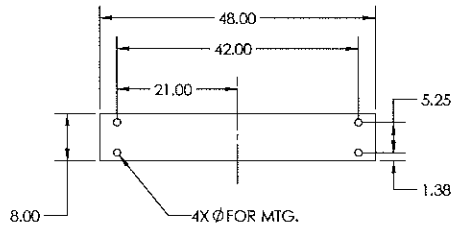
DRAWN BY: EFI DATE: 5/22/2019
CHECKED BY: SMO

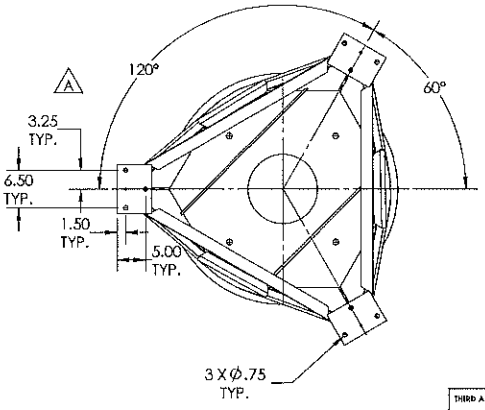
GRUNDFOS
Water Utility, Inc
AURORA, IL USA

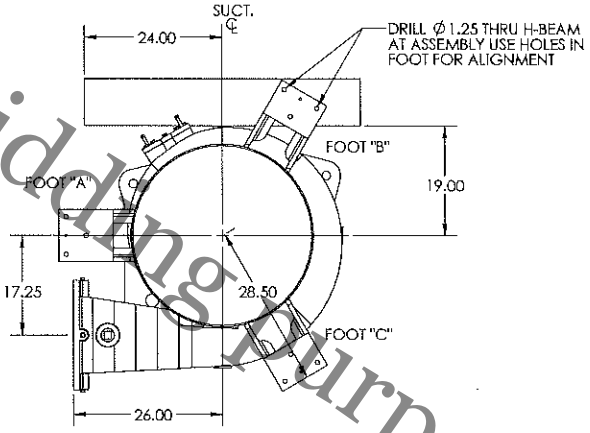
DESCRIPTION: INSTALLATION DRAWING
MODEL: NC 121225 3V3 PATTERN NO.

DWG. SIZE: B
DWG. NO.: PS-005496
REV.: A









REV.	DATE	ZONE	ECN NO. / DESCRIPTION	BY	CKD
-	-	-	See Sheet1	-	-

THIRD ANGLE PROJECTION

STANDARD MACHINE TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS IN INCHES

//	.005 TIR
⊥	.005 TIR
◎	.005 TIR
/	.005 TIR
∠	± .5°
√	125 RMS

±.02 TWO PLACE DECIMAL
±.005 THREE PLACE DECIMAL
BREAK OUTSIDE EDGES .005-.035
INSIDE CORNER R .035 MAX
ALL DRILL & TAP DEPTHS ± .06

DO NOT SCALE DRAWING
WEIGHT: N/A
PLOT SCALE: N/A
ORDER NO.

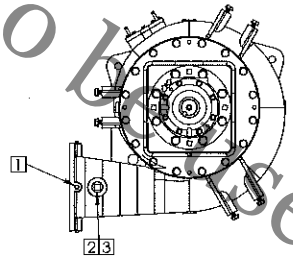
DRAWN BY: EFJ DATE: 5/22/2019
CHECKED BY: SMO

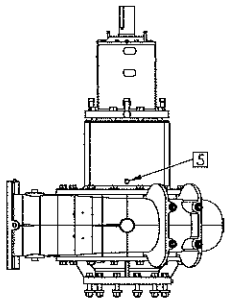
GRUNDFOS
Water Utility, Inc
AURORA, IL USA

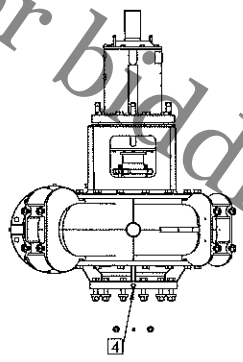
DESCRIPTION: INSTALLATION DETAILS
MODEL: NC 121225 3V3
PATENT NO.:

DWG. SIZE: B
DWG. NO.: PS-005496-1B
REV.: A

CONNECTIONS		
ITEM	SIZE NPT	DESCRIPTION
1	1/2	FOR GAUGE IN VOLUTE
2	2	FOR VENT IN VOLUTE
3	2	FOR DRAIN IN VOLUTE
4	1/2	FOR GAUGE IN SUCTION COVER
5	3/4	FOR DRAIN IN STUFFING BOX COVER







NOTES:
1. PER H.I.1.4.3.5.1 SUCTION AND DISCHARGE PIPING MUST BE ANCHORED, SUPPORTED & RESTRAINED NEAR THE PUMP TO AVOID APPLICATION OF FORCE & MOVEMENTS TO THE PUMP.
2. GAUGE LOCATIONS PER ANSI/HI 1.6.10.1.1 ARE RECOMMENDED.

REV.	DATE	SONE	ECN NO. / DESCRIPTION	BY	CKD
-	-	-	See Sheet1	-	-

THIRD ANGLE PROJECTION

STANDARD MACHINE TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS IN INCHES

// .005 TIR
⊥ .005 TIR
◎ .005 TIR
/ .005 TIR
∠ ± .5°
√ 125 RMS

±.02 TWO PLACE DECIMAL
±.005 THREE PLACE DECIMAL
BREAK OUTSIDE EDGES .005-.035
INSIDE CORNER R .035 MAX
ALL DRILL & TAP DEPTHS ± .06

DO NOT SCALE DRAWING

WEIGHT: N/A
PLOT SCALE: N/A
ORDER NO.

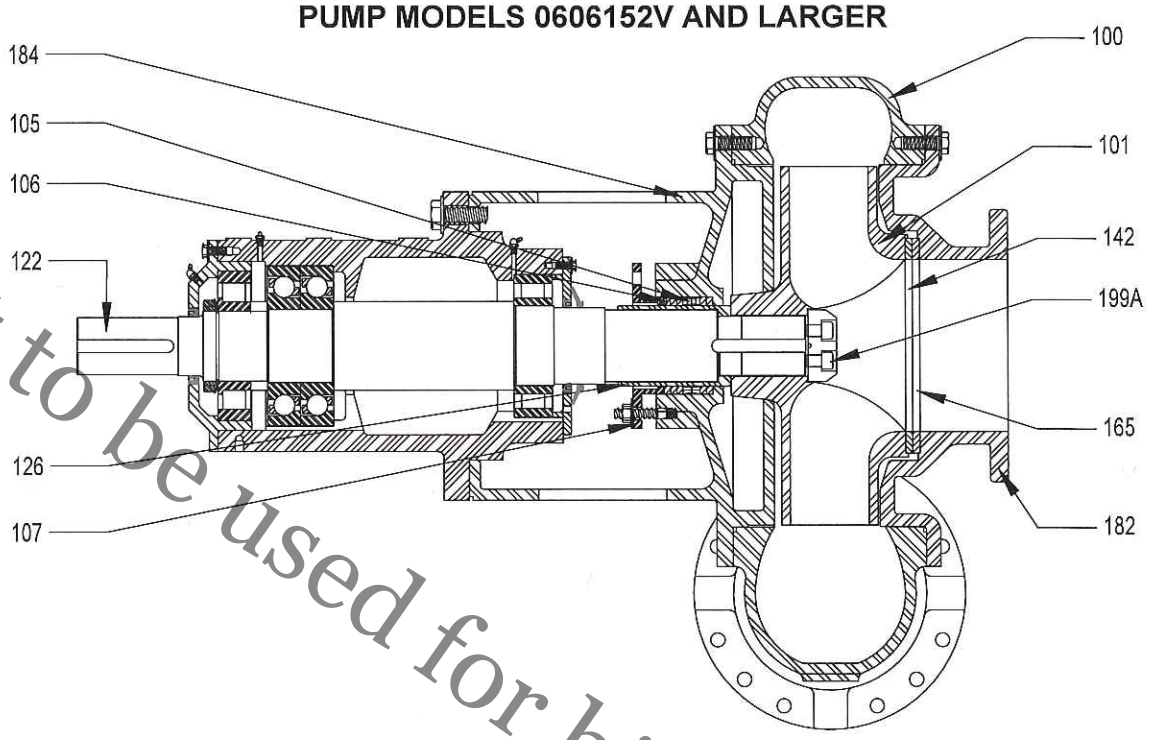
DRAWN BY: EFI DATE: 5/22/2019
CHECKED BY: SMO

GRUNDFOS
Water Utility, Inc
AURORA, IL USA

DESCRIPTION: INSTALLATION DETAILS
MODEL: NC 121225 3V3
PATTERN NO.

DWG. SIZE: B
DWG. NO.: PS-005496-1C
REV.: A

PUMP MODELS 0606152V AND LARGER



PARTS LIST AND MATERIALS OF CONSTRUCTION				
PART NO.	PART NAME	MATERIAL		
		Cast Iron	Cast Iron / 3% Nickel	Ductile Iron
100	Casing	Cast Iron	Cast Iron / 3% Nickel	Ductile Iron
101	Impeller	Cast Iron	Cast Iron / 3% Nickel	Cast Iron
105	Seal	Mechanical*		
106	Packing	Synthetic		
107	Gland	Bronze		
122	Shaft	Alloy Steel - AISI 4150		
126	Shaft Sleeve	420 SS		
142	Impeller Wear Ring	420 SS		
165	Suction Cover Wear Ring	420 SS		
182	Suction Cover	Cast Iron	Cast Iron / 3% Nickel	Ductile Iron
184	Stuffing Box Cover	Cast Iron	Cast Iron / 3% Nickel	Ductile Iron
199A	Impeller Nut	Cast Iron	Cast Iron / 3% Nickel	Cast Iron

*Bronze Optional

MATERIALS SPECIFICATIONS	
MATERIAL	SPECIFICATION
Cast Iron	ASTM A48 Class 35
Cast Iron / 3% Nickel	ASTM A48 Class 30 / 3% Nickel
Ductile Iron	ASTM A536 Grade 80-55-06
HC600	High Chromium Iron - ASTM A532-75a, Class 3, Type A
316 SS	Stainless Steel - AISI 316 or ACI CF-8M (cast)
420 SS	Stainless Steel - AISI 420 Series, Hardened
Bronze	SAE 40
Teflon	Glass Filled TFE
Synthetic	Garlock 9809 or equal

HEAVY DUTY WASTEWATER PUMPS

TECHNICAL DATA

	Model / Size			0606152V	0608152V	0808162V 0808163V 0808162V LC	1010212V 1010213V	1010212V 1010213V	1010242V	1212252V 1212253V 1212252V LC 1214255V
GENERAL	Bearing Frame			D1	D2	D2	D2	D3	D3	D3
	Weight		lb	800	1300	1500	2100	2100	2800	3200
			kg	363	590	681	953	953	1270	
	Casing wall thickness		inch	0.50	0.62	0.62	0.69	0.69	0.75	0.75
			mm	13	16	16	18	18	19	19
	Max. Working Pressure	C I	psi	130	130	130	130	130	130	130
			kPa	896	896	896	896	896	896	896
		D I	psi	200	200	200	200	200	200	200
			kPa	1379	1379	1379	1379	1379	1379	1379
	Power limit		HP	150	200	320	350	350	700	750
			kW	112	149	239	261	261	530	559
	Max. RPM			1750	1750	1750	1180	1180	1500	1180
IMPELLER	Max. Impeller Dia.		inch	14.50	15.00	16.50	20.00	20.50	24.00	24.00
	WR^2 for max imp. dia.		lb-ft^2	8.9	26.7	28.3	69.4	69.4	133	165
	Max. sphere	2 vane	inch	3.00	3.00	3.50	4.25	4.25	5.00	5.00
			mm	76	76	89	108	108	127	127
		3 vane	inch	n/a	n/a	2.00	2.50	2.50	n/a	3.00
			mm			51	64	64		76
		5 vane	inch	n/a	n/a	n/a	n/a	n/a	n/a	2.60
			mm							66
SHAFT	Dia. through Impeller		inch	2.19	3.00	3.00	3.00	3.00	3.50	3.50
			mm	56	76	76	76	76	89	89
	Dia. under Sleeve		inch	2.56	3.25	3.25	3.25	4.25	425.00	4.25
			mm	65	83	83	83	108	108	108
	Dia. between Bearings		inch	3.31	4.12	4.13	4.13	5.25	5.25	5.25
			mm	84	105	105	105	133	133	133
	Dia. at Coupling		inch	2.13	2.75	2.75	2.75	3.38	3.38	3.38
			mm	54	70	70	70	86	86	86
	Length IB bg ~ imp.		inch	14.15	15.41	15.41	16.22	19.00	19.00	19.00
			mm	359	391	391	412	483	483	483
	Length IB bg ~ OB bg		inch	14.83	16.97	16.97	16.97	18.27	18.75	18.27
			mm	377	431	431	431	464	476	464
	Tor. shaft stiffness kt		in-lbs/rad	1.460E+06	3.560E+06	3.560E+06	3.503E+06	6.950E+06	6.940E+06	7.045E+06
BEARINGS	Bearing Frame			D1	D2	D2	D2	D3	D3	D3
	OB rad			NJ 313 EC	NJ 317 EC	NJ 317 EC	NJ 317 EC	NJ 321 EC	NJ 321 EC	NJ 321 EC
	OB ax			7313 BECB	7318 BECB	7318 BECB	7318 BECB	7322 BECB	7322 BECB	7322 BECB
	IB rad			NU 2215 EC	NU 318 EC	NU 318 EC	NU 318 EC	NU 2224 EC	NU 2224 EC	NU 2224 EC
STUFFING BOX	Bore dia.		inch	4.00	4.75	4.75	4.75	5.75	5.75	5.75
			mm	102	121	121	121	146	146	146
	Bore depth		inch	3.75	3.75	3.75	3.75	3.75	3.75	3.75
			mm	95	95	95	95	95	95	95
	Sleeve OD		inch	3.00	3.75	3.75	3.75	4.75	4.75	4.75
			mm	76	95	95	95	121	121	121
	Axial clearance		inch	3.88	4.51	4.51	5.07	5.56	5.56	5.44
	face Stuff. Box to IB Retainer		mm	99	115	115	129	141	141	138
	Gland bolt No.			4	4	4	4	4	4	4
	Gland bolt dia.		inch	0.62	0.62	0.62	0.62	0.62	0.62	0.62
			mm	16	16	16	16	16	16	16
	Gland bolt B.C.		inch	6.25	7.00	7.00	7.00	8.00	8.00	8.00
			mm	159	178	178	178	203	203	203
	No. of packing rings			5	5	5	5	5	5	5
	Size of packing rings		inch	0.50	0.50	0.50	0.50	0.5	0.5	0.5
			mm	13	13	13	13	13	13	13

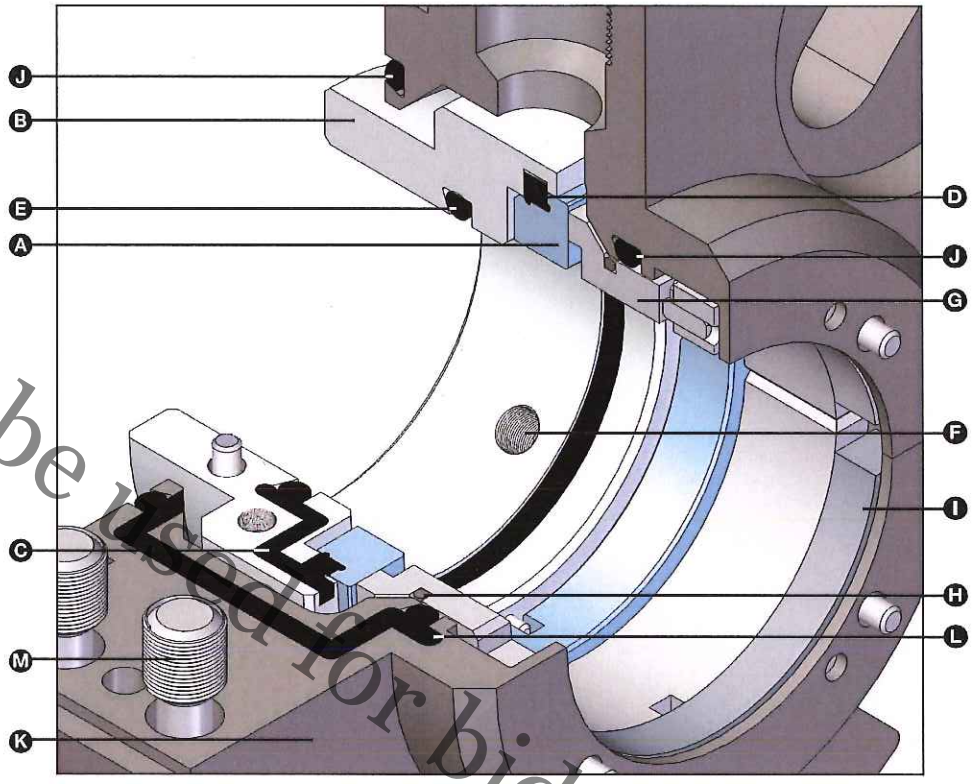
	Model / Size			1616332V 1616333V 1620335V	1616332V 1616333V 1620335V	2020412V 2020413V	2424503V	2424503V	3030623V
GENERAL	Bearing Frame			D4	D5	D5	D5	D6	D6
	Weight		lb	5700	5700	10500	16000	17000	28000
			kg	2588	2588	4767	7264	7718	12712
	Casing wall thickness		inch	1.00	1.00	1.12	1.25	1.25	1.50
			mm	25	25	28	32	32	38
	Max. Working Pressure	C I	psi	130	130	120	110	110	110
			kPa	896	896	827	758	758	758
		D I	psi	200	200	185	170	170	170
			kPa	1379	1379	1275	1172	1172	1172
	Power limit		HP	650	1300	2000	1650	2900	3750
			kW	485	969	1491	1230	2163	2796
	Max. RPM			700	880	705	500	585	440
IMPELLER	Max. Impeller Dia.		inch	33.30	33.30	41.00	48.00	50.00	60.00
	WR^2 for max imp. dia.		lb-ft^2	518	518	1960	4267	4267	110000
	Max. sphere	2 vane	inch	6.75	6.75	8.50	n/a	n/a	n/a
			mm	171	171	216			
		3 vane	inch	4.00	4.00	5.00	6.00	6.00	7.5
			mm	102	102	127	152	152	191
		5 vane	inch	3.50	3.50	n/a	n/a	n/a	n/a
			mm	89	89				
SHAFT	Dia. through Impeller		inch	4.75	5.00	5.75	6.75	6.75	7.50
			mm	121	127	146	171	171	191
	Dia. under Sleeve		inch	5.25	7.00	7.00	7.00	8.25	8.25
			mm	133	178	178	178	210	210
	Dia. between Bearings		inch	6.50	8.75	8.75	8.75	10.25	10.25
			mm	165	222	222	222	260	260
	Dia. at Coupling		inch	4.50	5.50	5.50	5.50	6.75	7.50
			mm	114	140	140	140	171	191
	Length IB bg ~ imp.		inch	26.77	29.83	30.26	31.46	33.83	37.32
			mm	680	758	769	799	859	948
	Length IB bg ~ OB bg		inch	22.27	24.24	24.24	24.24	31.98	31.98
			mm	566	616	616	616	812	812
	Tor. shaft stiffness kt		in-lbs/rad	1.589E+07	3.105E+07	3.586E+07	3.888E+07	6.293E+07	7.438E+07
BEARINGS	Bearing Frame			D4	D5	D5	D5	D6	D6
	OB rad			NJ 326 EC	NJ 332 EC	NJ 332 EC	NJ 332 EC	23144 CC	23144 CC
	OB ax			7328 G2M	7336 BCBM	7336 BCBM	7336 BCBM	29348 E	29348 E
	IB rad			NU 2230 EC	NU 2240 EC	NU 2240 EC	NU 2240 EC	24048 CC	24048 CC
STUFFING BOX	Bore dia.		inch	7.50	9.25	9.25	9.25	10.50	10.50
			mm	191	235	235	235	267	267
	Bore depth		inch	5.75	6.00	6.00	6.00	5.50	5.50
			mm	146	152	152	152	140	140
	Sleeve OD		inch	6.00	7.75	7.75	7.75	9.00	9.00
			mm	152	197	197	197	229	229
	Axial clearance		inch	6.82	6.44	6.44	9.69	6	6.75
	face Stuff. Box to IB Retainer		mm	173	164	164	246	152	171
	Gland bolt No.			4	4	4	4	4	4
	Gland bolt dia.		inch	0.75	0.75	0.75	0.75	0.75	0.75
			mm	19	19	19	19	19	19
	Gland bolt B.C.		inch	10.00	11.50	11.50	11.50	13.25	13.25
			mm	254	292	292	292	337	337
	No. of packing rings			5	5	5	5	5	5
	Size of packing rings		inch	0.75	0.75	0.75	0.75	0.75	0.75
			mm	19	19	19	19	19	19

TYPE 3740

Wet Running Cartridge Split Seal

3740

A – Mating Ring
B – Mating Ring Adapter Assy.
C – Sealing Element Gasket
D – Sealing Element Strip
E – Sealing Element O-Ring
F – Set Screw
G – Primary Ring
H – Retaining Ring
I – Spring Adapter Assy. Set
J – O-Ring (Split)
K – Gland Plate Assy.
L – Gland Plate Gasket
M – Captive Socket Head Cap Crews



Product Description

The Type 3740 is a family of split seals using the latest modular split seal technology from John Crane that also combines the unique design requirements for wet-running and dry-running services onto one common seal platform.

- The Type 3740 wet-running split seal incorporates the best features for fast and easy seal installation, while providing reliable seal performance in demanding pump and other rotating equipment fluid services.
- The Type 3740D dry-running split seal is designed for the large shaft run-out and harsh operating conditions commonly associated with top-entry vessel mixing services and other dry-running applications.

Typical Applications

- Agitators / Mixers
- Centrifugal Pumps
- Positive Displacement Pumps
- Split Case Pumps
- Chemicals
- Light Slurries
- Marine
- Paper Stock
- Water / Wastewater

Performance Capabilities

- Temperatures: Up to 121°C / 250°F
- Pressures: Up to 31.0 bar g / 450 psig excursion
  20.7 bar g / 300 psig continuously
- Speeds: Up to 17.8 m/s / 3500 fpm
- Runout: Up to 1.52mm / 0.060" TIR

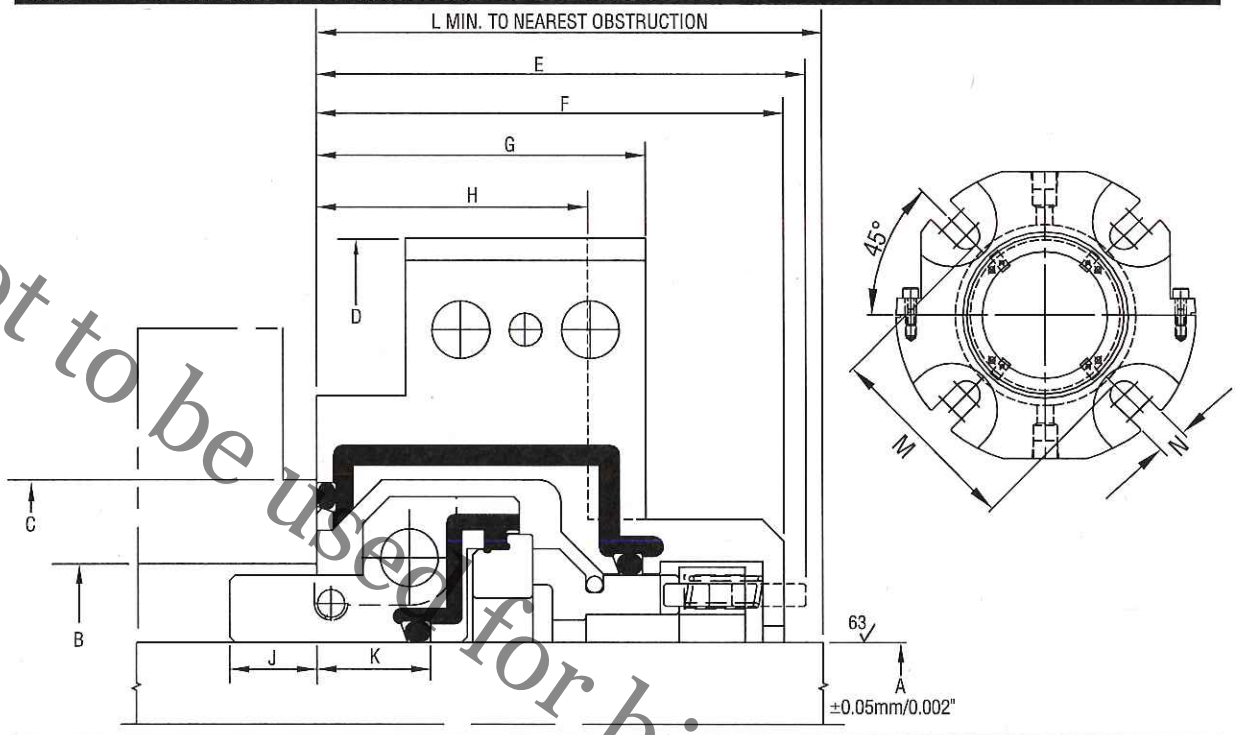
Design Features

- Factory-preassembled rotor assembly for fast, easy yet precise rotating face installation.
- Separate stationary seal face for visual assurance the halves are correctly aligned.
- Factory-preassembled gland plate assembly for easy, single-step installation.
- Balanced primary ring design for increased pressure capability.
- Premium seal face materials for optimal performance.
- Captive socket head cap screws to eliminate lost or dropped screws.
- Same-side screws on all hardware for easy access and faster installation.
- Dovetail O-ring grooves to contain all O-rings without requiring adhesives.
- Fast and easy field repair kits that do not require any special tools, adhesives or procedures.
- Two connections in the gland to provide easy access for flush piping.

TYPE 3740

Wet Running Cartridge Split Seal

Type 3740 Typical Arrangement/Dimensional Data



Type 3740 Dimensional Data (inches)

SEAL SIZE	SIZE CODE	A	B MIN.	B MAX.	C MIN.	D	E	F	G	H	J	K	L MIN.	M	N
1.375	0349	1.375	2.000	2.375	2.625	5.250	2.070	1.980	1.500	1.250	0.375	0.475	2.130	2.813	0.562
1.500	0381	1.500	2.125	2.500	2.750	5.250	2.070	1.980	1.500	1.250	0.375	0.475	2.130	3.063	0.562
1.625	0412	1.625	2.250	2.625	2.875	5.500	2.070	1.980	1.500	1.250	0.375	0.475	2.130	3.188	0.562
1.750	0444	1.750	2.375	2.750	3.000	5.500	2.070	1.980	1.500	1.250	0.375	0.475	2.130	3.313	0.562
1.875	0476	1.875	2.500	2.875	3.125	5.500	2.070	1.980	1.500	1.250	0.375	0.475	2.130	3.313	0.562
2.000	0508	2.000	2.625	3.000	3.250	5.750	2.070	1.980	1.500	1.250	0.375	0.475	2.130	3.563	0.562
2.125	0539	2.125	2.750	3.125	3.375	6.250	2.070	1.980	1.500	1.250	0.375	0.475	2.130	3.937	0.688
2.250	0571	2.250	3.000	3.375	3.625	6.250	2.070	1.980	1.500	1.250	0.375	0.475	2.130	3.937	0.688
2.375	0603	2.375	3.000	3.500	3.750	6.250	2.070	1.980	1.500	1.250	0.375	0.475	2.130	3.937	0.688
2.500	0635	2.500	3.250	3.750	4.000	6.750	2.290	2.185	1.625	1.375	0.365	0.545	2.350	4.250	0.688
2.625	0666	2.625	3.500	3.905	4.155	7.000	2.290	2.185	1.625	1.375	0.365	0.545	2.350	4.500	0.688
2.750	0698	2.750	3.500	3.905	4.155	7.000	2.290	2.185	1.625	1.375	0.365	0.545	2.350	4.500	0.688
2.875	0730	2.875	3.750	4.188	4.438	7.500	2.290	2.185	1.625	1.375	0.365	0.545	2.350	4.750	0.688
3.000	0762	3.000	3.750	4.375	4.625	7.500	2.290	2.185	1.625	1.375	0.365	0.545	2.350	4.750	0.688
3.125	0793	3.125	3.875	4.313	4.563	7.750	2.290	2.185	1.625	1.375	0.365	0.545	2.350	4.875	0.688
3.250	0825	3.250	4.000	4.500	4.750	7.750	2.290	2.185	1.625	1.375	0.365	0.545	2.350	5.000	0.688
3.375	0857	3.375	4.250	4.750	5.000	8.000	2.290	2.185	1.625	1.375	0.365	0.545	2.350	5.250	0.812
3.500	0889	3.500	4.250	4.750	5.000	8.000	2.290	2.185	1.625	1.375	0.365	0.545	2.350	5.250	0.812
3.625	0920	3.625	4.500	5.188	5.438	9.000	2.750	2.625	1.850	1.530	0.485	0.640	2.840	5.938	0.812
3.750	0952	3.750	4.500	5.188	5.438	9.000	2.750	2.625	1.850	1.530	0.485	0.640	2.840	5.938	0.812
3.875	0984	3.875	4.750	5.438	5.688	9.000	2.750	2.625	1.850	1.530	0.485	0.640	2.840	5.938	0.812
4.000	1016	4.000	4.750	5.438	5.688	9.000	2.750	2.625	1.850	1.530	0.485	0.640	2.840	5.938	0.812
4.125	1047	4.125	5.000	5.688	5.938	9.500	2.750	2.625	1.850	1.530	0.485	0.640	2.840	6.438	0.812
4.250	1079	4.250	5.000	5.688	5.938	9.500	2.750	2.625	1.850	1.530	0.485	0.640	2.840	6.438	0.812
4.375	1111	4.375	5.250	5.938	6.188	9.500	2.750	2.625	1.850	1.530	0.485	0.640	2.840	6.438	0.812
4.500	1143	4.500	5.250	5.938	6.188	9.500	2.750	2.625	1.850	1.530	0.485	0.640	2.840	6.438	0.812
4.750	1206	4.750	5.500	6.188	6.438	10.000	2.750	2.625	1.850	1.530	0.485	0.640	2.840	6.938	0.812
5.000	1270	5.000	5.750	6.438	6.688	10.000	2.750	2.625	1.850	1.530	0.485	0.640	2.840	6.938	0.812
5.125	1301	5.125	6.000	6.813	7.063	11.500	2.750	2.625	1.850	1.530	0.485	0.640	2.840	8.062	0.938
5.250	1333	5.250	6.000	6.813	7.063	11.500	2.750	2.625	1.850	1.530	0.485	0.640	2.840	8.062	0.938
5.375	1365	5.375	6.250	6.938	7.188	11.500	2.750	2.625	1.850	1.530	0.485	0.640	2.840	8.062	0.938
5.500	1397	5.500	6.250	6.938	7.188	11.500	2.750	2.625	1.850	1.530	0.485	0.640	2.840	8.062	0.938
5.750	1460	5.750	6.500	7.188	7.438	11.500	2.750	2.625	1.850	1.530	0.485	0.640	2.840	8.062	0.938
5.875	1492	5.875	6.750	7.438	7.688	11.500	2.750	2.625	1.850	1.530	0.485	0.640	2.840	8.062	0.938
6.000	1524	6.000	6.750	7.438	7.688	11.500	2.750	2.625	1.850	1.530	0.485	0.640	2.840	8.062	0.938

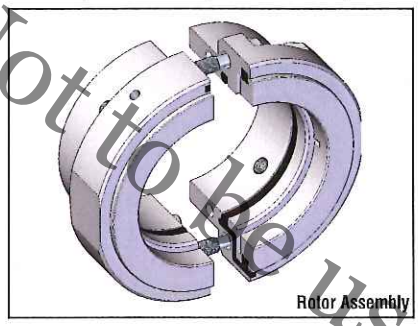
TYPE 3740

Wet Running Cartridge Split Seal

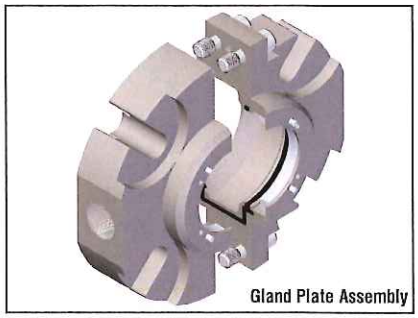
Modular Split Seal Technology

The Type 3740 Cartridge Split Seal is the latest in split seal design technology that makes installation as fast and as easy as possible, yet ensures the important step of proper seal face halves alignment is done correctly for optimal performance. The Type 3740 seal is comprised of pre-assembled modules that combine multiple individual parts into three components:

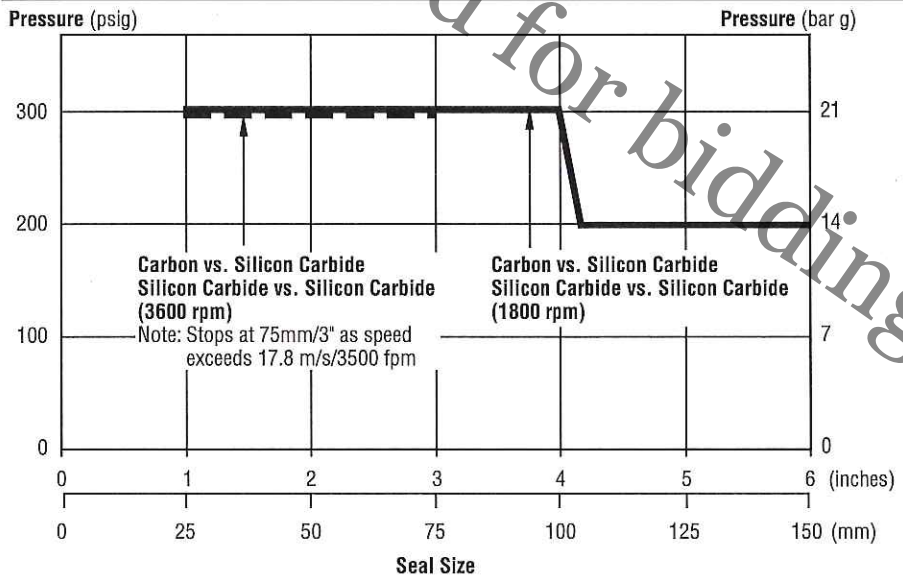
- Rotor assembly – rotating mating ring seal face and hardware
- Primary ring assembly – stationary primary ring seal face and retaining ring clip
- Gland plate assembly – all stationary hardware


Rotor Assembly


Primary Ring Assembly


Gland Plate Assembly

Basic Pressure Ratings



The Basic Pressure Rating is for a standard Type 3740 seal, as shown in the typical arrangement, when installed according to the criteria given in this data sheet and generally accepted industrial practices.

Contact John Crane Engineering for pressure excursion operation above the curve and up to 31.0 bar g / 450 psig.

The Basic Pressure Rating assumes stable operation at the rated speed in a clean, cool, lubricating, nonvolatile liquid, with an adequate flush rate. When used with the Multiplier Factors, the Basic Pressure Rating can be adjusted to provide a conservative estimate of the dynamic pressure rating. For process services outside this range or a more precise assessment of the dynamic pressure rating, contact John Crane for more information.

Multiplier Factors

	Selection Considerations	Multiplier Factor
Sealed Fluid Temperature	Below 80°C/175°F	x 1.00
	From 80°C to 125°C/175°F to 250°F	x 0.90

Using the Basic Pressure Rating chart, the maximum pressure would be 20.7 bar g/300 psig.

From the Multiplier Factors chart, apply the multipliers for the specific service requirements to determine the maximum operating pressure for the application.

20.7 bar g/300 psig x 0.90 = 18.6 bar g/270 psig.

Example for Determining Pressure Rating Limits

Seal: 50mm/2" diameter Type 3740
Product: Water
Face Material: Carbon vs. Silicon Carbide
Temperature: 85°C/185°F
Speed: 1800 rpm

TYPE 3740

Wet Running Cartridge Split Seal

Materials of Construction

SEAL COMPONENTS	MATERIALS	
Description	**Standard**	**Options**
Primary Ring	Carbon	Silicon Carbide
Mating Ring	Silicon Carbide	—
Gland Plate Assembly Mating Ring Adapter Assembly Spring Adapter Assembly Set	316 Stainless Steel	Alloy 20 Monel® Titanium Inconel® 625
Retaining Ring	Alloy X-750	—
Springs	Alloy C-276	—
Elastomers	~~Ethylene Propylene~~ Fluoroelastomer	—

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For Type 3740 Installation Instructions see I-3740.
For Type 3740 Repair Kit Instructions see I-3740RK.

For your nearest John Crane facility, please contact one of the locations below.

North America
Morton Grove, IL, USA
1-800-SEALING
Tel: 1-847-967-2400
Fax: 1-847-967-3915

Europe
Slough, UK
Tel: 44-1753-224000
Fax: 44-1753-224224

Latin America
São Paulo, Brazil
Tel: 55-11-3371-2500
Fax: 55-11-3371-2599

Middle East & Africa
Dubai, United Arab Emirates
Tel: 97-1481-27800
Fax: 97-1488-62830

Asia Pacific
Singapore
Tel: 65-6512-5200
Fax: 65-6512-5233

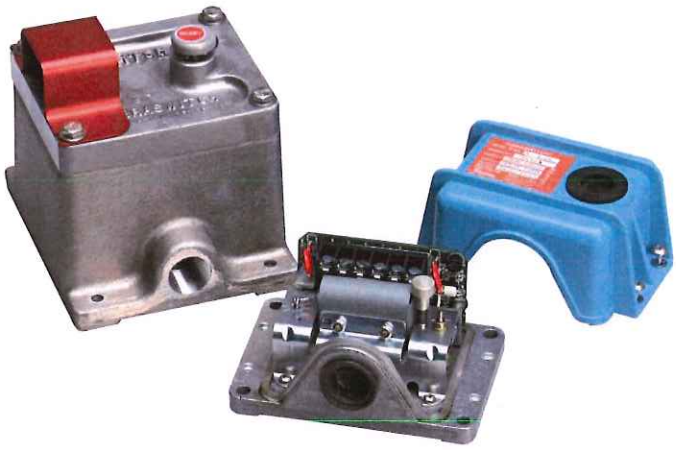
Model ~~375A~~/376A Vibraswitch® Malfunction Detectors

General Description

These Robertshaw Vibraswitch Malfunction Detectors are acceleration sensitive vibration instruments with electronic circuitry to provide maximum protection to rotating and reciprocating machinery due to damages resulting from mechanical malfunctions. Although identical in outside appearance and dimensionally the same as the existing Models 365 and 366, these instruments include "built-in" electronic circuitry for start and/or monitoring time delay functions for the prevention of false shutdowns resulting from transient vibrations. All models include provisions for remote reset.

"Start Delay" is often required on machines that start automatically and exhibit excessive vibration for short periods of time only during starting. Proper set point adjustment on the Vibraswitch for adequate protection during normal running conditions may cause the Vibraswitch to "trip" as the instrument senses these high starting transient vibrations without the use of "Start Delay." Examples of such machines are refrigeration compressors and high-speed turbines.

"Monitor Delay" is required on machines that exhibit excessive vibration of a transient nature which occurs during normal operation. If a Vibraswitch without monitor delay has its set point sufficiently high so as not to trip-out under the transient vibration levels, inadequate protection would result during the normal running conditions. Examples of this type machine include liquid pumps that experience momentary cavitations resulting in excessive vibration.



Features and Benefits:

- **Complete Vibration Protection in a Single Package**
  Reasonably priced, lower installation costs
- ~~**Explosion Proof Model (375A)**~~
  ~~FM Approved~~
  ~~InMetro Approved~~
- **Weather Proof Model (376A)**
  NEMA 4
  NEMA 4X (optional)
- **Acceleration Sensitive**
  Measures destructive forces
- **Selectable Time Delay Control Options**
  Permits maximum application flexibility
- **Ease of Adjustment**
  Set it and forget it – one adjustment
- **Continuous Reliable Protection**
  No attention required after installation
- **Solid State Switching**
  Alarm or shutdown voltage completely isolated from instrument supply

Principle of Operation

The Model 375A and 376A Vibraswitches employ a magnetic circuit opposed by inertial and adjustable spring forces in the actuating mechanism. Operation of the unit may be understood by reference to Figure 1

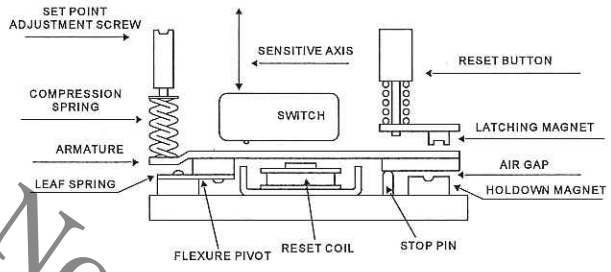


FIGURE 1

The armature is constrained so as to respond to only a single direction of motion, by a frictionless flexure pivot composed of two overlapping blocks with a leaf spring loaded in one direction to hold the blocks together. The armature rotates about the pivot, being forced in one direction by the adjusting spring force and the other direction by the magnetic force.

When the entire assembly is subjected to vibration perpendicular to the base, the peak acceleration times the effective mass of the armature produces an inertial force, aided by the adjustable spring tending to force the armature away from the stop pin and the restraining force of the magnet. When the peak acceleration exceeds the set point level, the armature leaves the stop pin, increasing the air gap and decreasing the magnetic force with the armature continuing to move up until it reaches the latch magnet, actuating the switch during its upward travel. The effect of temperature in the mechanism is negligible as the elastic modulus of the adjusting spring and magnetic flux through the air gap both decrease slightly with increasing temperature thereby compensating each other.

Electronic Operation

"Start Delay Only" models hold the Vibraswitch armature in its "reset" position for a preset starting time after application of supply voltage to the instrument. This prevents the Vibraswitch from tripping out during machine startup. Fixed timing periods of 15, 30, 60 or 90 seconds are available. After the time period, the Vibraswitch functions as normal with shutdown or alarm functions provided by utilizing the SPDT switch contacts in the unit.

"Monitor Delay Only" models prevent nuisance shutdowns due to tripping-out of the Vibraswitch during high level short term transient vibration conditions by automatically resetting the Vibraswitch. Under continuing high vibration, the Vibraswitch trips, is immediately reset, trips out again and is reset; this "sampling" process continuing until the time delay period has elapsed, after which the unit remains "tripped" out. An AC output by means of a solid state "TRIAC" switch can be used for either ALARM or SHUTDOWN. The "TRIAC" switch can be set for either NO or NC operation by repositioning the jumper plug located on the circuit board.

"Start and Monitor Delay" models provide the control functions of both START delay and MONITOR delay in a single instrument. The "Start and Monitor Delay" models employ the same "TRIAC" switch found in the "Monitor Delay Only" models.

Specifications

Enclosure:

375A ..... Aluminum, unpainted (standard)
FM Approved for Class I, Division 1, Groups C & D; Class II, Division 1, Groups E, F & G hazardous locations
Aluminum, epoxy painted (optional)

376A .....Aluminum base, unpainted (standard) with ABS thermoplastic cover & Kraton thermoplastic gasket, NEMA 4.
Epoxy painted base (optional), NEMA 4X

Switch Contacts:

Start Delay Only Models:
SPDT (dry contacts)
5 A at 120 or 240 VAC

Monitor or Start & Monitor Delay Models:
SPST Triac (solid state contacts)
2 A maximum, 50 mA minimum at
120 VAC only (will not switch DC)
Field selectable for NO or NC operation

Set Point Range:

Mounted Horizontal ..... 0 to 4.5 G (peak)
Mounted Vertical ..... 0 to 3.5 G (peak)

Frequency Range ..... 0 to 300 Hz
Set Point Adjustment ..... 1 G per turn (approximate)
Temperature limits:
Storage ..... -40° to +160° F (-40° to +71° C)
Operating ..... -20 to +140° F (-29° to +60° C)
Shock ..... 75 G @ 11 ms maximum
Supply Voltage: ..... 120 VAC ±10%, 50/60 Hz
Supply Power: ..... 15 W maximum
Delay Time Accuracy: ..... ±30%
Net weight:
375A ..... 6.5 lbs (2.9 kg)
376A ..... 2.25 lbs (1 kg)
Shipping weight:
375A ..... 7 lbs (3.2 kg)
376A ..... 3 lbs (1.4 kg)
Agency Certification:
375A ..... FM Files 0Q7A3.AE & 0R1H7.AE
376A ..... None

Ordering Information

375A – A3 – C4 – E

Key Model Number
Supply Voltage – See Table 1
Delay Function – See Table 2
Start Delay Time – See Table 3
Monitor Delay Time – See Table 4
Special Options – See Table 5

Key Model Number

Designation	Description
375A	Explosion Proof Vibraswitch, FM Certified
376A	Weather Proof Vibraswitch, NEMA 4

Table 1 – Supply Voltage

Designation	Description
A	120 VAC ±10%, 50/60 Hz

Table 2 – Delay Function

Designation	Description
1	Start Delay Only
2	Monitor Delay Only
3	Start & Monitor Delay

Table 3 – Start Delay Time

Designation	Description
A	None
C	15 Seconds
D	30 Seconds
E	60 seconds
F	90 Seconds

Table 4 – Monitor Delay Time

Designation	Description
0	None
2	2 Seconds
3	5 Seconds
4	10 Seconds

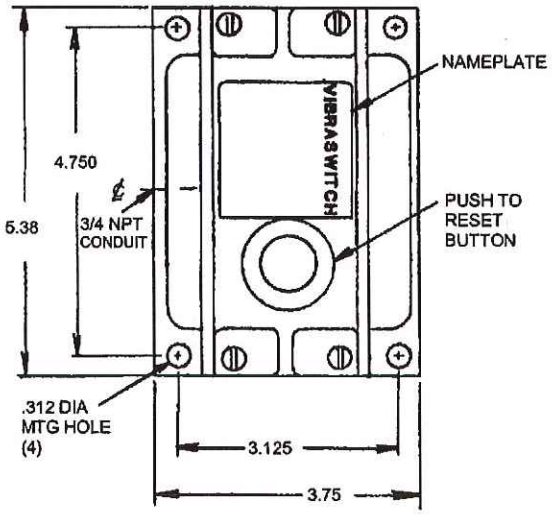
Table 5 – Special Options

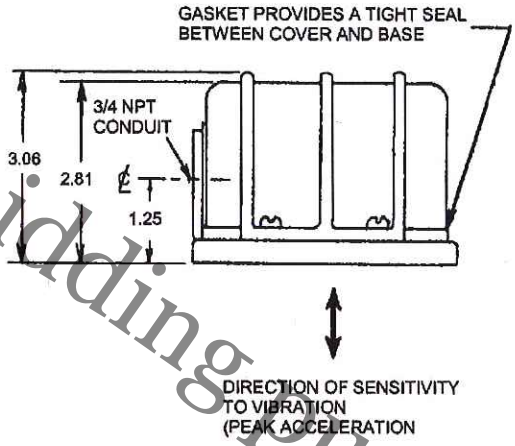
Designation	Description
Omit	No special options
	For the 375A – Epoxy painted enclosure
E	For the 376A – Epoxy painted base, NEMA 4X

Accessory Items
(Must be ordered separately)

Part no.	Description
904GB016	Rain shield for unprotected outdoor installations, steel, zinc plated
904GB016-03	Rain shield, steel, zinc plated and painted with gray epoxy enamel.

Model 376A Dimensions





Note:
The mechanical reset pushbutton on the Vibraswitch will only reset the mechanical portion of the Vibraswitch and will not re-initiate the Start and/or Monitor Delay function and will not reset the solid state switch. The mechanical reset is normally only used when adjusting the set point.

GRUNDFOS

BEARING LIFE AT A SPECIFIC OPERATING POINT

PUMP MODEL: 7100 NC - 121225 3V

Morris Pumps Bearing Frame D3-NC3

Prepared By: Elias Figueroa ***DATE:*** 4/2/2019

1. OPERATING CONDITIONS

Q =	7,500	gpm	Flow	% of BEP = 91%
H =	151.0	ft	Head	
Q_{BEP} =	8,265	gpm	Flow at BEP (max trim)	
H_{BEP} =	272	ft	Head at BEP (max trim)	
N =	1,190	rpm	Speed	
s =	1.00		Specific Gravity of Fluid	
p_S =	0.00	psi	Suction Pressure	
g =	386.40	in/sec^2	Acceleration of Gravity	
Orientation =	V		Vertical (V) or Horizontal (H)	

2. PUMP CHARACTERISTICS

D_2 =	21.38	in	Impeller OD
D_{2F}=	21.38	in	Impeller OD Front Shroud
D_{2B} =	21.38	in	Impeller OD Back Shroud
D_S =	4.751	in	OD of the Shaft Sleeve
D_{HU} =	7.02	in	Dia of Rear Impeller Hub
D_{WR} =	15.00	in	OD of Wearing Rings
D_{SUC} =	12.00	in	Dia of the Impeller Inlet/Eye
D_{BVOD} =	0.00	in	Dia of the Back Vanes
D_{BVID} =	0.00	in	ID of the Back Vanes
b_2 =	6.75	in	Width of the Impeller back shroud to front shroud for Specific Speed<4000, For Specific Speed =>4000 Width of the Impeller from the back shroud to the tip of the impeller
B_C =	13.50	in	Distance between Bearing Centerlines
Z =	21.32	in	Shaft Overhang
W_I =	300.00	lbf	Impeller Weight
W_S =	475.00	lbf	Shaft & Rotor (where applicable) Weight
η_{BV} =	0.00		Efficiency of the Back Vanes

3. CALCULATED DATA

Specific Weight of Water

k = 0.036 lbf/in^3

Specific Speed

$S = N*Q_{BEP}^{0.5}/H_{BEP}^{0.75}$ = **1615**

Radial Force Factor

K_R = Per HI Figure 1.3.5.1d = **0.25**

Diameter Ratio

D_{2F}/D_2 = 1.00	Front shroud
D_{2B}/D_2 = 1.00	Back shroud
D_{SUC}/D_2 = 0.56	Suction
D_{HU}/D_2 = 0.33	Rear Hub

Axial Thrust Factor

K_F = Per HI Figure 1.3.5.2.1b = 0.80	Thrust factor front impeller shroud
K_B = Per HI Figure 1.3.5.2.1b = 0.80	Thrust factor back impeller shroud
K_{SUC} = Per HI Figure 1.3.5.2.1b = 0.70	Thrust factor impeller suction inlet
K_{HU}= Per HI Figure 1.3.5.2.1b = 0.66	Thrust factor rear impeller hub
$K_{F\,AV}= (K_F+K_{SUC})/2$ = 0.75	
$K_{B\,AV}=(K_B+K_H)/2$ = 0.73	

Impeller Data

$A_F = \Pi*D_{2F}^2/4 - \Pi*D_{SUC}^2/4$ = 245.7 in^2 Area of front shroud

$A_B = \Pi*D_{2B}^2/4 - \Pi*D_{HU}^2/4 =$	320.1	in^2	Area of back shroud
$A_{HU} = \Pi*D_{HU}^2/4 =$	38.7	in^2	Area of back impeller hub
$A_{BT} = \Pi*D_{2F}^2/4 - \Pi*D_{2B}^2/4 =$	0.0	in^2	Area of blade thrust
$A_{BV} = \Pi*(D_{BVOD}^2-D_{BVID}^2)/4 =$	0	in^2	back vanes area
$A_H = \Pi*D_S^2/4 =$	17.7	in^2	seal area

Radial Force & Loading

$F_R = K_R(H*s/2.307)*D_2*b_2$

$F_R =$	2,351	lbf	
$F_N = F_R$ + (For Hor Only) $W_I =$	*2,351*	lbf	**Resultant Radial Force**
$R_{IB} = (F_N*(S_O+B_C))/B_C$			
$R_{IB} =$	*6,064*	lbf	**Radial Load on Inboard (Radial) Bearing**
$R_{OB} = (F_N*S_O)/B_C$			
$R_{OB} =$	*3,713*	lbf	**Radial Load on Outboard (Thrust) Bearing**

Axial (Thrust) Force & Loading

$F_F = -(H*s/2.307)*((K_{F\,AV}*A_F) =$	-12,038	lbf	
$F_B = (H*s/2.307)*((K_{B\,AV}*A_B) =$	15,251	lbf	
$F_{BT} = (H*s/2.307)*((.9*A_{BT}) =$	0	lbf	
$F_H = -p_s*A_H =$	0	lbf	
$F_{MOMENTUM} = -(s * Q^2)/(567*D_{SUC}^2) =$	-689	lbf	
Fimpeller (For Vertical Only) =	300	lbf	
Fshaft (For Vertical Only) =	475	lbf	
$A_{BV} = \Pi*(D_{BVOD}^2-D_{BVID}^2)/4$	0	in^2	back vanes area
$A_H = \Pi*D_S^2/4 =$	17.7	in^2	seal area
$u_{BV} = \Pi*D_{BVOD}*N =$	0	in/sec	peripherial velocity at the tip of the back vane
$u_H = \Pi*D_{HU}*N =$	437	in/sec	velocity at the impeller hub

$P_{AV} = 0.375kn_{BV}(A_{BV}-A_H)(u_{BV}^2-u_H^2)s/2g$

$P_{AV} =$	*0*	lbf	Axial thrust reduction for back vanes (up)
$F_A=F_{NET}=F_F+F_B+F_{BT}+F_H+F_{MOM}+F_{imp}+F_{shaft} =$	*3,298*	lbf	**Axial Load on Outboard (Thrust) Bearing**

4. BEARING LIFE

Inboard Radial Bearing: **Single row cylindrical roller bearings SKF # NU-2224 ECJ**

For d = 4.724 in. (120 mm) & D = 7.358 in. (215 mm)

C =	116901	lbf			
P =	6,064	lbf			
L10h = (10^6/60*N)(C/P)^10/3 =	*268,989*	hr	**L10 MIN =**	100000	hr

Outboard Axial Thrust Bearing: **Single row angular contact ball bearings (DT) Mounted in Tandem SKF # 7322 BECBY**

For d = 4.33 in. (110 mm) & D = 9.45 in. (240 mm)

C = C * 1.62 =	163886	lbf			
P =	3,713	lbf			
L10h = (10^6/60*N)(C/P)^3 =	*283,176*	hr	**L10 MIN =**	100000	hr

Outboard Radial Bearing: **Single row cylindrical roller bearings SKF # NJ-321 ECJ**

For d = 4.134 in. (105 mm) & D = 7.071 in. (225 mm)

C =	112404	lbf			
P =	3,416	lbf			
L10h = (10^6/60*N)(C/P)^3 =	*1,598,454*	hr	**L10 MIN =**	100000	hr

NOTES & CLARIFICATIONS:
The ABMA L-10 bearing life of all bearings exceed the specified requirements.

TNEMEC

PRODUCT DATA SHEET

HI-BUILD EPOXOLINE® II N69F or V69F

PRODUCT PROFILE

GENERIC DESCRIPTION Polyamidoamine Epoxy

COMMON USAGE An advanced generation epoxy for the protection and finishing of steel and concrete. It has excellent resistance to abrasion and is suitable for immersion as well as chemical contact exposure. Contact your local Tnemec representative for a list of chemicals. This product can also be used as a block filler on cementitious or masonry substrates. **Note:** Series V69F conforms with air pollution regulations limiting Volatile Organic Compounds (VOC) to a maximum of 250 grams/litre (2.08 lbs/gal) in areas requiring less than 100 grams/litre VOC, please refer to the Series L69F data sheet.

COLORS Limited color availability. Contact your Tnemec representative.

FINISH Satin

COATING SYSTEM

SURFACER/FILLER/PATCHER 215

PRIMERS **Steel:** Self-priming or Series 1, 27, 37H, 66, L69, L69F, N69, V69, 90E-92, 90G-1K97, 90-97, H90-97, 90-98, 91-H_2O, 94-H_2O, 135, 161, 394, 530
Galvanized Steel and Non-Ferrous Metal: Self-priming or Series 66, L69, L69F, N69, V69, 161
Concrete: Self-priming or Series 130, 215, 218
CMU: Self-priming or Series 130, 215, 218, 1254

TOPCOATS 22, 40H-413, 66, L69, L69F, N69, N69F, V69, V69F, 72, 73, 84, 104, 113, 114, 141, 156, 157, 161, 175, 180, 181, 287, 446, 740, 750, 1028, 1029, 1070, 1070V, 1071, 1071V, 1072, 1072V, 1074, 1074U, 1075, 1075U, 1077, 1078, 1080, 1081. Refer to COLORS on applicable topcoat data sheets for additional information. **Note:** The following recoat times apply for Series N69F/V69F: Immersion Service—Surface must be scarified after 30 days. Atmospheric Service—After 30 days, scarification or an epoxy tie-coat is required. When topcoating with Series 740 or 750, recoat time for N69F or V69F is 14 days. Contact your Tnemec representative for specific recommendations.

SURFACE PREPARATION

PRIMED STEEL **Immersion Service:** Scarify the epoxy prime coat surface by abrasive blasting with fine abrasive before topcoating if it has been exterior exposed for 30 days or longer and N69F/V69F is the specified topcoat.

STEEL **Immersion Service:** SSPC-SP10/NACE 2 Near-White Blast Cleaning with a minimum angular anchor profile of 1.5 mils.
Non-Immersion Service: SSPC-SP6/NACE 3 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

GALVANIZED STEEL & NON-FERROUS METAL Surface preparation recommendations will vary depending on substrate and exposure conditions. Contact your Tnemec representative or Tnemec Technical Services.

CAST/DUCTILE IRON Contact your Tnemec representative or Tnemec Technical Services.

CONCRETE Allow new concrete to cure 28 days. For optimum results and/or immersion service, abrasive blast referencing SSPC-SP13/NACE 6, ICRI CSP 2-4 Surface Preparation of Concrete and Tnemec's Surface Preparation and Application Guide.

CMU Allow mortar to cure for 28 days. Level protrusions and mortar spatter.

PAINTED SURFACES **Non-Immersion Service:** Ask your Tnemec representative for specific recommendations.

ALL SURFACES Must be clean, dry and free of oil, grease, chalk and other contaminants.

TECHNICAL DATA

VOLUME SOLIDS 69.0 ± 2.0% (mixed) †

RECOMMENDED DFT 2.0 to 10.0 mils (50 to 255 microns) per coat. **Note:** The number of coats and thickness requirements will vary with substrate, application method and exposure. Contact your Tnemec representative.

CURING TIME AT 5 MILS DFT

Temperature	To Handle	To Recoat	Immersion
75°F (24°C)	4 hours	5 hours	7 days
65°F (18°C)	7-8 hours	9-11 hours	8 days
55°F (13°C)	12-14 hours	16-20 hours	9-10 days
45°F (7°C)	18-22 hours	28-32 hours	12-13 days
35°F (2°C)	28-32 hours	46-50 hours	16-18 days

Curing time varies with surface temperature, air movement, humidity and film thickness.

VOLATILE ORGANIC COMPOUNDS

N69F
Unthinned: 2.30 lbs/gallon (280 grams/litre)
Thinned 10% (No. 4 Thinner): 2.75 lbs/gallon (330 grams/litre)
Thinned 10% (No. 60 Thinner): 2.76 lbs/gallon (331 grams/litre)

V69F
Unthinned: 1.90 lbs/gallon (228 grams/litre)
Thinned 3.5% (No. 4 Thinner): 2.08 lbs/gallon (250 grams/litre) †

HAPS

N69F
Unthinned: 2.35 lbs/gal solids
Thinned 10% (No. 4 Thinner): 3.20 lbs/gal solids
Thinned 10% (No. 60 Thinner): 2.35 lbs/gal solids

V69F
Unthinned: 2.00 lbs/gal solids
Thinned 3.5% (No. 4 Thinner): 2.20 lbs/gal solids

HI-BUILD EPOXOLINE® II | N69F or V69F

THEORETICAL COVERAGE 1,107 mil sq ft/gal (27.2 m²/L at 25 microns). See APPLICATION for coverage rates. †

NUMBER OF COMPONENTS Two: Part A (amine) and Part B (epoxy) — One (Part A) to one (Part B) by volume.

PACKAGING 5 gallon (18.9L) pails - Order in multiples of 2.

NET WEIGHT PER GALLON N69F: 13.34 ± 0.25 lbs (6.10 ± .11 kg) (mixed) V69F: 13.90 ± 0.25 lbs (6.31 ± .11 kg) (mixed) †

STORAGE TEMPERATURE Minimum 20°F (-7°C) Maximum 110°F (43°C)

TEMPERATURE RESISTANCE (Dry) Continuous 250°F (121°C) Intermittent 275°F (135°C)

SHELF LIFE Part A: 24 months; Part B: 12 months at recommended storage temperature.

FLASH POINT - SETA N69F & V69F Part A: 82°F (28°C) N69F Part B: 93°F (34°C) V69F Part B: 86°F (30°C)

HEALTH & SAFETY Paint products contain chemical ingredients which are considered hazardous. Read container label warning and Material Safety Data Sheet for important health and safety information prior to the use of this product.
Keep out of the reach of children.

APPLICATION

COVERAGE RATES

	Dry Mils (Microns)	Wet Mils (Microns)	Sq Ft/Gal (m²/Gal)
Suggested (1)	6.0 (150)	9.0 (230)	184 (17.1)
Minimum	2.0 (50)	3.0 (75)	553 (51.4)
Maximum	10.0 (250)	15.0 (375)	111 (10.3)

Dense Concrete & Masonry: From 100 to 150 sq ft (9.3 to 13.9 m²) per gallon.
CMU: From 75 to 100 sq ft (7.0 to 9.3 m²) per gallon.
(1) Note for Steel: Roller or brush application requires two or more coats to obtain recommended film thickness. Also, Series N69F can be spray applied to an optional high-build film thickness range of 8.0 to 10.0 dry mils (205 to 255 dry microns) or 11.5 to 14.5 wet mils (209 to 370 wet microns). Allow for overspray and surface irregularities. Film thickness is rounded to the nearest 0.5 mil or 5 microns. Application of coating below minimum or above maximum recommended dry film thicknesses may adversely affect coating performance. †

MIXING
1. Start with equal amounts of both Parts A & B.
2. Using a power mixer, separately stir Parts A & B.
3. Add Part A to Part B under agitation, stir until thoroughly mixed.
4. Both components should be above 50°F (10°C) prior to mixing. For application to surfaces between 35°F to 50°F (2°C to 10°C), allow mixed material to stand thirty (30) minutes and restir before using. For optimum application properties, blended components should be above 60°F (16°C).

THINNING Use No. 4 or No. 60 Thinner. For air spray, thin up to 10% or 3/4 pint (380 mL) per gallon. For airless spray, roller or brush, thin up to 5% or 1/4 pint (190 mL) per gallon. **Note:** When using Series V69F, a maximum of 3.5% of No. 4 Thinner may be used to comply with VOC regulations.

POT LIFE 2 hours at 50°F (10°C) 1 hour at 75°F (24°C) 30 minutes at 100°F (38°C)

SPRAY LIFE 30 minutes at 75°F (24°C)
Note: Spray application after listed times will adversely affect ability to achieve recommended dry film thickness.

APPLICATION EQUIPMENT

Air Spray •

Gun	Fluid Tip	Air Cap	Air Hose ID	Mat'l Hose ID	Atomizing Pressure	Pot Pressure
DeVilbiss JGA	E	765 or 704	5/16" or 3/8" (7.9 or 9.5 mm)	3/8" or 1/2" (9.5 or 12.7 mm)	75-100 psi (5.2-6.9 bar)	10-20 psi (0.7-1.4 bar)

Low temperatures or longer hoses require higher pot pressure.

Airless Spray •

Tip Orifice	Atomizing Pressure	Mat'l Hose ID	Manifold Filter
0.015"-0.019" (380-485 microns)	3000-4800 psi (207-330 bar)	1/4" or 3/8" (6.4 or 9.5 mm)	60 mesh (250 microns)

Use appropriate tip/atomizing pressure for equipment, applicator technique and weather conditions.
• Spray application of first coat on CMU should be followed by backrolling.
Note: Application over inorganic zinc-rich primers: Apply a wet mist coat and allow tiny bubbles to form. When bubbles disappear in 1 to 2 minutes, apply a full wet coat at specified mil thickness.
Roller: Use 3/8" or 1/2" (9.5 mm or 12.7 mm) synthetic woven nap roller cover. Use longer nap to obtain penetration on rough or porous surfaces.
Brush: Recommended for small areas only. Use high quality natural or synthetic bristle brushes.

SURFACE TEMPERATURE Minimum 35°F (2°C) Maximum 135°F (57°C)
The surface should be dry and at least 5°F (3°C) above the dew point. Coating will not cure below minimum surface temperature.

CLEANUP Flush and clean all equipment immediately after use with the recommended thinner or MEK.

† Values may vary with color.

SECTION 4

NIDEC MOTOR CORPORATION
8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136

DATE: 3/22/2019

P.O. NO.: 4511756426
Order/Line NO.: 20182550 SO 100

TO: GRUNDFOS WATER UTILITY INC
Yeomans Chicago Corp
P O Box 6620
Aurora, IL, 60598-0620
ATTN: SOHEB MOMIN

Model Number: NA
Catalog Number:
Titan VSS-NT TEFC
CONF,MOTOR,TITAN VSS-NT TEFC

REVISIONS:
(NONE)

MARKS: 99603246

ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.

Features:

```
HOLD PRODUCTION
Horsepower ..... 00400.00~00000.00 ~ KW: 298.4
Enclosure ..... TEFC
Poles ..... 06~00 ~ RPM: 1200~0
Frame Size ..... 5807~P
Phase/Frequency/Voltage.. 3~060~460
Winding Type ..... Random Wound
Service Factor ..... 1.15
Insulation Class ..... Class "F" ~ VPI-2000
Altitude In Feet (Max) .. 3300 Ft.(1000 M)
Ambient In Degree C (Max) +40 C
Efficiency Class ..... Premium Efficiency
Application ..... Vertical Centrifugal Pump
Inverter Duty NEMA MG1 Part 31
Customer Part Number ....
Base Diameter (Inches) ..... 30.5
Pricebook Thrust Value (lbs).. 1930
Customer Down Thrust (lbs) ... 1
Customer Shutoff Thrust (lbs).
Up Thrust (lbs) .....
Inverter Duty Rating Details:
Load Type (Base Hz & Below) .. Variable Torque
Speed Range (Base Hz & Below). 10:1
"AK" Dimension (Inches).. NA
Shaft Dimensions:~U=2.625 ~ AH/V=5.000
KEYWAY=0.625 ~ ES=3.500
Temperature Rise (Sine Wave): "F" Rise @ SF (Resist)
Starting Method ..... Direct-On-Line Start
Duty Cycle ..... Continuous Duty
Efficiency Value ..... 95.4 % ~ Guaranteed
Load Inertia: NEMA ~ Standard Inertia: 4199 LB-FT2
Number Of Starts Per Hour: NEMA
Motor Type Code ..... JVEI
Rotor Inertia (LB-FT²)          242. LB-FT²
Qty. of Bearings PE (Shaft)     1
Qty. of Bearings SE (OPP)       1
Bearing Number PE (Shaft)       6226-J/C3
Bearing Number SE (OPP)         6226-Z-J/C3
```

NIDEC MOTOR CORPORATION

8050 WEST FLORISSANT AVE.
ST. LOUIS, MO 63136

DATE: 3/22/2019

P.O. NO.: 4511756426
Order/Line NO.: 20182550 SO 100

TO: GRUNDFOS WATER UTILITY INC
Yeomans Chicago Corp
P O Box 6620
Aurora, IL, 60598-0620
ATTN: SOHEB MOMIN

Model Number: NA
Catalog Number:
Titan VSS-NT TEFC
CONF,MOTOR,TITAN VSS-NT TEFC

REVISIONS:
(NONE)

MARKS: 99603246

ALL DOCUMENTS HEREIN ARE CONSIDERED CERTIFIED BY NIDEC MOTOR CORPORATION.
THANK YOU FOR YOUR ORDER AND THE OPPORTUNITY TO SERVE YOU.

Accessories:

```
Ground Lug In Conduit Box
Inpro/Seal Ground Ring CDR
Insul. Bearing - Upper Bracket
Special Balance
Siemens T-Sentry 115/230V SMSE
ATA Vib. Detect/Prox Probe:
Vib Det/Prox Probe Type .... ATOE
Manufacturer ............... ATOE
Manufacturer's Part Number.. ATOE
Q-1 Upper/Short End Bracket
Mounting Arrangement SE Std. Mounting Position
No Vib Detect On Lower/PE Brk
Mounting Arrangement PE
Total Qty Of Detectors 1
Q-1 Accessory Outlet Box ~ Opposite Side of Main O/B
3/4" NPT Conduit Opening
Test Requirements:
Complete Initial Test-Unwit.
```

USE THE DATA PROVIDED BELOW TO SELECT THE APPROPRIATE DIMENSION PRINT

Horsepower	400
Pole(s)	06
Voltage(s)	460
Frame Size	5807P
Shaft U Diameter	2.625
Outlet Box AF	10.94
Outlet Box AA	3.50
Accessory Outlet Box DM	0.75

Nidec
All for dreams

May 01, 2019

NIDEC-USEM MOTOR CERTIFICATE FOR VFD POWER

The 400HP motors that will be supplied for Grundfos-Yeomans PO # 4511756426 / Nidec-USEM sales order 20182550-100 will meet NEMA MG-1 Part 31 Inverter Duty. The motors are compatible with PWM type VFD's when properly installed and applied. The actual installation site is Rock River IL Pump Station.

If you have any further questions or concerns, please call or email.

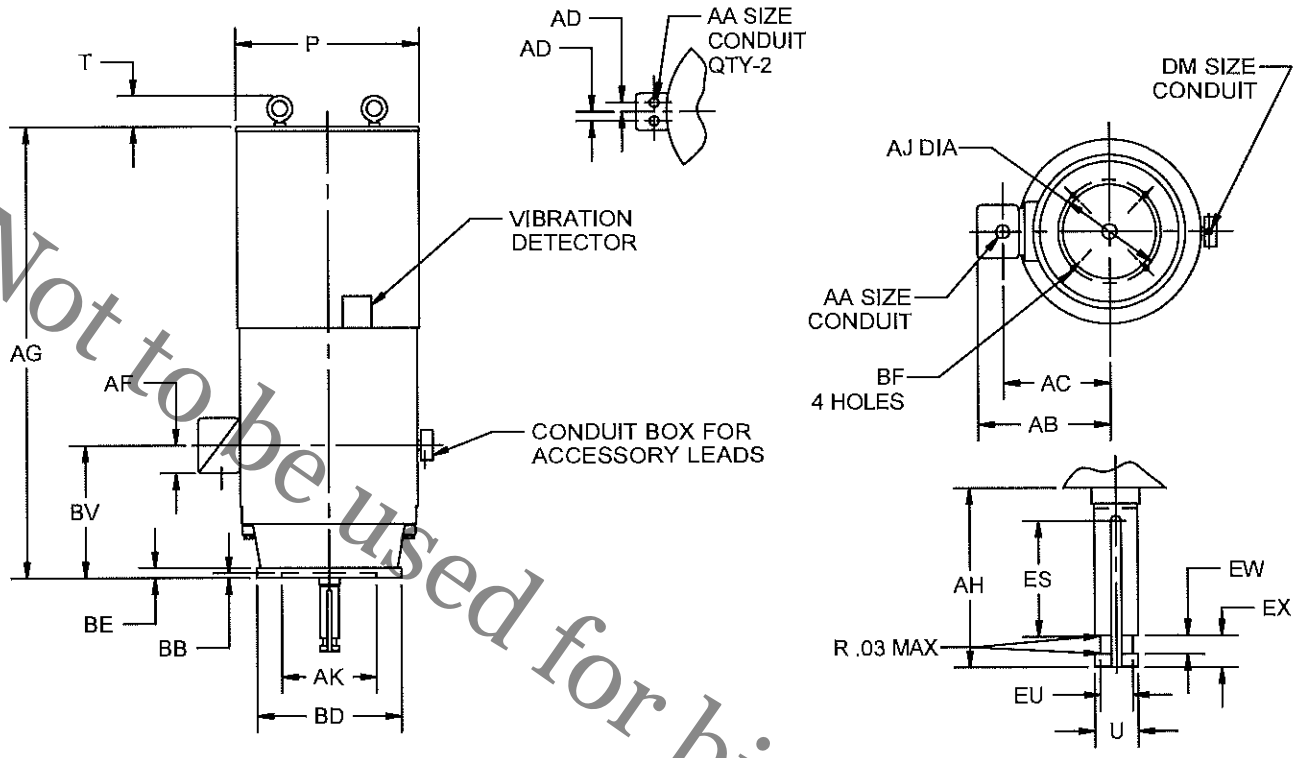
Yours truly,

Brian Wolek

INDUSTRIAL MOTORS AND SYSTEMS
PHONE: (815) 444-1229 FAX: (815) 444-1242 EMAIL: brian.wolek@nidec-motor.com

NIDEC MOTOR CORPORATION

EFFECTIVE: 20-JAN-15	DIMENSION PRINT WITH STYLE "P" BASE FRAME: 5807P THRU 5811PH BASIC TYPE: JV	PRINT: 09-2549-09
SUPERSEDES: 13-JUL-05		SHEET: 1 OF 1



ALL DIMENSIONS ARE IN INCHES

FRAME	HP	VOLTS	AB	AC	AD	AF
5800	THRU 500	460	26.13	20.63	-	8.06
	ALL	2300				
	OVER 500	460	32.00	25.38	3.00	10.94
	ALL	4000	27.13	21.63	-	10.00

AA
3 NPT
3 1/2 NPT
4 NPT

DM
3/4 NPT
1 NPT
1 1/2 NPT

FRAME	AG
5807	57.00
5809	64.00
5811	72.00

FRAME	P	T	AJ	AK +.005	BB MIN	BD MAX	BE	BF	BV	XP
5800P	31.13	4.00	26.000	22.000	.25	30.50	1.25	.81	16.75	17.63
5800PH			14.750	13.500		24.50		.69		
			22.000					.94		

	POLES(RPM)				U -.001	AH ±.062	ES MIN	EU -.005	EW +.002	EX -.005	SQ KEY
	2(3600)	4(1800)	6(1200)	8(900)							
HP	ALL THRU 600	ALL THRU 300	ALL THRU 200	ALL THRU 150	2.125	4.500	3.00	1.750	0.375	0.750	.500
	—	350 THRU 450	250 THRU 300	200	2.375	5.000	3.50	2.000	0.375	0.750	.625
	—	500 THRU 600	350 THRU 400	250 THRU 300	2.625	5.000	3.50	2.250	0.375	0.750	.625
	—	700 THRU 800	450 THRU 500	350 THRU 400	2.875	7.000	5.00	2.375	0.500	1.000	.750
	—	—	600	450 THRU 500	3.125	7.000	5.00	2.625	0.500	1.000	.750

	POLES(RPM)				U -.001	AH ±.062	ES MIN	EU -.005	EW +.002	EX -.005	SQ KEY
	10(720)	12(600)	14(514)	16(450)							
HP	ALL THRU 125	ALL THRU 100	ALL THRU 75	ALL THRU 75	2.125	4.500	3.00	1.750	0.375	0.750	.500
	150	125 THRU 150	100 THRU 125	100	2.375	5.000	3.50	2.000	0.375	0.750	.625
	200	200	150	125 THRU 150	2.625	5.000	3.50	2.250	0.375	0.750	.625
	250 THRU 300	250	200	200	2.875	7.000	5.00	2.375	0.500	1.000	.750
	350 THRU 400	300	250	250	3.125	7.000	5.00	2.625	0.500	1.000	.750

1. DIMENSIONS MAY VARY BY +/-.25" DUE TO CASTING AND/OR FABRICATION VARIATIONS.
2. CONDUIT OPENINGS MAY BE LOCATED IN STEPS OF 90 DEGREES. STANDARD IS AS SHOWN WITH CONDUIT OPENINGS DOWN.

TOLERANCES	
FACE RUNOUT	.007 F.I.R.
PERMISSIBLE ECCENTRICITY OF MOUNTING RABBET	.007 F.I.R.
PERMISSIBLE SHAFT RUNOUT	.003 F.I.R.
MAXIMUM SHAFT END PLAY	.010

09-2549/A

Nidec Motor Corporation
St. Louis, Missouri

ISSUED BY
K. FRIEDMAN
APPROVED BY
K. POTTER

NAMEPLATE DATA

CATALOG NUMBER:				NAMEPLATE PART #:	422707-006		
MODEL		FR	5807P	TYPE	JVEI	ENCL	TEFC
SHAFT END BRG	6226-J/C3 - QTY 1			OPP END BRG	6226-Z-J/C3 - QTY 1		
PH	3	MAX AMB	40 C	ID#	(ref: Order#: 20182550, Type: SO, Line#: 100)		
INSUL CLASS	F	Asm. Pos.		DUTY	CONT		

HP	400		RPM	1190		HP		RPM	
VOLTS	460					VOLTS			
FL AMPS	469.0					FL AMPS			
SF AMPS	536.0					SF AMPS			
SF	1.15	DESIGN	#	CODE	G	SF		DESIGN	CODE
NEMA NOM EFFICIENCY	96.2	NOM PF	83.1	KiloWatt	298.4	NEMA NOM EFFICIENCY		NOM PF	
GUARANTEED EFFICIENCY	95.4	MAX KVAR		HZ	60	GUARANTEED EFFICIENCY		MAX KVAR	HZ

HAZARDOUS LOCATION DATA (IF APPLICABLE):

DIVISION		CLASS I		GROUP I	
TEMP CODE		CLASS II		GROUP II	

VFD DATA (IF APPLICABLE):

VOLTS	460		
AMPS	492.5		
TORQUE 1	1766LB-FT	TORQUE 2	
VFD LOAD TYPE 1	VT/PWM	VFD LOAD TYPE 2	
VFD HERTZ RANGE 1	6-60	VFD HERTZ RANGE 2	
VFD SPEED RANGE 1	120-1200	VFD SPEED RANGE 2	
SERVICE FACTOR	1.00	FL SLIP	
NO. POLES		MAGNETIZING AMPS	
VECTOR MAX RPM		Encoder PPR	
Radians / Seconds		Encoder Volts	

TEAO DATA (IF APPLICABLE):

HP (AIR OVER)		HP (AIR OVER M/S)		RPM (AIR OVER)		RPM (AIR OVER M/S)	
FPM AIR VELOCITY		FPM AIR VELOCITY M/S		FPM AIR VELOCITY SEC			

ADDITIONAL NAMEPLATE DATA:

Decal / Plate	WD=499495	Customer PN	
Notes		Non Rev Ratchet	
Max Temp Rise		OPP/Upper Oil Cap	GREASE
Thermal (WDG)	OVER TEMP PROT 1	SHAFT/Lower Oil Cap	GREASE
Altitude		Usable At	
Regulatory Notes		Regulatory Compliance	CC 030A
COS		Marine Duty	
Balance	0.08 IN/SEC	Arctic Duty	
3/4 Load Eff.	96.2	Inrush Limit	
Motor Weight (LBS)	5180	Direction of Rotation	
Sound Level		Special Note 1	
Vertical Thrust (LBS)	1930	Special Note 2	
Thrust Percentage	NORMAL	Special Note 3	
Bearing Life		Special Note 4	
Starting Method		Special Note 5	
Number of Starts		Special Note 6	
200/208V 60Hz Max Amps		SH Max. Temp.	
190V 50 hz Max Amps		SH Voltage	
380V 50 Hz Max Amps		SH Watts	
NEMA Inertia		Load Inertia	
Sumpheater Voltage		Sumpheater Wattage	
Special Accessory Note 1		Special Accessory Note 16	
Special Accessory Note 2		Special Accessory Note 17	
Special Accessory Note 3		Special Accessory Note 18	
Special Accessory Note 4		Special Accessory Note 19	
Special Accessory Note 5		Special Accessory Note 20	
Special Accessory Note 6		Special Accessory Note 21	
Special Accessory Note 7		Special Accessory Note 22	
Special Accessory Note 8		Special Accessory Note 23	
Special Accessory Note 9		Special Accessory Note 24	
Special Accessory Note 10		Special Accessory Note 25	
Special Accessory Note 11		Special Accessory Note 26	
Special Accessory Note 12		Special Accessory Note 27	
Special Accessory Note 13		Special Accessory Note 28	
Special Accessory Note 14		Special Accessory Note 29	
Special Accessory Note 15		Special Accessory Note 30	
Heater in C/B Voltage		Heater in C/B Watts	
Zone 2 Group		Division 2 Service Factor	
Note 1		Note 2	
Note 3			

NIDEC MOTOR CORPORATION

ST. LOUIS, MO

TYPICAL NAMEPLATE DATA
ACTUAL MOTOR NAMEPLATE LAYOUT MAY VARY
SOME FIELDS MAY BE OMITTED

MOTOR PERFORMANCE

MODEL NO.	CATALOG NO.	PHASE	TYPE	FRAME
NA	NA	3	JVEI	5807P

ORDER NO.	20182550	LINE NO.	100

MPI:	258609
HP:	400
POLES:	6
VOLTS:	460
HZ:	60
SERVICE FACTOR:	1.15
EFFICIENCY (%):	
S.F.	96
FULL	96.2
3/4	96.2
1/2	95.5
1/4	92.4
POWER FACTOR (%):	
S.F.	83.6
FULL	83.1
3/4	80.4
1/2	72.9
1/4	52.7
NO LOAD	4.4
LOCKED ROTOR	20
AMPS:	
S.F.	536
FULL	469
3/4	363
1/2	269
1/4	192
NO LOAD	155.7
LOCKED ROTOR	3110.8
NEMA CODE LETTER	G
NEMA DESIGN LETTER	#
FULL LOAD RPM	1190
NEMA NOMINAL / EFFICIENCY (%)	96.2
GUARANTEED EFFICIENCY (%)	95.4
MAX KVAR	105.4
AMBIENT (°C)	40
ALTITUDE (FASL)	3300
SAFE STALL TIME-HOT (SEC)	30
SOUND PRESSURE (DBA @ 1M)	85
TORQUES:	
BREAKDOWN{% F.L.}	230
LOCKED ROTOR{% F.L.}	100
FULL LOAD{LB-FT}	1766

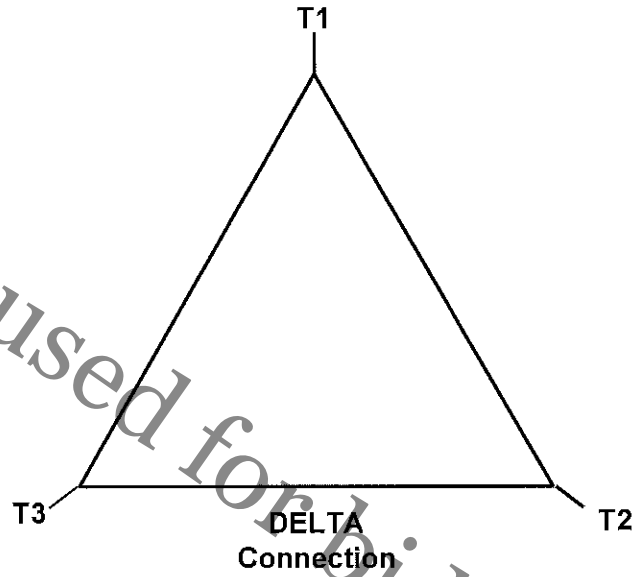
NEMA Nominal and Guaranteed Efficiencies are up to 3,300 feet above sea level and 25 ° C ambient

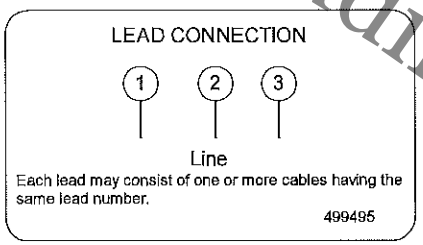
The Above Data Is Typical, Sinewave Power Unless Noted Otherwise

NIDEC MOTOR CORPORATION
ST. LOUIS, MO

499495

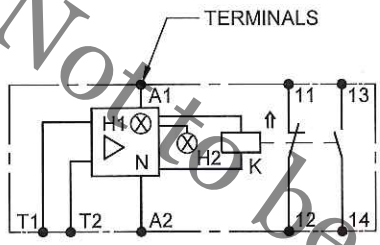
Motor Wiring Diagram

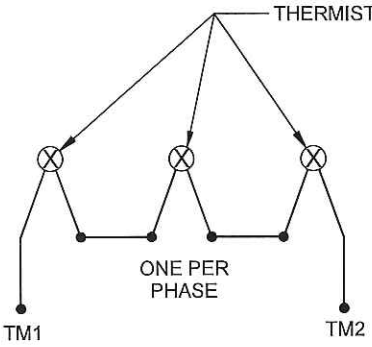




To reverse direction of rotation interchange connections L1 and L2.
Each lead may be comprised of one or more cables.
Each cable will be marked with the appropriate lead number.

EFFECTIVE: 2/27/96
SUPERCEDES: X736618, 96441, 179879, 284138
Connection Plate: 499495
Connection Decal: 912113





THERMASENTRY THERMISTORS

1. THERE ARE QTY-3 POSITIVE TEMPERATURE COEFFICIENT (PTC) THERMISTORS (1 PER PHASE) INSTALLED IN THE MOTOR WINDING. ONE PER PHASE, CONNECTED IN SERIES. TERMINATED ON TERMINAL STRIP TERMINALS T1 AND T2 IN THE MOTOR ACCESSORY CONNECTION BOX. THESE ARE TO BE WIRED TO THE REMOTE-MOUNTED CONTROL MODULE SUPPLIED WITH THE MOTOR. WIRE THE THERMISTOR LEADS TM1 AND TM2 TO THE MODULE TERMINALS T1 AND T2.

2. WIRE CONTROL POWER TO MODULE TERMINALS A1 AND A2. CONTROL POWER MAY BE 24 TO 240 VOLTS AC OR DC.

3. FOR NORMALLY OPEN CONTACTS, USE MODULE TERMINALS 13 AND 14. REV. E
4. FOR NORMALLY CLOSED CONTACTS, USE MODULE TERMINALS 11 AND 12.

NOTES:

1. OUTPUT CONTACT RATING IS:
   - AC 240 VOLTS 3 AMPERES MAXIMUM
   - DC 24 VOLTS 1 AMPERE MAXIMUM

2. DO NOT APPLY POWER DIRECTLY ACROSS 11 AND 12 OR 13 AND 14. REV. E
3. THE MODULE AUTOMATICALLY RESETS ITSELF WHEN TEMPERATURE DROPS TO A SAFE LEVEL.

TYPICAL CONNECTION DIAGRAM, REMOTE MOUNTED
THERMASENTRY WITH N.O. AND N.C. CONTACTS

ACCESSORY LISTING
QTY. 1 - SEIMENS THERMASENTRY CONTROL MODULE N.O./N.C.
QTY. 3 - THERMASENTRY THERMISTORS

ITEMS AND MATERIALS SPECIFIED HEREIN MUST COMPLY WITH THE EUROPEAN REDUCTION OF HAZARDOUS SUBSTANCES (ROHS 3) DIRECTIVE 2011/65/EU, REGULATIONS (EC) NO. 1907/2006 (REACH) AS OF 1 JUNE 2007, CALIFORNIA PROP 65 AND ALL SUBSEQUENT UPDATES. PLEASE REFER TO THE OFFICIAL DOCUMENTS FOR COMPLETE DEFINITIONS AND LIMITS FOR ALL RESTRICTED SUBSTANCES UNDER ROHS 3, REACH AND CALIFORNIA PROP 65.

NIDEC CONFIDENTIAL
NIDEC MOTOR CORPORATION 19-DEC-18

REVISION DESCRIPTION FOR: 18703356
CHANGED TERMINALS IN NOTES 11 WAS 95, 12 WAS 96, 13 WAS 97, 14 WAS 98.

MATERIAL: ----

SCALE: NONE | UNITS: INCHES

TOLERANCES ON DIMENSIONS (UNLESS OTHERWISE SPECIFIED)
INCHES | mm
ANGLES X°= ±1°

TITLE: DRAWING, CUSTOMER CONNECTION DIAGRAM

NIDEC MOTOR CORPORATION

ISSUED BY: R. LOPEZ | APPROVED BY: M. RAMIREZ | REVISION DATE: 20-DEC-18

CODE | DWG NO.: 0625703 | REV: E | SHEET NUMBER: 1 OF 1 | DWG SIZE: A

NMCA (OCT-2013)

SOLIDEDGE

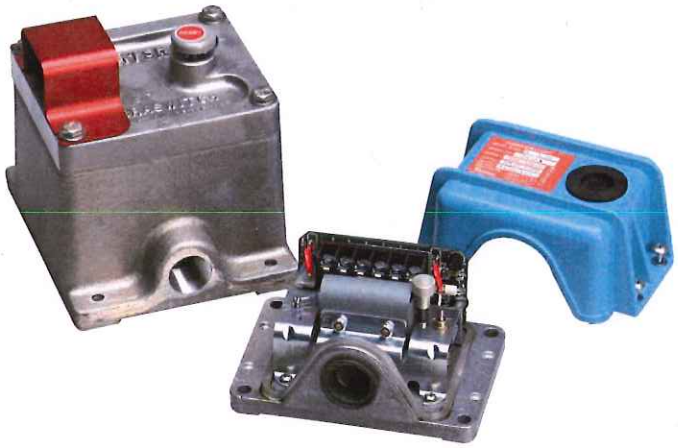
Model ~~375A~~/376A Vibraswitch® Malfunction Detectors

General Description

These Robertshaw Vibraswitch Malfunction Detectors are acceleration sensitive vibration instruments with electronic circuitry to provide maximum protection to rotating and reciprocating machinery due to damages resulting from mechanical malfunctions. Although identical in outside appearance and dimensionally the same as the existing Models 365 and 366, these instruments include "built-in" electronic circuitry for start and/or monitoring time delay functions for the prevention of false shutdowns resulting from transient vibrations. All models include provisions for remote reset.

"Start Delay" is often required on machines that start automatically and exhibit excessive vibration for short periods of time only during starting. Proper set point adjustment on the Vibraswitch for adequate protection during normal running conditions may cause the Vibraswitch to "trip" as the instrument senses these high starting transient vibrations without the use of "Start Delay." Examples of such machines are refrigeration compressors and high-speed turbines.

"Monitor Delay" is required on machines that exhibit excessive vibration of a transient nature which occurs during normal operation. If a Vibraswitch without monitor delay has its set point sufficiently high so as not to trip-out under the transient vibration levels, inadequate protection would result during the normal running conditions. Examples of this type machine include liquid pumps that experience momentary cavitations resulting in excessive vibration.



Features and Benefits:

- **Complete Vibration Protection in a Single Package**
  Reasonably priced, lower installation costs
- ~~**Explosion Proof Model (375A)**~~
  ~~FM Approved~~
  ~~InMetro Approved~~
- **Weather Proof Model (376A)**
  NEMA 4
  NEMA 4X (optional)
- **Acceleration Sensitive**
  Measures destructive forces
- **Selectable Time Delay Control Options**
  Permits maximum application flexibility
- **Ease of Adjustment**
  Set it and forget it – one adjustment
- **Continuous Reliable Protection**
  No attention required after installation
- **Solid State Switching**
  Alarm or shutdown voltage completely isolated from instrument supply

Principle of Operation

The Model 375A and 376A Vibraswitches employ a magnetic circuit opposed by inertial and adjustable spring forces in the actuating mechanism. Operation of the unit may be understood by reference to Figure 1

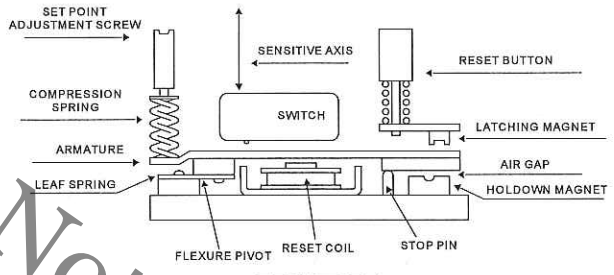


FIGURE 1

The armature is constrained so as to respond to only a single direction of motion, by a frictionless flexure pivot composed of two overlapping blocks with a leaf spring loaded in one direction to hold the blocks together. The armature rotates about the pivot; being forced in one direction by the adjusting spring force and the other direction by the magnetic force.

When the entire assembly is subjected to vibration perpendicular to the base, the peak acceleration times the effective mass of the armature produces an inertial force, aided by the adjustable spring tending to force the armature away from the stop pin and the restraining force of the magnet. When the peak acceleration exceeds the set point level, the armature leaves the stop pin, increasing the air gap and decreasing the magnetic force with the armature continuing to move up until it reaches the latch magnet, actuating the switch during its upward travel. The effect of temperature in the mechanism is negligible as the elastic modulus of the adjusting spring and magnetic flux through the air gap both decrease slightly with increasing temperature thereby compensating each other.

Electronic Operation

"Start Delay Only" models hold the Vibraswitch armature in its "reset" position for a preset starting time after application of supply voltage to the instrument. This prevents the Vibraswitch from tripping out during machine startup. Fixed timing periods of 15, 30, 60 or 90 seconds are available. After the time period, the Vibraswitch functions as normal with shutdown or alarm functions provided by utilizing the SPDT switch contacts in the unit.

"Monitor Delay Only" models prevent nuisance shutdowns due to tripping-out of the Vibraswitch during high level short term transient vibration conditions by automatically resetting the Vibraswitch. Under continuing high vibration, the Vibraswitch trips, is immediately reset, trips out again and is reset; this "sampling" process continuing until the time delay period has elapsed, after which the unit remains "tripped" out. An AC output by means of a solid state "TRIAC" switch can be used for either ALARM or SHUTDOWN. The "TRIAC" switch can be set for either NO or NC operation by repositioning the jumper plug located on the circuit board.

"Start and Monitor Delay" models provide the control functions of both START delay and MONITOR delay in a single instrument. The "Start and Monitor Delay" models employ the same "TRIAC" switch found in the "Monitor Delay Only" models.

Specifications

Enclosure:
375A ..... Aluminum, unpainted (standard)
FM Approved for Class I, Division 1, Groups C & D; Class II, Division 1, Groups E, F & G hazardous locations
Aluminum, epoxy painted (optional)
376A ..... Aluminum base, unpainted (standard) with ABS thermoplastic cover & Kraton thermoplastic gasket, NEMA 4.
Epoxy painted base (optional), NEMA 4X

Switch Contacts:
Start Delay Only Models:
SPDT (dry contacts)
5 A at 120 or 240 VAC
Monitor or Start & Monitor Delay Models:
SPST Triac (solid state contacts)
2 A maximum, 50 mA minimum at 120 VAC only (will not switch DC)
Field selectable for NO or NC operation

Set Point Range:
Mounted Horizontal ..... 0 to 4.5 G (peak)
Mounted Vertical ..... 0 to 3.5 G (peak)
Frequency Range ..... 0 to 300 Hz
Set Point Adjustment ..... 1 G per turn (approximate)
Temperature limits:
Storage ..... -40° to +160° F (-40° to +71° C)
Operating ..... -20 to +140° F (-29° to +60° C)
Shock ..... 75 G @ 11 ms maximum
Supply Voltage: ..... 120 VAC ±10%, 50/60 Hz
Supply Power: ..... 15 W maximum
Delay Time Accuracy: ..... ±30%
Net weight:
375A ..... 6.5 lbs (2.9 kg)
376A ..... 2.25 lbs (1 kg)
Shipping weight:
375A ..... 7 lbs (3.2 kg)
376A ..... 3 lbs (1.4 kg)
Agency Certification:
375A ..... FM Files 0Q7A3.AE & 0R1H7.AE
376A ..... None

Ordering Information

375A – A3 – C4 – E

Key Model Number
Supply Voltage – See Table 1
Delay Function – See Table 2
Start Delay Time – See Table 3
Monitor Delay Time – See Table 4
Special Options – See Table 5

Key Model Number

Designation	Description
375A	Explosion Proof Vibraswitch, FM Certified
376A	Weather Proof Vibraswitch, NEMA 4

Table 1 – Supply Voltage

Designation	Description
A	120 VAC ±10%, 50/60 Hz

Table 2 – Delay Function

Designation	Description
1	Start Delay Only
2	Monitor Delay Only
3	Start & Monitor Delay

Table 3 – Start Delay Time

Designation	Description
A	None
C	15 Seconds
D	30 Seconds
E	60 seconds
F	90 Seconds

Table 4 – Monitor Delay Time

Designation	Description
0	None
2	2 Seconds
3	5 Seconds
4	10 Seconds

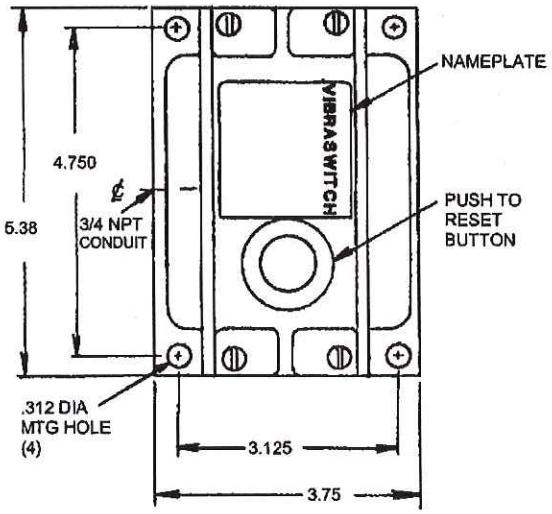
Table 5 – Special Options

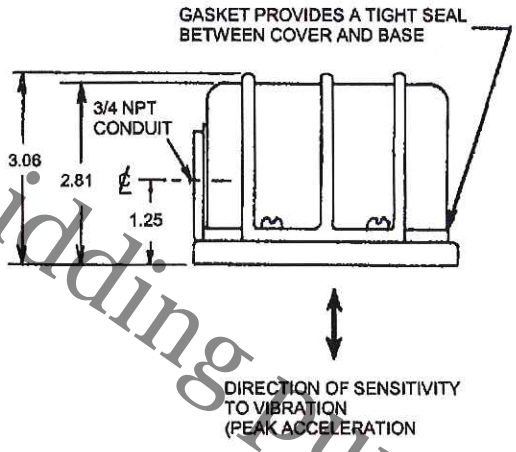
Designation	Description
Omit	No special options
	For the 375A – Epoxy painted enclosure
E	For the 376A – Epoxy painted base, NEMA 4X

Accessory Items
(Must be ordered separately)

Part no.	Description
904GB016	Rain shield for unprotected outdoor installations, steel, zinc plated
904GB016-03	Rain shield, steel, zinc plated and painted with gray epoxy enamel.

Model 376A Dimensions





Note:
The mechanical reset pushbutton on the Vibraswitch will only reset the mechanical portion of the Vibraswitch and will not re-initiate the Start and/or Monitor Delay function and will not reset the solid state switch. The mechanical reset is normally only used when adjusting the set point.

SECTION 5

LATERAL AND TORSIONAL ANALYSIS TO FOLLOW

Appendix B

District Provided Variable Frequency Drive (VFD) Information

(VFD Procurement for Cherry Valley Lift Station Pump Replacement - Capital Project No. 1911)

VIII - Technical Specifications

VFD Procurement for Cherry Valley Lift Station Pump Replacement
Capital Project No. 1911

Section 16483
VARIABLE FREQUENCY DRIVES

PART 1. GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract
B. Proposed Pump Motor Data
C. Cherry Valley Lift Station Record Drawings

1.2 SUMMARY

A. IEEE 519 levels must be met at the PCC described in this Specification.
B. Section includes separately enclosed, pre-assembled, combination VFDs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors. Manufacturer can provide 6-pulse drives with passive harmonic filters in lieu of 18-pulse with bypass.

1.	P2-101-2	469FLA	(18-pulse w/ bypass)
2.	P3-101-3	469FLA	(18-pulse w/ bypass)

1.3 DEFINITIONS

A. CPT: Control power transformer.
B. IGBT: Insulated-gate bipolar transistor.
C. LED: Light-emitting diode.
D. MCP: Motor Control Panel
E. PCC: Point of common coupling.
F. PID: Proportional-Integral-Derivative
G. PWM: Pulse-width modulated.
H. RFI: Radio-frequency interference.
I. TDD: Total demand (harmonic current) distortion.
J. THD(V): Total harmonic voltage demand.
K. VFD: Variable Frequency Drive

1.4 SUBMITTALS

A. Submit under the provisions of Section III 2.2 of these specifications.
B. Shop Drawings: For each VFD indicated, include the dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting

arrangements, and details, including required clearances and service space around equipment.

1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
   a) Each installed unit's type and details.
   b) Factory-installed devices.
   c) Enclosure types and details.
   d) Nameplate legends.
   e) Short-circuit current (withstand) rating of complete assembly with documentation substantiating rating indicated. The short circuit rating of the assembly shall be greater than the available fault current of the power supply feeding the VFD assembly.
   f) Features, characteristics, ratings, and factory settings of each VFD and installed devices.
   g) Specified modifications.
2. Schematic and Connection Wiring Diagrams for power, signal, and control wiring.
3. Product Data: For each type and rating of VFD indicated, include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.
   a) Complete system rating including overall drive system operating data, including efficiencies, input current ratings, output current rating, and power factors, at driven equipment actual loads of 0, 40, 60, 80, 100, and 110 percent of rated speed.
   b) Maximum heat dissipation from enclosure.
   c) Layout of controller face showing pushbuttons, switches, instruments, indicating lights, etc.
   d) Itemized bill-of-materials listing all system components.
   e) Complete system interconnection diagrams between controller, DV/DT filter, motor, and all related components or controls external to system, including wire numbers and terminal board point identification.
   f) Complete system schematic (elementary) wiring diagrams.

C. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

D. Harmonic Analysis Study and Report: Comply with IEEE 399 and NETA Acceptance Testing Specification; identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFD input filtering to limit TDD and THD(V) at each VFD to specified levels.

1. Prior to installation, the VFD manufacturer shall provide the estimated total harmonic distortion (THD) caused by the VFD's. The results shall be based on a computer aided circuit simulation of the total actual system, with information obtained from the power service provider and the user.

E. Source quality-control reports.

F. Field quality-control reports.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under the provisions of Section III 2.2 of these specifications.
B. VFD operation and maintenance manuals shall include the following:
   1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
   2. Manufacturer's written instructions for setting field-adjustable overload relays.
   3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
   4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
   5. Recommended spare parts list.
   6. Warranty
   7. Installation Instruction Manuals.
   8. Operation Instruction Manuals.
   9. Setup Instruction Manuals.
   10. Programming Instruction Manuals.
   11. Repair and Preventative Maintenance Manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS (Not required)

1.7 QUALITY ASSURANCE

A. All variable frequency drives shall be by one manufacturer.
B. Supplier: Minimum 10 years' experience in furnishing similar size and type adjustable frequency, controlled speed, drive systems.
C. For the equipment specified herein, the manufacturer shall be ISO 9001 certified.
D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
E. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage and handling shall be in accordance with Section III 2.3 of these specifications.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than 14°F and not exceeding 104°F.
   2. Ambient Storage Temperature: Not less than -4°F and not exceeding 140°F.

3. Humidity: Less than 95 percent (noncondensing).
4. Altitude: Not exceeding 3,300 feet.

1.10 COORDINATION

A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
   1. Torque, speed, and horsepower requirements of the load.
   2. Ratings and characteristics of supply circuit and required control sequence.
   3. Ambient and environmental conditions of installation location.
   4. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.11 SPARE PARTS

A. None required.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.
B. Warranty Period: The six (6) year warranty period shall start upon equipment installation and successful start-up.
C. The warranty shall include parts, labor, travel and all associated living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

PART 2. PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Danfoss Inc.; Danfoss Drives Div.
   2. ABB
B. General Requirements for VFDs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
C. Application: Variable torque.
D. VFD Description: Variable-frequency power converter (rectifier, DC bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency. The solid state VFD shall employ a full wave rectifier, AC input / output Line Reactors (dual DC link reactors acceptable),

capacitors, and IGBT's as the output switching device.

1. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

E. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

F. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

G. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFD input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 5 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFD frequency rating.
4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 100 kA.
7. Vibration Withstand: Comply with IEC 60068-2-6.
8. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.5 times the base load current for three seconds.
9. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
10. Speed Regulation: Plus or minus 10 percent.
11. Output Carrier Frequency: Selectable; 0.5 to 8 kHz. In addition, the output carrier frequency shall be randomly modulated about the selected frequency.
12. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

H. Inverter Logic: Microprocessor based, isolated from all power circuits.

I. Isolated Control Interface: Allows VFDs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

J. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

K. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or

stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFD and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFDs and motor thermal characteristics, and for providing VFD overtemperature and motor overload alarm and trip: settings selectable via the keypad: NRTL approved.
6. Critical frequency rejection, with selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.
8. Reverse-phase protection.
9. Short-circuit protection.
10. Motor overtemperature fault.
11. Ground fault.
12. The VFD and softstart bypass motor control circuitry shall be protected from sustained power or phase loss. This protection shall utilize an under-voltage relay located on the secondary side of the 120 volt AC control power transformer and be set to deactivate all power circuitry if the voltage drops below the safe operating range (95 volts AC) of the mechanical contactors.

L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

M. Bidirectional Autospeed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means: Pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFD input current rating, whichever is larger.
2. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.
3. Auxiliary contacts "a" and "b" arranged to activate with disconnect handle.

Q. The controller’s full load output current rating shall be based on 40^{o} ambient temperature.

R. The drive shall employ a current limit circuit to provide trip free operation and shall have the capability to be set between 40 and 110 percent of the drive controller output. The current limit shall be able to be set either manually via the keypad, by a frequency level, by a logic input or by an analog input.

S. The VFD shall be optimized for a 4 kHz carrier frequency to reduce motor noise and provide high system efficiency. The carrier frequency shall be adjustable by the start-up engineer or the drive shall have the capability to inject a white noise

down the motor leads to reduce motor noise.

T. Galvanic and/or optical isolation shall be provided between the drive's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. Drives not including isolation on both analog I/O and discreet I/O shall include additional isolation modules as manufactured by Action Instruments, Inc. or District approved equal.

U. Door interlocked circuit breaker disconnect switch which will disconnect all input power from the drive and all internally mounted options. The disconnect handle shall be thru-the-door type, and be padlockable in the "Off" position.

V. 120 V AC control to allow VFD to interface with remote dry contacts.

2.2 CONTROLS AND INDICATION

A. Panel-Mounted, 3-position Hand-Off-Auto Switch: When in "Hand", the VFD will be started, and the speed will be controlled from the speed potentiometer. When in "Off", the VFD will be stopped. When in "Auto", the VFD will start via an external contact closure, and its speed will be controlled via an external speed reference

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
   1. Keypad: In addition to required programming and control keys.
   2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
      a) Control Authority: Supports at least four conditions: Off, local manual control at VFD, local automatic control at VFD, and automatic control through a remote source.

C. Historical Logging Information and Displays:
   1. Real-time clock with current time and date.
   2. Running log of total power versus time.
   3. Total run time.
   4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFD door and connected to display VFD parameters including, but not limited to:
   1. Output frequency (Hz).
   2. Motor speed (rpm).
   3. Motor status (running, stop, fault).
   4. Motor current (amperes).
   5. Fault or alarming status (code).
   6. Motor output voltage (V ac)
   7. Elapsed Time Meter.
   8. kWh meter.

E. Control Signal Interfaces:
   1. Electric Input Signal Interface:
   2. Inputs: A minimum of six (6) programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided with the

following available as a minimum:

a) Remote manual/auto
b) Remote start/stop
c) Remote forward/reverse
d) Remote preset speeds
e) Remote external trip
f) Remote fault reset
g) Process control speed reference interface, 4-20mA DC
h) Potentiometer and 0-10 V DC speed reference interface
i) Fixed frequencies using digital inputs.
j) RS-232 programming and operation interface port
k) Serial communications capability

3. Outputs: A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1) programmable analog output shall be provided, with the following available at minimum.
   a) Programmable relay outputs with one (1) set of form C contacts for each, selectable with the following available at minimum:
      (1) Fault
      (2) Run
      (3) Ready
      (4) Reversing
      (5) Jogging
      (6) At speed
      (7) In torque limit
      (8) Motor rotation direction opposite of commanded
      (9) Over-temperature.
4. Programmable open collector output with available 24 V DC power supply and selectable with the following available at minimum:
   a) Fault
   b) Run
   c) Ready
   d) Reversing
   e) Jogging
   f) At speed
   g) In torque limit
   h) Motor rotation direction opposite of commanded
   i) Over-temperature.
5. Programmable analog output signal, selectable with the following available at minimum:
   a) Output current
   b) Output frequency
   c) Motor speed
   d) Motor torque
   e) Motor power
   f) Motor voltage
   g) DC link voltage
6. Monitoring and Displays:
   a) The VFD display shall be a LCD type capable of displaying three (3) lines of text and the following thirteen (13) status indicators:

(1) Run
(2) Forward
(3) Reverse
(4) Stop
(5) Ready
(6) Alarm
(7) Fault
(8) Local
(9) Panel
(10) Remote
(11) Hand
(12) Auto
(13) Off

b) The VFD keypad shall be capable of displaying the following monitoring functions at a minimum:
(1) Output frequency
(2) Output speed
(3) Motor current
(4) Motor torque
(5) Motor power
(6) Motor voltage
(7) DC-link voltage
(8) Heatsink temperature
(9) Total operating days counter
(10) Operating hours (with reset function)
(11) Total megawatt hours
(12) Megawatt hours (with reset function)
(13) Voltage level of analog input
(14) Current level of analog input
(15) Digital inputs status
(16) Digital and relay outputs status
(17) Motor temperature rise, percentage of allowable.

7. Protecting Functions:
a) The VFD shall include the following protective features at minimum:
(1) Over-current
(2) Over-voltage
(3) Inverter fault
(4) Under-voltage
(5) Phase loss
(6) Output phase loss
(7) Under-temperature
(8) Over-temperature
(9) Motor stalled
(10) Motor over-temperature
(11) Motor under-load
(12) Logic voltage failure
(13) Microprocessor failure
(14) DC injection braking.

b) The VFD shall provide ground fault protection during power-up, starting, and running. VFD with no ground fault protection during

running are not acceptable.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
   1. Number of Loops: One.

G. Three (3) programmable critical frequency lockout ranges to prevent the VFD from continuously operating at an unstable speed.

H. Four (4) programmable preset speeds.

I. The VFD shall Ramp or Coast to a stop, as selected by the user.

J. For fan and pump applications, the acceleration and deceleration profile shall be an S-curve to avoid abrupt speed changes.

2.3 LINE CONDITIONING AND FILTERING

A. Based on the harmonic analysis study and report, the VFD shall be provided with line-side harmonic reduction, as required, to insure that the current distortion limits, as defined in table 10.3 of IEEE 519-1992, are met. PCC1, defined as the low voltage side of the distribution transformer, is used for purposes of calculation and referred, by the turns ratio of the transformer, to the PCC defined by the IEEE Recommended Practices as the Consumer-Utility interface. The tables of limits set forth therein are with reference to the PCC (Isc/Il < 20). This can be done by utilizing 18-pulse drives or 6-pulse drives with passive harmonic filters. Passive filters must have capacitor cut-out contactors to remove the capacitors when the generator is running. Electrical contractor to provide wiring between SCADA panel and passive harmonic filters to cut out capacitors while generator is running. Passive harmonic filters can be provided by the following manufacturers:
   1. MTE Matrix AP Harmonic Filter.
   2. Mirus International
   3. TCI, LLC

B. Harmonic solutions shall be designed to withstand up to 2% line imbalances with the maximum Current Distortion not to exceed 11% at 100% load.

C. Harmonic solutions shall be capable of withstanding up to 2% ambient voltage distortion with the maximum Current Distortion not to exceed 12% at 100% load.

D. To ascertain the harmonic contribution of the VFD's at the PCC and to show compliance with IEEE 519-1992, harmonic analysis shall be performed and submitted with the bid package, provided that the VFD vendor is in receipt of the below listed information 10 working days prior to the bid date. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.
   1. kVA rating of the low voltage distribution transformer(s)
   2. X/R Ratio of utility low voltage distribution transformer(s)
   3. Primary voltage
   4. Secondary voltage
   5. Secondary %IZ (impedance)
   6. Length, size, & number of conductors between transformer LV side and distribution panel

7. System Single Line Diagram and electrical equipment list showing transformer and VFD detail
8. Total linear load kW to be connected to the distribution transformer
9. Anticipated maximum demand load (15 minute or 30 minute) on the distribution transformer (IEEE 519)

E. The use of 12 pulse rectifiers, Active filters or Active converter sections are not acceptable.

F. The VFD shall provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor. DC Link reactor shall be installed so that power fluctuations to the DC Capacitors shall be reduced to increase Capacitor life. VFD's without a DC link reactor shall provide a 3% impedance line side reactor and provide spare capacitors.

2.4 BYPASS SYSTEMS

A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

B. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.

C. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with barriers arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
1. Bypass Contactor: Load-break, IEC-rated contactor.
2. Output Isolating Contactor: Non-load-break, IEC-rated contactor.
3. A drive input contactor shall be used for isolation.

D. Bypass Contactor Configuration: Reduced-voltage soft start.
1. NORMAL/BYPASS Selector Switch.
2. HAND/OFF/AUTO Selector Switch.
3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFD while the motor is running in the bypass mode.
4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
   a) Operating Voltage: Depending on contactor IEC size and line- voltage rating, manufacturer's standard matching control power or line voltage.
   b) Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: Provide 120 Vac power of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
6. Overload Relays: NEMA ICS 2.
   a) Solid-State Overload Relays:
      (1) Switch or dial selectable for motor-running overload protection.

(2) Sensors in each phase.
(3) Class 20 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

7. The output/bypass contactors are to be electrically and mechanical interlocked for safety reasons.

2.5 ENCLOSURES

A. Provide single enclosure for all components.

B. VFD Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Indoor Dry and Clean Locations: Type 1, filtered and gasketed.

C. Required Dimension Restrictions: Enclosure shall be designed to have the following dimensions:

1. Length: Total length available, including space between enclosures, for both18-pulse VFD enclosures is 180".
2. Depth: 36" or less.
3. Height: 105" or less.
4. Enclosures that do not meet these restrictions must be approved by the District.

2.6 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFD enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, type.
   a) Push Buttons: Recessed types; momentary.
   b) Pilot Lights: LED types; push to test.
   c) Selector Switches: Rotary type.

B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

2.7 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFDs according to requirements in NEMA ICS 61800-2.

1. Test each VFD while connected to a motor that is comparable to that for which the VFD is rated.
2. Verification of Performance: Rate VFDs according to operation of functions and features specified.

B. VFDs will be considered defective if they do not pass tests and inspections.
C. Prepare test and inspection reports.

PART 3. EXECUTION

3.1 EXAMINATION

A. The District shall examine VFD upon delivery. VFD's that are wet, moisture damaged, or mold damaged shall be rejected.
B. The Manufacturer's representative shall examine areas, surfaces, and substrates to receive VFD's, with Installation Contractor present, for compliance with requirements for installation tolerances and other conditions affecting performance.
C. The Manufacturer's representative shall examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.
D. The Installation Contractor shall proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HARMONIC ANALYSIS STUDY

A. Perform a harmonic analysis study to identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFD input filtering to limit TDD and THD(V) at each VFD to specified levels.
B. Prepare a harmonic analysis study and report complying with IEEE 399 and NETA Acceptance Testing Specification. Submit under the provisions of Section III 2.2.

3.3 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be performed under simulated field conditions in accordance with the latest version of UL and NEMA standards.
    1. All printed circuit boards shall be functionally tested via automatic test equipment prior to unit installation.
    2. All inverter power sub-assemblies shall undergo a burn-in test.
    3. After all pre-tests have been performed, each complete VFD shall undergo a burn-in test. The drive shall be burned in with a motor load without an unscheduled shutdown.
B. Submit final VFD test reports under the provisions of Section III 2.2.

3.4 STARTUP SERVICES

A. The Manufacturer shall coordinate start-up services with the Installing Contractor.
B. Installation of the VFD's will be staged. The Manufacturer will be required to provide a minimum of one (1) 8-hour trip for each VFD.

C. The Manufacturer shall provide start-up commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. The commissioning personnel shall be the same personnel that will provide the factory service and warranty repairs at the customer's site. Sales personnel and other agents who are not factory certified technicians for VFD field repair shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system. Three (3) copies of the Start-Up Report shall be included in the close-out documents.

D. The start-up report shall include the following information in addition to the Manufacturer's standard information:
   1. Motor amp and kW at low limit and high limit speeds.
   2. Acceleration and deceleration settings.

3.5 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable pressure switches.

3.6 PROTECTION

A. Replace VFD's whose interiors have been exposed to water or other liquids prior to installation.

3.7 DEMONSTRATION

A. A factory-authorized service representative shall train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFD's at the time of the equipment commissioning. This may be combined with start-up services.

END OF SECTION