SPECIFICATIONS AND CONTRACT DOCUMENTS

BID SET

For the Construction of

HILLARD N. FLETCHER WATER RESOURCE AND RECOVERY FACILITY HEADWORKS IMPROVEMENTS

TUSCALOOSA, ALABAMA

OCA Project No. A19-1146
Garver Project No. 21W10480

VOLUME 1 OF 3
DIVISIONS 00 - 44

Prepared For:

City of Tuscaloosa

January 2024

GarverUSA.com

HFWRRF HEADWORKS IMPROVEMENTS
GARVER PROJECT NO. 21W10480

I hereby certify that the applicable portions of this project's specifications, details, and plans were prepared by me or under my direct supervision and that I am a duly Licensed Engineer under the laws of the State of Alabama.

SEAL AND SIGNATURE	APPLICABLE DIVISION OR PROJECT RESPONSIBILITY
Wes Cardwell, P.E.  Digitally Signed: January 10, 2024	Division 01 Division 02 Division [illegible] Division 40 Division [illegible]44
Kipp Martin, P.E.  Digitally Signed: January 10, 2024	Division 03 Division [illegible]05 Division [illegible]0[illegible]

CERTIFICATIONS

SEAL AND SIGNATURE	APPLICABLE DIVISION OR PROJECT RESPONSIBILITY
Jonathan White, P.E.  Digitally Signed: January 10, 2024	Division 26

GARVER, LLC CERTIFICATE OF AUTHORIZATION:
AL ENGINEERING COA NO. 500-E Expiration Date: December 31, 2025

HILLARD N. FLETCHER WATER RESOURCE AND RECOVERY FACILITY
HEADWORKS IMPROVEMENTS
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TUSCALOOSA FRONT ENDS

TECHNICAL SPECIFICATIONS

CITY OF TUSCALOOSA, ALABAMA

PUBLIC WORKS CONTRACT

WALTER MADDOX, MAYOR

CITY COUNCIL OF TUSCALOOSA

Council Members:
Matthew Wilson
Raevan Howard Williams
Norman Crow
Lee Busby
Kip Tyner
John Faile
Cassius Lanier

Scott Holmes, City Attorney

PROJECT: Hilliard N. Fletcher WRRF Headworks Improvements

FILE: A19-1146 OCE: 2024.714.001

DEPARTMENT: Water and Sewer

CONTRACTOR: _____

(2024)

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CITY OF TUSCALOOSA
ADVERTISEMENT FOR BIDS

Project Name: Hilliard N. Fletcher WRRF Headworks Improvements
File Number: A19-1146 **Engineering Project Number: 2024.714.001**

Sealed Bid Proposals will be received by the City of Tuscaloosa, at the Council Chamber of City Hall, 2201 University Boulevard, on February 6, 2024, at 10:00 am local time for this project, at which time bids will be opened and read.

Pre-Bid Conference: Attendance at the MANDATORY Pre-Bid Conference is required in order for a General Contractor to submit a bid on this Project. The Pre-Bid Conference will be held at the Council Chamber of City Hall, 2201 University Boulevard, on January 30, 2024, at 10:00 am local time.

Project Scope: Work generally includes installation of two owner furnished mechanically cleaned bar screens and shaftless screw conveyors, rehabilitation of gates, and relocation of one washer compactor unit.

Award of the contract will be made within fifty (50) calendar days from the date of the bid opening.

Plans and Specifications: Plans and specifications and all related Contract Documents are open for public inspection at the office of Hilliard N. Fletcher WRRF , located at 4010 Reese Phifer Avenue, Tuscaloosa, Alabama. The contact person for the project is Wes Cardwell, PE, Project Manager. They can be reached at RWCardwell@GarverUSA.com or (205) 443-3080.

Official Bid Documents can also be downloaded at www.centralbidding.com. Electronic Bids can be submitted at www.centralbidding.com. For any questions about the electronic bidding process, please contact Central Bidding at 225-810-4814 or support@centralbidding.com.

CITY OF TUSCALOOSA
SECTION TWO- INSTRUCTION TO BIDDERS

Project Name: Hilliard N. Fletcher WRRF Headworks Improvements
File Number: A19-1146 **Engineering Project Number: 2024.714.001**

1. Intention: The Advertisement for Bids, Instruction to Bidders, Contract Agreement, any modifications or supplemental conditions to the Contract Agreement, Bid Proposal, and the Plans and Specifications are interrelated and apply to the complete work to which they relate.

2. Definitions: Where the following words, or the pronouns used in their stead, occur herein, they shall have the following meaning:

"Awarding Authority" shall mean the City of Tuscaloosa, Alabama.

"Bidder" shall mean any person, firm or corporation, that is responsible, submitting a responsive bid for the Project contemplated by the contract documents, who meets the requirements set forth in the contract documents, maintains a permanent place of business, has adequate forces and equipment to perform the work on the Project properly and within the time limit that is established, has sufficient experience in the type work provided for in the contract documents and has adequate financial status and resources to meets its obligations contingent to the work.

"City" or "Owner" shall mean the City of Tuscaloosa, Alabama, as the awarding authority or its authorized and legal representatives.

"Construction Manager" shall mean that person or entity employed by the City to provide Construction Manager services on the work or Project, who shall be the City's representative on the Project.

"Contractor" shall mean initially the successful or probable low bidder and then the party of the first part to the construction agreement or the legally authorized representatives of such party, including a trade contractor.

"Engineer/Architect" shall mean an Engineer or Architect responsible for design and related services on the Project, and if no Construction Manager is employed, then the Engineer is the representative of the City of Tuscaloosa, Alabama, on the Project. References to the "Engineer" shall mean the Construction Manager, if the City has employed such services, to the extent such services are applicable to construction management activity as set forth in the agreement between the City and the Construction Manager, and the context herein indicates that it would relate to services traditionally and customarily performed by a Construction Manager; otherwise, "Engineer" shall refer to the Engineer or Architect.

"Federal Agency" shall mean the Department of Treasury

"Force Account Work" work paid for by reimbursing for the actual cost for labor, materials and equipment usage incurred in the performance of the work, as directed, including a percentage for overhead and profit where appropriate.

"Gender": a word importing one gender shall if appropriate extend to and be applied to the other gender. The masculine shall include the feminine and vice versa, unless the context clearly indicates otherwise.

"Inspector" shall mean a representative of the Engineer/Architect, Construction Manager or the City, as the case may be.

"Non-Resident Contractor" shall mean a contractor which is neither (a) organized and existing under the laws of the State of Alabama nor (b) maintains its principal place of business in the State of Alabama. A non-resident contractor which has maintained a permanent branch office within the State of Alabama for at least five (5) continuous years shall not thereafter be deemed to be a non-resident contractor so long as the contractor continues to maintain a branch office within Alabama.

"Project" shall mean the Public Work to which these Contract Documents relate, including the labor, materials and all work to be done by Contractor that is the subject of the bid, plans, specifications and contract documents.

"Public Property" Real property which the awarding authority owns or has contractual right to own or purchase, including easements, rights-of-way, or otherwise.

"Public Work(s)" shall mean a Project consisting of the construction, repair, renovation, or maintenance of public buildings, structures, sewers, water works, roads, bridges, docks, underpasses and viaducts, as well as any other improvement to be constructed, repaired or renovated or maintained on public property to be paid, in whole or in part, with public funds or with financing to be retired with public funds in the form of lease payments or otherwise.

"Responsible Bidder" shall mean a bidder who, among other qualities determined necessary for performance, is competent, experienced and financially able to perform the contract.

"Responsive Bidder" shall mean a bidder who submits a bid that complies with the instructions, terms and conditions of the invitation for bids, including plans, drawings, specifications and other provisions of the contract documents.

"Retainage" shall mean that money belonging to the Contractor which has been retained by the awarding authority conditioned upon final completion and acceptance of all work in connection with the Project.

"Singular/Plural" the singular shall include the plural and vice versa, unless the context clearly indicates otherwise.

"Trade Contracts" "Trade contracts" or "multiple prime contracts" are multiple but separate contracts with the City on the same Project that represent significant construction activities performed concurrently with and closely coordinated with construction activities performed on the Project under other trade contracts.

"Unbalanced Bid" Unbalanced bids may be considered non-responsive and may be subject to rejection. An unbalanced bid includes but is not limited to one which results in a substantial advance payment to the contractor.

3. Work to be Performed: The City contemplates the construction of a public works project as generally described in the Advertisement for Bid and as more particularly described, shown and depicted on the plans, specifications, drawings and in the contract documents.

4. Bidding, Generally:

A. Bids must be enclosed in a sealed envelope, addressed to the City of Tuscaloosa, Attention: City Clerk, 2201 University Boulevard, City Hall, Tuscaloosa, Alabama, or may be submitted by controlled, secure electronic means through Central Bidding at www.centralbidding.com. For any questions about the electronic bidding process, please contact Central Bidding at 225-810-4814 or support@centralbidding.com.

B. Bids shall be labeled on the outside of the sealed envelope to indicate the Project Name and include the following language: "Bid Enclosed." Electronic bids will follow all of these listed conditions B through H.

C. Bids shall be labeled on the outside of the sealed envelope with the General Contractor's license number.

D. When submitting a bid, Bidders must use proposal forms contained in the contract documents or bid schedules provided to plan holders. Bidders shall state the amount bid for each item as shown therein and all blanks shall be properly filled in and bid proposal executed as required. All sealed Bids shall include a copy of the General Contractor's license and failure to include a copy of the bidder's General Contractor license within the bid will result in the bid being rejected.

E. Any bidder may withdraw his or its bid, either personally or by written request (not by facsimile) at any time prior to the scheduled opening time for receipt of bids. Except as provided in Ala. Code §39-2-11(b)(c)(d), no bid may be withdrawn after opening of bids prior to the time of returning bid bonds as provided for herein.

F. Any unauthorized conditions, limitations or provisos attached to the bid proposal, except as otherwise provided herein, will render a bid proposal informal and may cause its rejection.

G. Unbalanced bids may be subject to rejection. Bids without a copy of the General Contractor's license will be rejected.

H. Bids will be opened in public at the time and date specified in the Notice of Advertisement for bids, unless otherwise altered by addendum. All bidders are invited to be present at the opening of bids. No bids will be received after the time established for the opening of bids.

I. Prices for mobilization and demobilization combined shall not exceed 5% of the total base bid unless either:

(1) a reasonable explanation is provided in writing by the bidder within the sealed bid and this explanation provided by the bidder is accepted by the Owner; or

(2) the Owner has waived in writing (by Addendum or otherwise) this restricted amount not to exceed 5% for mobilization and demobilization before the deadline for sealed bids to be turned in.

5. Responsible, responsive bidders: The City reserves the right to reject any bid determined by the City to not be a responsible bidder or whose bid proposal is not responsive.

In determining whether a bidder or bid is responsible and/or responsive, the City reserves the right to also request and consider the following factors:

A. Types or kinds of materials or items best suited to the City's needs for the Project.

B. If requested, the current financial statement provided by the bidder and/ or the bidder’s bonding capability or limits.

C. If requested, the City may consider the following provided by the Bidder: an accurate inventory of equipment to be used on the Project; a list of key personnel who will work on the Project and detailed histories of key personnel’s qualifications and/or experience.

D. The City may consider similar work performed by any person, firm, or corporation associated with the Bidder, key personnel of the Bidder and/or Members, Officers and Directors of the Bidder within the last five (5) years.

E. The City may consider references familiar with the bidder's competence, qualifications, experience, capabilities, skill and integrity.

F. The City may consider Bidder’s bankruptcies, judgments, liens or litigation (including any arbitration or mediation proceedings) to which the bidder (the legal entity, corporation, LLC, company), officers and the key personnel on the Project are a party to or have been a party to.

G. The Bidder’s General Contractor's State license number and class.

H. Bidder's performance and prosecution of past projects for the City of Tuscaloosa and listed references.

I. An unbalanced bid.

J. Other information asked for and supplied in the bid proposal.

The City may make such investigations as he deems necessary to determine the ability of the Bidder to perform the work, and the Bidder shall furnish to the City all such information and data for this purpose as the City may request. The City reserves the right to reject any Proposal if the evidence submitted by, or investigation of, such Bidder fails to satisfy the City that such Bidder is properly qualified to carry out the obligations of the Contract and complete the work contemplated therein.

6. Bid Bonds: Each bidder must submit with its bid, a cashier's check drawn on an Alabama bank, made payable to the City of Tuscaloosa or a fully executed bid bond on the form that is contained in the contract documents, executed by a surety company duly authorized and qualified to make bond in the State of Alabama. All bonds and/or cashier's check will be made payable to the City of Tuscaloosa for an amount not less than five (5) percent of the City's or its engineers or architects estimated cost of the Project or of the total bid in the proposal, but in no event more than $10,000.00. The purpose of said bid bond is to insure that the successful bidder will enter into a written contract with the City for the Project on the form included in the contract documents and furnish a performance bond and payment bond executed by a surety company duly authorized and qualified to make such bond in the State of Alabama, in the amount required and provide evidence of insurance as required by the bid documents within time specified or if no time is specified, within twenty (20) days after the forms have been presented to the successful bidder for signature. Provided; however, if extenuating circumstances prevail, the City may grant an extension of time not exceeding ten (10) days for the return of the contract bonds and evidence of insurance.

The price or cost of all items bid shall remain in effect for a period of fifty (50) days after Notice of Award.

7. Return of Bid Bonds: All bid bonds, except those of the three lowest bona fide bidders, will be returned immediately after bids have been checked, tabulated and the relation of the bids established. The bid bonds of the three lowest bidders may be retained and will be returned as soon as the contract bonds and the contract documents of the successful bidder have been approved and properly executed. Award of the contract will be made within the time specified after the opening of bids. In the event no award is made within such time, all bids may be rejected and all bonds returned.

Provided; however, the potentially successful bidder may enter into a written agreement with the City for an extension of time for consideration of its bid, in which case, the bidder's bond shall remain in full force and effect or the City may permit said bidder to substitute a satisfactory surety for the cashier's check if submitted as a guaranty to the bid bond.

8. Forfeiture of Bid Bonds: Should the successful bidder or bidders to whom a contract is awarded fail to execute a contract(s) and furnish acceptable contract securities and evidence of insurance, as required, within thirty (30) days after the prescribed forms have been presented to

him/her, the City may retain from the proposal guaranty, if it is a cashier's check or recovered from the principal or the sureties, if the guaranty is a bid bond, the difference between the amount of the contract as awarded, and the amount of the proposals of the new lowest bidder. If no other bids are received, the full amount of the proposal guaranty may be so retained and recovered as liquidated damages for such default. Any sum so retained or recovered shall be the property of the awarding authority.

9. Consideration of Bid Proposals:

A. Generally: The contract will be awarded to the lowest responsible and responsive bidder, unless the City determines that all the bids are unreasonable or that it is not in the best interest of the City to accept any of the bids. Award of the contract will be made on the basis of the lowest actual bid amount for the contract, which is defined as the total of the bid and/or extended total amounts for unit price items, plus requested and accepted additive or deductive alternates, pursuant to the provisions hereof. The City reserves the right to reject all bids and/or reject and rebid the Project should it determine the same is in the best interest of the City.

B. Minor irregularities, as determined by the City, may not cause a bid to be non-responsive and may be waived by the City.

C. Bidder must possess all licenses and permits required by applicable law, rule or regulation for the performance of the work prior to bidding.

D. Where the City elects to prequalify contractors prior to bidding, it shall be understood that such prequalification may be general in nature and shall not limit the City's right to revoke such prequalification pursuant to Ala. Code §39-2-4(d) (1975).

E. Joint ventures shall not generally be considered acceptable bids without special waiver from the City, which must be requested in writing at least fourteen (14) days prior to bid opening.

F. Additive and/or Deductive Alternates: If the City has elected to request bids for additive and/or deductive alternates, then the following procedure shall be the basis for calculating such bids:

1) Deductive Alternates: Any deductive alternate from the base bid shall constitute cumulative deductions from the base bid; and in determining the lowest bidder, if the City elects to consider any deductive alternates, the City will proceed to consider the bids upon the basis of the base bids of all qualified bidders minus the respective deduction stated for the first alternate. If the City determines that it wishes to proceed to consider additional deductive alternates, it may do so sequentially and in like manner throughout the deductive alternates the City elects, so that the base bids of all qualified bidders shall be calculated minus the respective number of deductive alternates in sequence the City has elected to consider. The lowest responsible responsive bid will be the lowest actual

base bid of a qualified bidder less the selected sequential deductive alternates.

2) Additive Alternates: To determine additive alternates, any additive alternate shall constitute cumulative additions to the base bid; and in determining the lowest bidder if the City elects to consider any additive alternates, the City will proceed to consider the bids upon the basis of the base bid of all bidders plus the respective addition stated for the first alternate. If the City determines that it wishes to proceed to consider additional additive alternates it may do so sequentially, and in like manner, throughout the additive alternates, the City elects, so that the base bids of all qualified bidders shall be calculated plus the respective number of additive alternates in sequence the City has elected to consider. The lowest responsible responsive bid will be the lowest actual base bid of a qualified bidder plus the selected sequential additive alternates. Once the City has determined the lowest responsible responsive bidder as set forth herein, then it may award the contract on the basis of accepting and/or rejecting any additive and/or deductive alternates of that bid as it determines is in the best interest of the City.

G. Contracts will be awarded in compliance with Code of Alabama Sec. 39-2-6 through 39-2-14

10. Materials and Work: All materials, which the engineering plans specify or are required, will be installed as they are shown on the drawings, plans and/or specs.

A. Brand names, catalog numbers, weights, etc., are used to indicate levels of quality only and are not intended to restrict the bidding. If bidding on an item of another brand or manufacturer than that specified, bidder's proposal should be accompanied by brochures or other pertinent literature giving detailed specifications of the item(s) on which the proposal is being made. Bids or proposals received without sufficient literature to determine equal quality may not be considered. Final determination as to equal quality will be made by the City.

B. Quantities: The quantities shown in the proposal shall be considered by the contractor as the quantities required to complete the work for the purpose of bidding. Should the actual quantities required in the construction of the work be greater or less than the quantities shown, an amount equal to the difference of quantities at the unit prices bid for the items will be added to or deducted from the contract total.

C. Adjustment Items: During the course of work, the prices bid for adjustment items may be used by the City to increase or decrease the total cost for the work if the quantity of work exceeds or is less than the amount shown on plans.

D. The attention of all bidders is called to the fact that all or a portion of this Project may be federally funded and if so, the special conditions of a federally funded

contract including federal labor standard provisions, the minimum wage rates included in the contract documents, plans and specifications must be followed.

E. Construction Crews: The Contractor will be required to furnish at least one separate construction crew during the work as set forth in the contract. Unless waived by the City, the Contractor shall perform on the sites and with his own organization and equipment, at least fifty percent of the total amount of the work to be performed under this Contract. The Contractor may only subcontract a maximum of fifty (50%) percent of the work without City consent. If, during the progress of the work hereunder, the Contractor requests a reduction of such percentage, and the City representative determines that it would be to the City's advantage, the percentage of the labor required to be performed by the Contractor's own organization may be reduced; PROVIDED prior written approval of such reduction is obtained by the Contractor from the City.

11. Execution of Contract, Notice to Proceed: Award of the contract will be made within the time specified after the opening of bids. The bidder to whom award is made shall enter into a written contract for the Project with the City on the forms provided in the contract documents, furnish the required performance and labor and material bonds with proper surety and furnish the evidence of insurance as required, all within twenty (20) days of presentation of the prescribed forms to the bidder. If extenuating circumstances prevail, the City may grant an extension of time not exceeding five (5) days for the return of the contract, required bonds and evidence of insurance. Within twenty (20) days after presentation by the bidder to the City, the City shall review the bonds, surety and evidence of insurance to ascertain whether they meet the requirements of the contract documents, and if such requirements have been met the City shall complete the execution of the contract. Unless otherwise agreed by the parties in writing, a notice to proceed order will be issued by the City or its representatives within fifteen (15) days after final execution of the contract by the City. The Contractor shall begin work on the date specified in the Notice to Proceed.

12. Labor, Material and Performance Bonds: Within twenty (20) days after the prescribed forms have been presented, the successful bidder shall execute a performance bond with good and sufficient surety from a company duly authorized and qualified to make such bond in the State of Alabama, a performance bond made payable to the City of Tuscaloosa, with a penalty equal to 100 percent of the amount of the contract price and in addition thereto, another bond with good and sufficient surety by a surety company duly authorized and qualified to make such bond in the State of Alabama, payable to the City of Tuscaloosa, in an amount equal to 100 percent of the contract price with an obligation that such contractor shall promptly make payments to all persons supplying it or them with labor, materials or supplies for or in prosecution of the Project provided for in such contract and for the payment of reasonable attorney fees incurred by any successful claimants or plaintiffs in civil actions on said bond, pursuant to the provisions of Ala. Code §39-1-1 (1975).

13. Surety and Insurer Qualifications: All certificates of insurance and bonds (furnished in connection with the work to be performed under this contract) shall be countersigned by a

licensed agent residing and engaged in doing business in the State of Alabama. The surety and insurer shall be licensed and authorized to do business in the State of Alabama. The surety companies on bonds shall be rated A- or better by A. M. BEST and listed on the United States Treasury Department 570 list.

14. Power-of-Attorney: The attorney-in-fact (resident agent) who executes the performance bond and/or payment bond on behalf of the surety must attach a notarized copy of his or her power-of-attorney as evidence of his authority to bind the surety of the date of execution of the bonds. Certification by a resident agent authorized to do business in Alabama is required.

15. Insurance: The successful contractor shall file with the City, at the time of delivery of the signed contract, satisfactory evidence of insurance, the requirements as set forth in the contract agreement. Satisfactory evidence of insurance shall include at a minimum, the insurers standard "Certificate of Insurance" (modified pursuant to insurance requirements of the contract agreement) and the agents verification of insurance as required by Section 26. If the City deems that additional evidence or clarification, etc., of insurance is appropriate, the bidder shall promptly furnish the same to the City upon request.

16. Examination of Contract Documents and of the Site of the Project: Before submitting a bid proposal for the Project, each bidder shall carefully examine the Contract Documents, including but not limited to plans, drawings, specifications, contract, etc., visit the site, and satisfy itself as to the nature and location of the Project, and the general and local conditions, including weather, the general character of the site or building, the character and extent of existing work within or adjacent to the site, any other work being performed or proposed thereon at the time of submission of their bids. It shall obtain full knowledge as to transportation, disposal, handling, and storage of materials, availability of water, electric power, and all other facilities in the area which will have a bearing on the performance of the Project for which they submit their proposals. The submission of a proposal shall be prima facie evidence that the bidder has made such examination and visit and has judged for and satisfied himself as to conditions to be encountered regarding the character, difficulties, quality, and quantities of work to be performed and the material and equipment to be furnished, and as to the contract requirements and contingencies involved. It shall be the Bidder's obligation to verify for himself and to his complete satisfaction, all information concerning site and surface conditions.

17. Subsurface Reports: Prior to Bid opening, the City will make available to prospective Bidders, upon request, any information that it may have as to subsurface conditions and surface topography at the work site. Investigations of subsurface conditions were made for the purpose of study and design, and neither the City nor its consultants that performed such testing assume any responsibility whatsoever in respect to the sufficiency or accuracy of borings, or of the logs of test borings, or of other investigations that have been made, or of the interpretations made thereof, and there is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations are representative of those existing throughout such area, or any part thereof, or that unforeseen developments may not occur.

Logs of test borings, geotechnical reports, or topographic maps showing a record of the data obtained by the investigations of surface and subsurface conditions that are made available shall not be considered a part of the Contract Documents, and are available only for the convenience of the Bidders. Such logs and reports represent only the opinion of the Engineer/Architect or Consultant as to the character of the materials encountered by him in his investigations of the test borings.

Information derived from inspection of logs of test borings, or pits, geotechnical reports, topographic maps, or from Drawings showing location of utilities and structures will not in any way relieve the Contractor from any risk, or from properly examining the site and making such additional investigations as he may elect, or from properly fulfilling all the terms of the Contract Documents.

The City shall not be responsible for any interpretations or conclusions drawn from any subsurface exploration reports or borings. Each bidder is to base his bid upon his determination of the subsurface conditions and of the types and quantities or material to be encountered or needed. Additional tests or other exploratory operations may be made at no cost to the City.

18. Interpretation of Plans and Specifications: If any bidder contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of plans, specifications, or other proposed contract documents, he may submit to the Engineer/Architect or Construction Manager, as the case may be, a written request for an interpretation thereof at least ten (10) days prior to bid opening or as otherwise proscribed in the bid documents. The bidder submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made only by written addendum duly issued and a copy of such addendum will be mailed or delivered to each person receiving a set of such documents. The City, Construction Manager or Engineer/Architect will not be responsible for any other explanations or interpretations of the proposed documents.

19. General Contractor's Permit or License: The attention of all bidders is called to the provisions of the State law governing general contractors as set forth in Ala. Code §34-8-1 et seq. (1975), particularly in regard to the need for and evidence of a State general contractor's license. The provisions of said statute are adopted herein by reference and form a part of the Contract with the selected bidder should this Project be awarded. Bidders are reminded that they will be governed by said statutes insofar as they are applicable. To summarize the above quoted statutes, Ala. Code §34-8-1, et seq. (1975) provides that no one is entitled to bid and no contract may be awarded to anyone who does not possess a valid general contractor's permit or license, including specialty classifications for the work, as provided by the foregoing sections of the State Code, and rules and regulations promulgated pursuant thereto and that said bid may not be considered without evidence being produced that he is so qualified. Trade contractors must be duly licensed in accordance with applicable law. The City may not enter into a contract with a nonresident corporation that is not qualified under the State law to do business in Alabama. Bidder <u>MUST</u> include with proposal contractor's current license number and a copy of the license.

State law, Ala. Code §34-8-8(b) (1975) requires all bids to be rejected which do not contain general contractor's license number.

20. U. S. Products Preference: The successful bidder (contractor) shall comply with Ala. Code §39-3-1 (1975), shall agree to utilize in the execution of the Project, materials, supplies and products manufactured, mined, processed or otherwise produced in the United States or its territories, if the same are available at reasonable and competitive prices and not contrary to any sole source specifications. It is further stipulated that a breach of the foregoing provision of this agreement by the contractor in failing to utilize domestic products shall result in a downward adjustment in the contract price equal to any realized savings or benefit to the Contractor.

21. Use of Domestic Steel: The successful bidder shall comply with Ala. Code §39-3-4 (1975), requiring the use of steel produced within the United States for municipal construction projects when specifications in the construction contract require the use of steel and do not limit its supply to a sole source. This provision is subject to waiver if the procurement of domestic steel products becomes impractical as a result of national emergency, national strike or other causes. Violations of the use of domestic steel requirements shall result in a downward adjustment in the contract price to equal any savings or benefit to the Contractor.

22. In State Bidder Preference: Pursuant to Ala. Code §39-3-5 (1975), in the letting of public contracts in which municipal funds are utilized, except those contracts funded in whole or in part with funds received from a federal agency, preference shall be given to resident contractors, and a nonresident bidder domiciled in a state having laws granting preference to local contractors shall be awarded Alabama public contracts only on the same basis as the nonresident bidders' state awards contracts to Alabama contractors bidding under similar circumstances; and resident contractors in Alabama, as defined in Ala. Code §39-2-12 (1975), be they corporate, individuals or partnerships, are to be granted preference over non-residents in awarding of contracts in the same manner and to the same extent as provided by the laws of the state of the domicile of the nonresident. Nonresident bidders must accompany any written bid documents with a written opinion of an attorney-at-law licensed to practice law in such nonresident bidder's state of domicile, as to the preferences, if any or none, granted by the law of that state to its own business entities whose principal places of business are in that state in the letting of a public contract.

23. Applicable Laws: Each Bidder shall inform himself of, and the Bidder awarded a contract shall comply with, federal, state, and local laws, statutes, and ordinances relative to the execution of the work. This requirement includes, but is not limited to, applicable regulations concerning minimum wage rates, the use of domestic products, U.S. steel and resident labor, non-discrimination in the employment of labor, protection of public and employee safety and health, environmental protection, the protection of natural resources, fire protection, burning and non-burning requirements, permits, fees and similar subjects. Certain statutory requirements are summarized immediately hereinafter. The attention of all bidders is called to the fact that the work will be subject to compliance with all applicable City building and technical codes and will be subject, in addition to all other inspections, to inspection by a representative of the City of Tuscaloosa Building Inspections Department.

24. SRF/DWSRF Special Requirements. If all or any portion of the Project to which this contract applies is funded in whole or in part by the proceeds of a loan or loans from the Alabama Department of Environmental Management (ADEM) through either a State Revolving Fund for Wastewater or Water (SRF or DWSRF, respectively), additional requirements for the Contractor exist (Requirements). These Requirements relate to Project objectives for utilization of Minority Business Enterprises/Women Business Enterprises (MBE/WBE). The Contractor must document efforts made to utilize MBE/WBE firms and submit to ADEM, with a copy to the City within ten (10) days after contract execution, evidence of the positive steps in accordance with the requirements to utilize small minority and women businesses in the procurement of subcontracts.

Other Requirements relate to Federal Labor Standards, Title VI of the Civil Rights Act of 1964, Equal Employment Opportunity, Affirmative Action Equal Opportunity Clause, Goals and Timetables, compliance with Occupational Safety and Health Act of 1970 and Section 107 of Contract Work Hours and Safety Standards Act (PL91-54) which are adopted herein by reference to the extent applicable. For DWSRF and SRF funded projects, special requirements are also set forth in Supplemental General Conditions. If not attached to the contract documents, Contractors should contact the City representative and/or the City's consulting engineer for a copy of all special requirements and conditions.

25. Special Conditions for Federally Funded Contracts. If all or any portion of the Project to which this contract applies is funded in whole or in part by the proceeds of a grant from an agency of the United States Government, additional requirements for the Contractor exist. A summary of these requirements entitled, "Special Conditions for Federally funded Contracts," is attached hereto and made a part hereof. Bidder should contact the Engineer or City Representative to confirm the applicability of these requirements to the Project.

26. Agent's Verification of Insurance. This form or a letter equivalent from the Insurance Agent should be submitted with each Contractor's Bid, or in the alternative, Contractor may provide a copy of the insurance policy or policies reflecting the coverages required herein.

27. Compliance with Immigration Law. By signing this contract, the contracting parties affirm, for the duration of the agreement, that they will not violate federal immigration law or knowingly employ, hire for employment or continue to employ an unauthorized alien within the State of Alabama. Furthermore, a contracting party found to be in violation of this provision shall be deemed in breach of the agreement and shall be responsible for all damages resulting therefrom, to the extent allowed by Federal law.

28. Compliance with Affordable Health Care Act. By signing this contract, the contracting parties affirm, for the duration of the agreement, that they will not violate federal compliance laws pertaining to the Affordable Health Care Act. Furthermore, a contracting party found to be in violation of this provision shall be deemed in breach of the agreement and shall be responsible for all damages resulting therefrom, to the extent allowed by Federal law.

29. Compliance with the City of Tuscaloosa Minority Enterprise / Disadvantage Business Enterprise (MBE/DBE/WBE) Policy for Public Works Projects Over $50,000. The City of Tuscaloosa has voluntarily adopted a Minority / Disadvantaged Business Enterprise ("MBE/DBE/WBE") Program designed to encourage the participation and development of minority and disadvantaged business enterprises and to promote equal business opportunities to the fullest extent allowed by state and federal law.

It is the intent of the City to foster competition among contractors, suppliers, and vendors that will result in better quality and more economical services rendered to the City. Under this policy, the City of Tuscaloosa has established a goal of ten to twenty percent (10-20%) inclusion of minority and disadvantaged business enterprises for all services required to deliver City projects. In no case shall the stated percentage be the determining factor in contract awards. Rather, contractors must demonstrate a good faith effort to attain the desired percentage goal.

The Policy as adopted is entitled THE CITY OF TUSCALOOSA MINORITY ENTERPRISE / DISADVANTAGED BUSINESS ENTERPRISE (MBE/DBE/WBE) POLICY FOR PUBLIC WORKS PROJECTS OVER $50,000, and is attached hereto as "Exhibit A" (the "Policy"). Contractors are encouraged read the Policy in its entirety, and must follow the instructions contained therein. **The Policy requires submission of various forms at specified times, and failure to do so may result in rejection of bid due to non-responsiveness.** Contractors shall work in coordination with the City of Tuscaloosa's Department of Infrastructure and Public Services:

Contact information is as follows:
Caramyl Drake
Community Development Program Manager
Community & Neighborhood Services
City of Tuscaloosa
Phone: (205) 248-5725
cdrake@tuscaloosa.com

30. Compliance with Act 2016-312. By signing this contract, the contracting parties affirm, for the duration of the agreement, that they are not currently engaged in, and will not engage in, the boycott of a person or an entity based in or doing business with a jurisdiction with which this state can enjoy open trade.

[END OF SECTION TWO- INSTRUCTION TO BIDDERS]

CITY OF TUSCALOOSA
SECTION THREE- BID PROPOSAL

Project Name: **Hilliard N. Fletcher WRRF Headworks Improvements**
File Number: **A19-1146** **Engineering Project Number:** **2024.714.001**

For Trade Package Bids (when applicable):
Trade: _____
Trade Package No.: _____

BIDDER (name of legal entity): _____

Address: _____
Phone: _____ **Email:** _____

NAME OF CONTACT PERSON FOR BIDDER: _____
PHONE AND EMAIL: _____

Licensed, Class _____ Alabama General Contractor No.:_____ (Attach Copy)

Alabama General Contractor Specialty _____

Alabama General Contractor License Major Categories:

(1)_____ (2) _____

ADDENDA: The Bidder hereby acknowledges that they received Addenda No's. _____, _____, _____, _____, (Bidder shall Insert No. of each Addendum received) and agrees that all addenda issued are hereby made part of the Contract Documents, and the Bidder further agrees that their Proposal(s) includes all impacts resulting from said addenda.

LUMP SUM: The Bidder agrees to accept as full payment of the work proposed under this Project, as services are rendered, as herein specified and as shown on the Contract Documents, upon the undersigned's own estimate of quantities and costs, the following lump sum of:
_____ Dollars and _____ cents
($_____) (*Amount written in words has precedence*)

ALTERNATES: Attach additional sheets for additive or deductive alternates, if in contract documents.

UNIT PRICES: Where the Project is bid in unit prices then Bidder agrees to perform the work in the stated quantities of the materials at the unit prices so bid, the cumulative total of which constitutes the base bid set forth below, and to accept as final payment for the work performed

under this Project as herein specified the extension of each such unit price for the quantities actually installed in accordance with the following or attached unit price schedule.

An unbalanced bid, as herein defined, may be considered non-responsive. A bid resulting in a substantial advance payment on an item that is for a single lump sum payment may be considered non responsive.

Prices for mobilization and demobilization combined shall not exceed 5% of the total base bid unless either:
(1) a reasonable explanation is provided in writing by the bidder within the sealed bid and this explanation provided by the bidder is accepted by the Owner; or
(2) the Owner has waived in writing (by Addendum or otherwise) this restricted amount not to exceed 5% for mobilization and demobilization before the deadline for sealed bids to be turned in.

Lump sum payments and unit price bids for a single or lump sum payment may be spread over the course of the period of work until the line item is complete at owner's option.

The Bidder's unit price for materials listed is as including the payment of taxes (See Page 3) where applicable: (Attach additional sheets if necessary)

BID:

	Material	Quantity	Unit Price	TOTAL
1.	See Attachment A – Bid Proposal			
2.				
3.				

TOTAL BASE BID $_____

*** Please use any provided Bid Schedule per any directions given by the Owner. If no Bid Schedule has been provided by the Owner, please use the allotted space above and attach extra sheets as necessary.**

SALES AND USE TAX SAVINGS ACCOUNTING:

Contractor MUST account for the sales tax NOT included in the bid proposal form as follows:

ESTIMATED SALES AND USE TAX
BASE BID: $_____
Additive Alternate (if applicable): $_____

Failure to provide an accounting of sales tax may render the bid non-responsive. Other than determining responsiveness, sales tax accounting shall not affect the bid pricing nor be considered in the determination of the lowest responsible and responsive bidder.

AS BUILT DRAWINGS: **T**he Bidder's Proposal contains $_____ for "as built drawings."

BIDDER'S DECLARATION AND UNDERSTANDING: The undersigned, hereinafter called the Bidder, declares that the only persons or parties interested in this Proposal are those named herein, that this Proposal is, in all respects, fair and without fraud, that it is made without collusion with any official of the City, and that the Proposal is made without any connection or collusion with any person submitting another Proposal on this Contract.

The Bidder further agrees that they have checked and verified the completeness of the Contract Documents and that they have exercised his own judgment regarding the interpretation of subsurface information utilizing all pertinent data in arriving at their conclusions. The Bidder shall be fully responsible for any and all damages or liability arising out of their own or their subcontractors' pre-bid investigations.

The Bidder understands and agrees that if a Contract is awarded, the City may elect to award all schedules under one Contract, lump sum, separately, or in any combination that best serves the interests of the City.

The Bidder agrees that they have carefully examined the Contract documents for the construction of the Project and they have checked and verified the completeness of the Contract Documents, that they have personally inspected the site, that they have satisfied themself as to the quantities involved, including materials and equipment, and conditions of work involved. Bidder further declares that they are fully aware of the fact that the description of the work, quantities of work and materials, as included herein, is brief and is intended only to indicate the general nature of the work and to identify the said quantities with the detailed requirements of the Contract Documents. Bidder also declares that their Proposal is made according to the provisions and under the terms of the Contract Documents, which Documents are hereby made a part of this Proposal.

The Bidder declares that they understand and agree that the quantities shown in the Advertisement for Bids and in the Proposal are approximate only and are subject to either increase or decrease; and that should quantities be decreased, they also understand and agree that payment will be made on actual quantities installed at the unit bid prices, and will make no claim for anticipated profits for any decreases in the quantities. Actual quantities will be determined upon completion of the work.

START OF CONSTRUCTION AND CONTRACT COMPLETION TIME: The Bidder further agrees to begin work on the date stated in the Notice to Proceed and to fully complete the work, in all respects, within the time specified in the contract documents for completion.

EXPERIENCE OF BIDDER: Bidder MUST submit the following list of at least three clients for whom projects involving construction of similar projects have been performed within the past 5 years.

1. _____
Name of Client Telephone Number

_____
Street City

_____
Facility Size Date

_____
Name of Engineer/Architect /Engineering Firm Telephone Number

---

2. _____
Name of Client Telephone Number

_____
Street City

_____
Facility Size Date

_____
Name of Engineer/Architect/Engineering Firm Telephone Number

---

3. _____
Name of Client Telephone Number

_____
Street City

_____
Facility Size Date

_____
Name of Engineer/Architect /Engineering Firm Telephone Number

PERFORMANCE OF WORK BY CONTRACTOR: The Bidder shall perform at least 50 percent of the work with his own forces (refer to the INSTRUCTIONS TO BIDDERS).

SUBCONTRACTORS: Unless the same information has been provided in the prequalification statement, the Bidder further certifies that if thei bid is accepted, the following subcontracting firms or businesses will be awarded subcontracts for the following portions of the work:

Description of Work _____

_____

Name

_____, _____, _____

Street City State Zip

Description of Work _____

_____

Name

_____, _____, _____

Street City State Zip

Description of Work _____

_____

Name

_____, _____, _____

Street City State Zip

Description of Work _____

_____

Name

_____, _____, _____

Street City State Zip

SURETY: If the Bidder is awarded a construction contract on this Proposal, the Surety who provides the Performance Bond and Payment Bond will be:

_____ whose address is

_____, _____, _____
Street City State Zip

Single Job Bond Limit _____ Aggregate Job Bond Limit _____

The Bidder declares that they understand and agree that the quantities shown in the Advertisement for Bids and in the Proposal are approximate only and are subject to either increase or decrease; and that should quantities be decreased, the Bidder also understands and agrees that payment will be made on actual quantities installed at the unit bid prices, and will make no claim for anticipated profits for any decreases in the quantities. Actual quantities will be determined upon completion of the work.

If the Bidder is a corporation, the Proposal shall be signed by an officer of the corporation; if a partnership it shall be signed by a partner. If signed by others, authority for signature shall be attached.

If Sole Proprietor or Partnership:

IN WITNESS hereto the undersigned has set their hand this _____ day of _____ _____, 20___.

_____
Signature of Bidder

_____
Title

If Corporation:

IN WITNESS WHEREOF the undersigned corporation has caused this instrument to be executed and its seal affixed by its duly authorized officers, this _____ day of _____, 20___.

_____
Name of Corporation

By_____
(seal) Title: _____

Attest _____
Secretary

Attached hereto is a Bid Bond or (Check) for the sum of $_____ according to the conditions under "Instructions to Bidders" and provisions therein.

Dated this _____day of _____, 20__.

BY:_____

_____

Title

[END OF SECTION THREE- BID PROPOSAL]

Attachment A – Bid Proposal

Hilliard N. Fletcher WRRF Headworks Improvements

(For additional information, reference Specification Section 01 20 00 – PRICE AND PAYMENT PROCEDURES)

Base Bid

Base Bid Item No.	Bid Qty	Description (Bidder to write Bid Price in words)	Unit Price	Bid Price
1	1 LS	Mobilization and demobilization for the lump sum of (maximum of 5% of base bid): _____ _____	N/A	$
2	1 LS	All Work as necessary for the Facility 10 – Headworks Improvements, defined in the Contract Documents except those items listed separately below, for the lump sum of: _____ _____	N/A	$
3	1 LS	Contingency Allowance to be used on a change authorization basis for items required during completion of the Project to be used solely at the discretion of the Owner, for the lump sum of: Twenty Five Thousand Dollars	N/A	$ 25,000
			Total Base Bid Price	$

CITY OF TUSCALOOSA
SECTION FOUR- BID BOND

BID BOND TO THE CITY OF TUSCALOOSA, ALABAMA

Project Name: Hilliard N. Fletcher WRRF Headworks Improvements
File Number: A19-1146 **Engineering Project Number: 2024.714.001**

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____ _____ as Principal; and _____ _____ as Surety, (**NOTE:** If cashier's check drawn on an Alabama Bank utilized in lieu of corporate surety, attach check as required by bid documents) are hereby held and firmly bound unto the City of Tuscaloosa, Alabama, a Municipal Corporation, as obligee, hereinafter called the City, in the sum of _____ _____ Dollars ($ _____) for the payment of which sum, well and truly to be made, the said Principal and Surety hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

The condition of the above obligation is such that whereas the Principal has submitted to the City a certain Bid (Proposal)attached hereto and made a part hereof, to enter into a contract in writing with the City, for this Project.

NOW, THEREFORE,

(a) If said Bid shall be rejected, or in the alternate,

(b) If said Bid shall be awarded and the Principal shall execute and deliver a contract in the Form of Agreement as included in the Contract Documents for the Project, and shall execute and deliver Performance Bond and Payment Bond in the Forms as attached to the Contract Documents executed by a surety company authorized and qualified to make such bonds in the State of Alabama and in the amounts as required by the Instructions to Bidders and submit the insurance certifications as required by the bid document and fulfill all other qualifications and requirements of the Contract Documents and bid specifications (all properly completed in accordance with said Bid), and shall in all other respects perform the agreement created by the acceptance of said Bid within thirty (30) days after the prescribed forms have been presented to Bidder for execution;

Then, this obligation shall be void, otherwise, the same shall remain in full force and effect; it being expressly understood and agreed that the liability of the Surety for any and all default of the Principal hereunder shall be the amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its bond shall in no way be impaired or affected by any extension of the time within which the City may accept such Bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the above-bonded parties have executed this instrument under their several seals, this the _____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.

WITNESS:

_____

PRINCIPAL:

_____(SEAL)

By: _____

Title: _____

Address: _____

_____

SURETY:

_____(SEAL)

_____

(Business Address)

_____

ATTEST:

_____

By: _____

Title: _____

Attorney in Fact

NOTE: Surety must be qualified and duly authorized to make bonds in the state. All Bonds and Sureties are subject to review and approval by the City Attorney. Valid current Power of Attorney for Corporate Surety must be attached.

NOTE: Bidder may submit a cashier's check drawn on an Alabama bank to the order of the City of Tuscaloosa equal to 5% of the amount bid, but in no event more than $10,000.00, in lieu of a Corporate Surety, under the same terms.

[END OF SECTION FOUR- BID BOND]

CITY OF TUSCALOOSA
SECTION FIVE- CONTRACT

Project Name: Hilliard N. Fletcher WRRF Headworks Improvements
File Number: A19-1146 **Engineering Project Number: 2024.714.001**

THIS AGREEMENT made and entered into by and between _____, hereinafter sometimes called the CONTRACTOR, as party of the first part, and the CITY OF TUSCALOOSA, Alabama, a Municipal Corporation, hereinafter sometimes called the CITY or OWNER, as party of the second part,

W-I-T-N-E-S-S-E-T-H:

In consideration of the amounts herein named and of the mutual agreements and provisions herein contained, the Contractor and the City agree in regard to a public works project (hereinafter either the "work" or the "Project") as described in the Advertisement for Bids.

The Contractor will perform the work and/or construct the Project as well as furnish at his own cost and expense all labor, tools, equipment and transportation as are herein and in the Contract documents required to be furnished by the Contractor, and shall perform all the work in a manner and form required to construct the Project described in and shown on the contract documents as the same are hereinafter more specifically described and as provided by the plans, specifications and documents which are attached hereto and made a part hereof, as if fully set out herein and addenda together with all plans and drawings on file in the office specified below.

ARTICLE I. GENERALLY

A. **Contract Documents:** As used throughout the documents constituting the contract, the term "Contract Documents" shall mean and include the following: Advertisement for Bids, Addenda (if issued), the Instructions to Bidders, the Bid Proposal, the General Specifications, the Detail Specifications, Supplemental and Special Conditions (if attached), together with this Contract Agreement and any modifications, including change orders, if made, and the drawings, plans and profiles that are now on file in the office referred to in the advertisement, the Performance Bond and the Labor and Material Bond, executed by the Contractor in connection with this Contract and insurance requirements and certificates.

All such documents hereinabove enumerated are adopted herein by reference and constitute the Contract between the parties to the same extent as if each were set out in full in this agreement.

B. **Independent Contractor:** The Contractor enters into this Contract with the City as an independent contractor and, as such, agrees that neither the City nor its officers, agents, employees or inspectors shall be responsible for the acts or omissions of the Contractor, or any subcontractor, or any of the Contractor's or subcontractor's agents or employees, or any other

persons performing any of the work pursuant to this Contract. The Contractor shall be solely responsible for controlling construction manner, means and techniques consistent with the contract documents, plans and specifications.

C. **Order of Precedence:** Should there be a direct conflict between the various elements of the contract documents to the extent that the same cannot be reconciled to be read *in para materia,* then precedence shall be given the same in the following order:

1. Subsequent modifications (change orders or amendments) to contract agreement after execution
2. Addenda (if issued)
3. Supplemental general conditions and special conditions (if included)
4. The Contract Agreement
5. General and technical specifications
6. Large Scale Drawings (if included)
7. Enlarged Plans (if included)
8. Plans (if included)
9. Instructions to bidders
10. Advertisement for bids
11. Proposal (Bid)
12. Purchasing Agent Appointment Agreement (if utilized)

Where more than one document relates to the same matter if both can be given reasonable effect both are to be retained. Written specifications will take precedence over drawings.

D. **Integration; Contract Terms and Construction:**

1. Integration: This Agreement, together with all documents which constitute the "Contract Documents," constitute the entire agreement of the parties, as a complete and final integration thereof with respect to its subject matter. All understandings and agreements heretofore had between and among the parties are merged into this Agreement, which alone fully and completely expresses their understandings. No representation, warranty, or covenant made by any party which is not contained in this Agreement or expressly referred to herein has been relied on by any party in entering into this Agreement.
2. Amendment in Writing: This Agreement may not be amended, modified, altered, changed, terminated, or waived in any respect whatsoever, except by a further agreement or change order, in writing, properly executed by all of the parties.
3. Binding Effect: This Agreement shall bind the parties and their respective personal representatives, heirs, next of kin, legatees, distributees, successors, and assigns.
4. Captions: The captions of this Agreement are for convenience and reference only, are not a part of this Agreement, and in no way define, describe, extend, or limit the scope or intent of this Agreement.

5. Construction: This Agreement shall be construed in its entirety according to its plain meaning and shall not be construed against the party who provided or drafted it.
6. Mandatory and Permissive: "Shall," "will," and "agrees" are mandatory; "may" is permissive.
7. Governing Laws: The laws of the State of Alabama shall govern the validity of this Agreement, the construction of its terms, the interpretation of the rights, the duties of the parties, the enforcement of its terms, and all other matters relating to this Agreement.
8. Ownership of Contract Documents: The Contract Documents, and copies of parts thereof, are furnished and owned either by the City or the design professional. All portions of the Contract Documents, and copies of parts thereof, are the instruments of service for this Project. They are not to be used on other work and are to be returned to the City on request at the completion of the Project. Any reuse of these materials without specific written verification or adaptation by the City will be at the risk of the user and without liability or legal expense to the City or Engineer/Architect. Such user shall hold the City and Engineer/Architect harmless from any and all damages, including reasonable attorneys' fees, from any and all claims arising from any such reuse. Any such verification and adoption shall entitle the City to further compensation at rates to be agreed upon by the user and the City.

E. **Rules of Construction:** For the purposes of this contract, except as otherwise expressly provided or unless the context otherwise requires:

1. Words of masculine, feminine or neuter gender include the correlative words of other genders. Singular terms include the plural as well as the singular, and vice versa.
2. All references herein to designated “articles,” “sections,” and other subdivisions or to lettered exhibits are to the designated articles, sections and subdivisions hereof and the exhibits annexed hereto unless expressly otherwise designated in context. All article, section, other subdivision and exhibit captions herein are used for reference only and do not limit or describe the scope or intent of, or in any way affect this agreement.
3. The terms “include,” “including,” and similar terms shall be construed as if followed by the phase, “without being limited to”.
4. The terms “herein,” “hereof,” and “hereunder,” and other words of similar import refer to this agreement as a whole and not to any particular article, section, other subdivision or exhibit.
5. All recitals set forth in, and all exhibits to, this agreement are hereby incorporated in this agreement by reference.
6. No inference in favor of or against any party shall be drawn from the fact that such party or such party’s counsel has drafted any portion hereof.

7. All references in this agreement to a separate instrument are to such separate instrument as the same may be amended or supplemented from time to time pursuant to the applicable provisions thereof.

F. **Construction Manager - Multiple Trade Contracts**: If indicated in the Advertisement for Bids, the City has elected to engage the services of a Construction Manager for the work on this Project. If so, the same will be indicated in the bid packages and special supplemental conditions will be attached in regard to trade contracts. Contractor, as one of the multiple trade contractors on the Project shall adhere to all terms and conditions of the contract documents, particularly the supplemental conditions regarding multiple trade or multiple prime contractors. Any provision of the general conditions in direct conflict with the supplemental conditions is superseded to the extent of the conflict. If using a Construction Manager format, then this shall be a multiple trade or multiple prime contract agreement subject to the supervision and direction of a Construction Manager, in accordance with the terms and provisions of the Construction Manager's agreement with the City, which agreement is adopted herein by reference.

G. **Coordination of Plans, Specifications, etc.:** The specifications, the plans, drawings and all supplementary documents are essential parts of the Contract, and requirements occurring in one are as binding as though occurring in all. They are intended to be comprehensive to describe and provide a complete work. In case of discrepancy, figured dimensions shall govern.

H. **Corrections of Plans, etc.:** Should any portions of the plans, specifications or drawings be obscure or in dispute, they shall be referred to the Engineer/Architect and he shall decide as to the true meaning and intent. The Engineer/Architect shall also have the right to correct any errors or omissions at any time when such corrections are necessary for the proper fulfillment of said plans and specifications.

I. **Taxes and Charges:** Except to the extent the City and the Contractor are utilizing a "Purchasing Agent Appointment agreement," Contractor shall withhold and pay all sales and use taxes and all withholding taxes, whether local, state or federal and pay all Social Security taxes and also all State Unemployment Compensation taxes, and pay or cause to be withheld, as the case may be, any and all taxes, charges, or fees or sums whatsoever, which are now or may hereafter be required to be paid or withheld under any laws. Pursuant to Ala. Code §39-1-3 (1975), Contractor shall be reimbursed for any additional severance, sales or uses taxes incurred as a result of an increase in such taxes during performance of the contract.

J. **Shop Drawings and Submittals.** The Contractor shall submit shop drawings, samples and submittals depicting or representing the construction of portions of the Project in accordance with the plans and specifications to the Engineer/Architect and if there is no Engineer or Architect on the Project, to the City representative. The Contractor shall pay for or the cost may be withheld from payments to the Contractor for more than two (2) reviews of the shop drawings, samples or submittals or similar element of work by the Engineer, Architect or City representative.

K. **Alabama Immigration Law.** By signing this contract, the contracting parties affirm, for the duration of the agreement, that they will not violate federal immigration law or knowingly employ, hire for employment or continue to employ an unauthorized alien within the State of Alabama. Furthermore, a contracting party found to be in violation of this provision shall be deemed in breach of the agreement and shall be responsible for all damages resulting therefrom, to the extent allowed by Federal law.

L. **Compliance with Affordable Health Care Act.** By signing this contract, the contracting parties affirm, for the duration of the agreement, that they will not violate federal compliance laws pertaining to the Affordable Health Care Act. Furthermore, a contracting party found to be in violation of this provision shall be deemed in breach of the agreement and shall be responsible for all damages resulting therefrom, to the extent allowed by Federal law.

M. **Compliance with Act 2016-312.** By signing this contract, the contracting parties affirm, for the duration of the agreement, that they are not currently engaged in, and will not engage in, the boycott of a person or an entity based in or doing business with a jurisdiction with which this state can enjoy open trade.

ARTICLE II. PAYMENTS, CLAIMS AND CHARGES, ETC.

A. **Contract Price:** The City will pay and the Contractor will accept in full consideration for the performance of the work/Project, subject to additions and deductions (including but not limited to liquidated damages) as provided in the contract documents and herein, the sum of _____ _____ ($_____) and/or in unit prices as shown in Bidder's schedule for the base bid amount of $_____, being the amount of the Contractor's bid as awarded by the City.

B. **Estimated Quantities and Unit Prices:** If award was made in whole or in part based upon unit prices, the Contractor agrees that the prices given in the Proposal are unit prices. The estimated quantities as stated in the Advertisement for Bids and in the Proposal and as indicated on the plans or in other places are approximate only, are subject either to increase or decrease and are only for the purpose of comparing on uniform basis the bids offered for the Project under this contract. The Contractor further agrees that should the quantities of any of the items of the work be increased, he will do the additional work at the unit prices set out in the Proposal and should the quantities be decreased, payment will be made on actual quantities at the unit prices and he will make no claim for anticipated profits for any decrease in the quantities. Actual quantities will be determined upon completion of the Project.

C. **Overtime Work by Contractor:** If the Contractor for his convenience and at his own expense should desire to carry on his work at night or outside regular hours, he shall submit written notice to the Engineer/Architect and he shall allow ample time for satisfactory arrangements to be made for inspecting the work in progress. At no time shall the notice be given less than 24 hours before such overtime work is started. The Contractor must obtain,

through the Engineer/Architect, the City's approval for work at night, on Saturdays, Sundays or legal holidays. The Contractor shall light the different parts of the Project as required to comply with all applicable federal and state regulations and with all applicable requirements of the City.

Overtime hours shall be considered any hours worked by the Contractor on Saturday, Sunday and legal holidays, which in the Engineer/Architect's opinion requires the Engineer/Architect's resident observers' presence to observe such overtime work. Overtime hours requiring the presence of City inspectors shall be considered any hours worked by the Contractor in excess of eight (8) hours during any working day and/or in excess of forty (40) hours from Monday through Friday and/or any time on Saturday, Sunday or legal holiday. In general, it should be expected that the Engineer/Architect's resident observer(s) or City's inspectors will be present at all times that the Contractor is working.

If the Contractor elects to schedule and perform overtime work, the Contractor shall pay the City for the City's resident inspector salaries plus costs for each hour of overtime work. Overtime shall be rounded up to the nearest whole hour. This amount shall include the inspector's salary at overtime rate, labor additive, which includes insurance, social security, workmen's compensation, sick pay, paid holidays, vacation pay and his vehicle and equipment. Payment to the City shall be made by a deduction from the Contractor's monthly payment invoice for any overtime worked.

D. **Payments on Account/Payments Withheld/Retainage:** Upon presentation of a verified application for payment, which shall include a "Contractor's Affidavit of Payment of Debts and Claims," AIA Form G706 or equivalent, then usually by the fifteenth (15^{th}) day of each calendar month or as soon thereafter as is practical, as the Project progresses, the City shall make partial payments to the Contractor of the billable work performed less payments already made and less deductions for any incomplete, unaccepted or defective work. In making partial payments to the Contractor, there shall be retained five (5%) percent of the estimated amount of work done and value of materials stored on the site or suitably stored and insured off-site. Provided; however, after fifty (50%) percent of the Project has been satisfactorily completed, no further retainage will be withheld.

Retainage shall be held until final completion and acceptance of all work covered by the Contract Documents unless escrow or deposit arrangements are agreed to by the City. When maintenance periods are included in the Contract Documents covering highways, bridges or similar structures, such period shall be considered a component part of the contract and retainage will be held until the expiration of such periods.

On completion and acceptance of each separate building, public work or other separately identifiable and complete division of the Project in regard to which a separate price has been stated in the Contract Documents or can be separately ascertained, payment may be made in full including retainage but less deductions. Provided; however, the City will not consider making such payment on any such item of work if it is an integral part of a complete project.

All materials and work covered by partial payments as provided for herein shall become the sole property of the City; provided, however, the Contractor shall not be relieved from the sole responsibility for the care and protection of materials and work upon which payments have been made and for the restoration of any damaged work.

The City may also withhold from time to time from payment to the Contractor such an amount or amounts as may be necessary to pay and fully satisfy all claims and demands for labor and services rendered in and about the Project, including any such amount or amounts due to be paid to or by any subcontractor or supplier, amounts for City's or Engineer/Architect's observers or inspectors for contractors' overtime as herein provided, or for engineering or design services associated with Contractor initiated change orders or submittals in excess of that permitted herein. The Contractor hereby authorizes the City as its agent, to apply such amounts so withheld to the payment of any amount so due to be paid and all other just and lawful claims other than claims for damages for tort. In case of disagreement with reference to any such claim or claims, the City may keep such amounts so withheld on account of such claim or claims until such disagreement is finally settled and determined.

In addition, the City may also withhold payment of the whole or any part of a verified or approved application for payment from the Contractor to such an extent as may be necessary to protect itself from loss on account of any of the following causes discovered subsequent to its verification or approvals:

1. Defective work.
2. Evidence indicating probable filing of claims by other parties against the Contractor.
3. Failure of the Contractor or subcontractor to promptly make payments to subcontractors or for materials, labor, food stuffs and supplies.
4. Damage to another contractor under separate contract with the City.
5. Assessment of liquidated damages.

When the above grounds are removed, applications for payment will then be verified and/or approved for amounts not previously verified and approved because of them.

The Contractor shall not attempt to withdraw at any time during the term of this contract or any extensions thereof, without the expressed written consent of the City, the whole or any part of the amounts so retained by the City from payments due the Contractor by the establishment of an escrow account or by depositing securities in lieu thereof, pursuant to Ala. Code §39-2-12(e) or (f), or any amendments thereto or any equivalent law, ordinance or regulation. It is expressly agreed between the parties hereto that should the City elect not to consent to the same, then the Contractor shall not elect to, attempt to or in any manner endeavor to withdraw such retained amounts.

E. **Claims for Extra Cost:** If the Contractor claims that any instructions by drawings or otherwise involve extra cost or any extension of time, he shall notify the City in writing within ten

(10) days after the receipt of such instructions and in any event before proceeding to execute the Project. Thereafter, the procedure shall be the same as that for change orders. No such claim shall be valid unless made in accordance with the terms of this section. There shall be no damages for delay. Except as otherwise herein provided, no charge for any extra work will be allowed unless the same has been duly authorized in writing by the City and the price stated in such order.

F. **Differing Site Conditions:** If, in the performance of the Contract, subsurface or latent conditions are found to be materially different from those indicated by the plans and specifications, or unknown conditions of an unusual nature are disclosed differing materially from conditions usually inherent in work of the character shown and specified, the Contractor shall immediately notify the Engineer/Architect in writing regarding such conditions but in no event later than forty-eight (48) hours after discovery of such conditions by the Contractor.

The written notice shall describe the conditions, and other pertinent information, in no event shall such notice be later than forty-eight (48) hours before such conditions are disturbed. Upon such notice, or upon such observation of conditions, the Engineer/Architect will promptly make such changes in the plans and/or Specifications as he finds necessary (if any are necessary) to conform to the different conditions, and any increase or decrease in the cost of the Project resulting from such changes may be adjusted as provided under Change Orders or Claims for Extra Cost as set forth in the Contract documents.

G. **Change Orders:** Change orders shall be allowed only under the following conditions: 1) Minor changes for a total monetary amount less than that required for competitive bidding; or 2) Changes for matters incidental to the original contract necessitated by unforeseeable circumstances arising in the course of work under the contract; or 3) Changes due to emergencies; or, 4) Changes provided for in the original bidding and original Contract Documents as alternates; 5) Changes of relatively minor items not contemplated when the plans and specifications were prepared and the Project was bid and which are in the public interest and generally do not exceed 10 percent of the Contract Price, subject to Alabama Bid Law exceptions.

The Contractor or successful bidder is expected to complete the Project as bid and specified within the financial parameters stated therein. However, if it shall be determined that a change order condition possibly exists in any given case during the performance of the contract, the Contractor shall promptly notify in writing the representative of the City and shall not implement such change until having notified the representative of the City. If the change is minor in the opinion of the representative of the City and does not involve, 1) an adjustment in the contract sum or construction bid price, or 2) result in extension of the contract time, or 3) a material change in the contract scope of services, then the City representative may authorize the change in writing to the Contractor. The Contractor shall not perform such change until receipt of such written change order.

In the event the change order requested by the Contractor involves, 1) an increase in the contract sum or construction bid price, 2) extend the contract time, or 3) materially change the

Contractor's scope of work or services, then the Contractor shall request a change order in writing and present the same to the City representative. The representative of the City, shall determine whether this is a change order which can be allowed and, if so, what exception it would fall under. The representative of the City shall then document the same, attach the same to the Contractor's request for a change order and submit the same with his recommendation to the City Council at its next or any subsequent regularly scheduled Council meeting for approval.

The City reserves the right to institute change orders as the Owner pursuant to the aforesaid terms and conditions. In no event is a change order to be executed by the Contractor prior to approval thereof by the City, except for emergencies.

H. **Determination of Adjustment of the Contract Sum:** The adjustment of the Contract Sum resulting from a change in the Work shall be determined by one of the following methods as determined by Owner:

1. By mutual agreement to a lump sum based on or negotiated from an itemized cost proposal from the Contractor.
2. Additions to the Contract Sum shall include the Contractor's direct costs plus a maximum 15% markup for overhead and profit. Where subcontract work is involved, the total mark-up for the Contractor and a subcontractor shall not exceed 25%. No allowance for overhead and profit shall be figured on a change which involves a net credit to the Owner. For the purposes of this method of determining an adjustment of the Contract Sum, "overhead" shall cover the Contractor's indirect costs of the change, such as the cost of bonds, superintendent and other job office personnel, watchman, job office, job office supplies and expenses, temporary facilities and utilities, and home office expenses.

I. **Construction Schedule and Periodical Estimates:** Immediately after execution and delivery of the contract and before the first partial payment is made, the Contractor shall deliver to the City and Engineer/Architect and Construction Manager, a construction schedule in a form satisfactory to the City or Construction Manager, which may include CPM for all major trades, showing the proposed dates of commencement and completion of each of the various activities, of work required under the Contract documents, the interrelationship of each activity, sequences, resources for each and the anticipated amount of each monthly payment that will become due the Contractor in accordance with the progress schedule. The Contractor shall also furnish (1) a detailed estimate giving a complete breakdown on the contract price and (2) periodical itemized estimates of the work done for the purpose of making partial payments, however the same will not be considered as fixing a basis for additions to or deductions from the contract price. Scheduling is particularly critical if Contractor is a trade contractor and adherence to the Construction Manager progress schedule is required.

NOTE: Depending upon the complexity of the work the City may require CPM or equivalent meeting all criteria above.

J. **Sales and Use Tax Savings:** Pursuant to the invitation for bids, sales and use taxes are not to be included in the bid. The project will be administered in compliance with Alabama state law regarding sales and use taxes. The Contractor shall be responsible for obtaining a certificate of exemption from the Alabama Department of Revenue for purchases of materials and other tangible property made part of the project. Any subcontractors purchasing materials or other tangible personal property as part of the project shall also be responsible for obtaining a certificate of exemption. The estimate sales and use tax saving must be accounted for on the bid proposal. Failure to provide the estimated sales and use tax savings may render the bid as non-responsive. Other than determining responsiveness of the bid, sales and use tax accounting shall not affect the bid pricing nor shall be considered in the determination of the lowest responsible and responsive bidder.

ARTICLE III. TIME

A. **Time for Completion/Delays:** The Contractor hereby agrees to commence work under this contract on the date to be specified in a written "Notice to Proceed" of the Engineer/Architect or thirty (30) days from the date of contract execution if no notice is issued, and to fully complete the Project within **300** consecutive calendar days thereafter. If this is a trade contract, then the Contractor shall perform within the time periods and at the times as established by the Construction Manager's approved construction schedule for the project. The Contractor further agrees to pay to the City, liquidated damages for each consecutive calendar day thereafter as hereinafter provided. Time is of the essence and a material element to this agreement.

NOTE: When maintenance periods are included in the contract for highways, bridges or similar structures, such periods shall be considered component parts of the contract. To the extent the construction schedule contains “float,” the parties agree that the same belongs to the Project and may be utilized by either party.

Delay: If the Contractor is delayed at any time in the progress of work by any of the following causes, the Contractor may be entitled to a reasonable extension of time as determined by the City in which to complete the Project. Provided, however, no such delay nor the extension of time if granted shall be grounds for a claim by the Contractor for damages or for additional cost, expenses, overhead or profit or other compensation:

1. Fires, abnormal floods, tornadoes or other cataclysmic phenomenon of nature.
2. Strikes, embargoes, lockouts, war, acts of public enemy.
3. Change orders.
4. Acts of performance or delays in performance by other contractors employed by the City or their subcontractors.
5. Causes beyond the control of the Contractor.

Provided further, that the Contractor shall immediately give notice in writing to the City and follow extension of time procedures as provided for herein. The City expressly disclaims any

liability to Contractor for any cost, expense or damage caused by other contractors, subcontractors or suppliers, including those engaged by the City. The City shall not be liable for damages or cost to the Contractor sustained due to any interference from utilities or appurtenances or from the operations of relocating the same.

B. **Extensions of Time:** All written requests for extensions of time must be submitted to Engineer/Architect within ten (10) days after the occurrence of the cause for delay. The Engineer/Architect shall ascertain the facts and the extent of the delay and shall recommend to the City Council whether it should extend the time for completing the Project. Any extension of time shall be in writing and processed as a change order.

For change orders requesting extensions of time due to rain, wind, flood or other natural phenomenon, the Contractor's written request must be accompanied, at the City's request, by a detailed report of weather at this site for the last ten (10) years with averages showing means and statistical deviations from mean averages to support request for extension.

No extension shall be made for delays due to rain, wind, flood or other natural phenomenon of normal intensity for the locality.

In the event any material changes, alterations, or additions are made as herein specified, which in the opinion of the Engineer/Architect will require additional time for execution of any work under the contract, then in that case, the time of the completion of the Project may be extended through change order. No extensions of time shall be given for any minor changes, alterations or additions. The Contractor shall not be entitled to any reparation or compensation on account of such additional time or extensions of time. To the extent that the construction schedule contains "float," the parties agree that the same belongs to the Project and may be utilized by either party.

C. **Right of the City to Terminate Contract:** If the Contractor should be adjudged as bankrupt, or if it should make a general assignment for the benefit of its creditors, or if a receiver should be appointed for the Contractor or any of its property, or if it should persistently or repeatedly refuse or fail to supply enough properly skilled workmen or if it should refuse or fail to make prompt payment to persons supplying labor for the Project under the Contract, or persistently disregard instructions of the Engineer/Architect or fail to observe or perform any provisions of the Contract documents, or fail or neglect to promptly prosecute or perform the Project in accordance with the contract documents or otherwise be guilty of a substantial violation of any provision of the Contract documents, then the City may, on giving at least thirty (30) days' written notice to the Contractor, without prejudice to any other rights or remedies of the City in the premises, terminate the Contractor's right to proceed with the Project. In such event, the City may take over the Project and prosecute the same to completion, by contract or otherwise, and the Contractor and its sureties shall be liable to the City for any and all excess cost occasioned to the City thereby, including attorney's fees; and in any such case, the City may take possession of and utilize in completing the Project such appliances and plant of the Contractor or its subcontractors as may be on the site work and necessary or useful thereof. In the event of

termination, the same shall not relieve the Contractor nor any of its sureties of their obligation pursuant to this agreement. In the event it becomes necessary for the City to maintain any legal action against the contractor, to enforce its rights herein, the Contractor shall pay the City all expenses associated therewith including a reasonable attorney's fee.

Owner may at any time and for any reason terminate Contractor's services and work at Owner's convenience. Upon receipt of such notice, Contractor shall, unless the notice directs otherwise, immediately discontinue the work and placing of orders for materials, facilities and supplies in connection with the performance of this Agreement. Upon such termination, Contractor shall be entitled to payment only as follows: (1) the actual cost of the work completed in conformity with this Agreement; plus, (2) such other costs actually incurred by Contractor as are permitted by the prime contract and approved by Owner; (3) plus ten percent (10%) of the cost of the work referred to in subparagraph (1) above for overhead and profit.

D. **Liquidated Damages:** Should the work under this contract not be completed within the time specified, scheduled or as extended, it is understood and agreed that there may be deducted by the City or Engineer/Architect from the partial and/or final payments to the Contractor or otherwise charged to the Contractor, a sum computed at the rate of **Two Thousand Dollars ($2,000.00)** per day beginning from the stated or extended date of completion and continuing for so long as the Project remains incomplete. It is understood and agreed that the above deduction is not a penalty, but money due to reimburse the City/Owner for inconvenience and damage to the general public, due to the delay in the completion of the Project and is reasonable. The collection of liquidated damages by the City shall not constitute an election or waiver by the City of recovery of additional delay or non-delay related damages from the Contractor, and the City expressly reserves the right to recover actual damages for other harms resulting from delay. The provisions of the liquidated damage clause shall apply and continue to apply even if the Contractor terminates or abandons the Project prior to the scheduled completion dates.

The amounts of such liquidated damages and actual damages incurred by reason of failure to complete the work stipulated in the Contract are hereby agreed upon as reasonable estimates of the costs which may be accrued by the City. It is expressly understood and agreed that these amounts are not to be considered in the nature of penalties, but as damages which have accrued against the Contractor. The City shall have the right to deduct such damages from any amount due, or that may become due the Contractor, or the amount of such damages shall be due and collectible from the Contractor or Surety.

ARTICLE IV. WORK AND MATERIALS

A. **Cooperation of Contractor:** The Contractor shall have available on the job site, at all times, at least one (1) copy of the plans and specifications if prepared for the Project.

He shall give the Project the constant attention necessary to facilitate the progress thereof and shall cooperate with the City, Engineer/Architect and with other Contractors in every way

possible. The Contractor shall at all times have a superintendent, capable of acting as his agent on the Project, who shall receive communications from the Engineer/Architect or his authorized representatives or the City's authorized representative. The superintendent shall have full authority to give and execute orders relating to the Project without delay and to promptly supply such tools, plant equipment, materials and labor as may be required.

The City reserves the right to utilize its own forces on the site or those of another contractor and to communicate through its representative directly with the Contractor.

B. **Coordination - Trade Contractors:** If the supplemental conditions are attached to these general conditions indicating that this Project involves the use of multiple trade or multiple prime contractors under the supervision and direction of a Construction Manager employed by the City, then each such trade contractor shall cooperate and coordinate its construction activities and operations with those of other trade contractors and other entities involved in the Project and included under different sections of the specifications that are dependent upon each other in any manner for proper and correct installation, connection and operation, to assure efficient, prompt, orderly and proper installation of each part of the Project.

When utilizing trade contractors and/or multiple prime contractors under the supervision of Construction Manager cooperation and coordination of activities is extremely important. Refer to the provisions of the supplemental conditions for detailed requirements.

C. **Superintendence:** The Contractor shall assign to and keep at the Project site competent supervisory personnel. The Contractor shall designate, in writing, before starting work, an authorized representative who shall be an employee of the Contractor and shall have complete authority to represent, to receive notice for, and to act for the Contractor. The Contractor shall not permit or allow any work to be conducted upon the Project site without the presence of supervisory personnel. The Engineer/Architect shall be notified in writing prior to any change in superintendent assignment. Using his best skill and attention, the Contractor shall give efficient supervision to the Project. The Contractor shall be solely responsible for all construction means, methods, techniques, and procedures, for providing adequate safety precautions, and for coordinating all portions of the Project under the Contract. It is specifically understood and agreed that neither the Engineer/Architect nor the City shall not have control or charge of and shall not be responsible for the construction means, methods, techniques, or procedures, or for providing adequate safety precautions in connection with the Project under the Contract.

D. **Contractor's Tools and Equipment:** The Contractor's tools and equipment used on the Project shall be furnished in sufficient quantity and of a capacity and type that will adequately and safely perform the work specified, and shall be maintained and used in a manner that will not create a hazard to persons or property, or cause a delay in the progress of the Project.

E. **Furnishing Labor and Equipment:** The Contractor shall furnish and pay for all equipment, labor and supervision, and all such materials as required to be furnished in the Notice to Bidders

and as may other-wise be necessary to the completion of the Project and the operation of each construction crew required.

F. **Employees:** The Contractor shall employ only competent, skillful workers on the Project, and whenever any person shall appear to be incompetent or to act in a disorderly, unsafe improper manner, such person shall promptly be removed from the Project by the Contractor.

G. **Materials and Appliances:** Unless otherwise stipulated, the Contractor shall provide and pay for all other materials, water, heating, lighting, fuel, power, transportation, machinery, appliances, telephone, sanitary facilities, temporary facilities and other facilities and incidentals necessary for the execution and completion of the Project.

The Contractor warrants to the City and the Engineer/Architect that, unless otherwise specified, all materials and equipment furnished under this contract shall be new, and both workmanship and materials shall be of good quality, free of faults and defects, and in conformance with the Contract Documents. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials. In selecting and/or approving equipment for installation in the Project, neither the City nor Engineer/Architect assume responsibility for injury or claims resulting from failure of the equipment to comply with applicable federal, state, and local safety codes or requirements, or the safety requirements of a recognized agency, or failure due to faulty design concepts, or defective workmanship and materials. Material and/or equipment damaged by flooding or other causes during the construction period shall be subject to rejection by the Engineer/Architect; reconditioning and/or repairing material and/or equipment is not acceptable.

H. **Asbestos and Hazardous Materials:** Unless specifically authorized and instructed to the contrary by the City, the Contractor shall not permit, allow, place, install or incorporate into the Project or upon the work site, any hazardous material(s), including, but not limited to, any products or materials that contain asbestos in any quantity. It shall be the responsibility of the Contractor to inspect all materials and products delivered for incorporation or installation in the Project to ensure that they contain no hazardous materials or asbestos. Where the Contractor or any subcontractor has or should have a reasonable suspicion that any product or material contains asbestos or other hazardous material, the Contractor shall immediately inspect the material or product, obtain a product or material data sheet, and notify the City's representative prior to installation or incorporation of the same into the Project. Any product or material determined to contain asbestos or other hazardous material shall be removed from the Project immediately and properly disposed of as required by law. Products or material to which the contractor should pay particular attention to avoid the presence of asbestos incorporated therein include, but are not limited to the following: concrete, batt insulation, roof insulation, building felts, mastics, water proofing products, adhesives, resilient flooring products, ceiling tiles, interior coatings, exterior coatings, roofing, pipe installation, duct installation and pre-assembled items of equipment. At the completion of the Project, the Contractor shall submit a duly executed Asbestos Affidavit in the form as attached hereto prior to final payment. The Contractor is

responsible for insuring that all of its employees and subcontractors are adequately trained to handle hazardous materials in accordance with 49 CFR §172(g).

I. **Protection of Work and Property:** The Contractor shall furnish and install all necessary temporary works for the protection of the Project. The Contractor shall at all times adequately maintain, guard and protect his own work from damage, and safely guard and protect private, commercial, industrial, the City's and others' property from injury or loss arising in connection with this Contract. He shall make good any such damage, injury or loss, except such as may be directly due to errors in the plans or specifications or caused by agents or employees of the City.

The Contractor shall protect all existing vegetation such as trees, shrubs, and grass on or adjacent to the site which are not required to be removed or do not unreasonably interfere with construction, as may be determined by the Engineer/Architect, and be responsible for all cutting or damaging of trees and shrubs or grassed areas, including damage due to careless operation of equipment, stockpiling of materials or equipment.

Care shall be taken by the Contractor in felling trees that are to be removed to avoid any unnecessary damage to vegetation or other trees that are to remain in place. Any limbs or branches unavoidably broken during such operations shall be trimmed with a clean cut and painted with an approved tree priming compound. The Contractor may be required to replace or restore at his own expense all vegetation not protected and preserved, as above required, that may be destroyed or damaged.

The Contractor shall provide and maintain all passageways, guard fences, lights, and other facilities required for protection by federal, state or municipal laws and regulations or local conditions.

The Contractor shall comply with local and state regulations governing the operation of premises which are occupied and shall perform the contract in such a manner as not to interrupt or interfere with the operation of other facilities.

The Contractor shall store his apparatus, materials, supplies, and equipment in such orderly fashion at the site of the Project as will not unduly interfere with the progress of his work or the work of any other contractor.

Necessary crossings of curbings, sidewalks, roadways or parkways shall be protected against damage and any damage shall be repaired by or at the expense of the Contractor.

The Contractor shall not place upon the Project or any part thereof, loads inconsistent with the design or safety of that portion of the Project.

The Contractor shall provide and maintain access to all public and private properties at all times and be responsible for any damage caused by his operation to existing driveways, yards, streets, parking lots, utilities, railroads, etc., and such damage shall be corrected at the Contractor’s

expense. Roadways authorized closed by State or Local authorities shall be maintained to provide access to all fire, police, and other emergency vehicles and all individuals having private property in the closed area. The Contractor shall notify at least 24 hours in advance the Fire, Police, and Transportation Departments having local jurisdiction, the Owner and any other individuals, businesses, or agencies that may be affected.

J. **Protection of Existing Utilities**. Contractor shall be responsible for any damage to existing structures or the interruption of any utility services which shall be repaired or restored promptly by and at the expense of the Contractor.

To that extent, the Contractor shall provide whatever measures are necessary to properly protect and maintain all existing utilities encountered in the course of the work. The Contractor shall be exclusively responsible to the utility owner for any and all damages to the various utilities caused by the Contractor's actions or lack of actions to adequately protect the same.

The Contractor shall determine the exact location of all existing utilities before commencing work and agrees hereby to be fully responsible and liable for any and all damages which might occur by his failure to exactly locate and/or preserve the location of any and all underground or overhead utilities. The Contractor shall be solely and directly responsible to the utility owner for any and all damages to the various utilities, caused by the Contractor's actions or lack of actions to adequately protect such utilities. If any utilities are to be affected during the course of construction, the Contractor shall so notify the owners thereof at least seventy-two (72) hours prior to any such construction activity. The Contractor shall fully cooperate and coordinate with all utility owners in the event of an interruption to any utility service. The cost for locating, uncovering and protecting underground and/or overhead utilities is included within the Contractor's bid price for various other items of work.

The Contractor shall maintain all storm sewers, drains and/or ditches so that flow is not disturbed or impeded. The Contractor shall protect storm drains, inlets and/or ditches, lawns, landscaping and other facilities, from damage during the testing, and flushing.

K. **Limiting Exposures:** The Contractor shall prosecute the work on the Project to insure that no part of the construction, complete or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to the following:

Excessive static or dynamic loading	Rodent and insect infestation
Excessive internal or external pressures	Combustion
Excessively high or low temperatures	Electrical Current
Thermal shock	High speed operation
Excessively high or low humidity	Improper lubrication
Air contamination or pollution	Unusual wear or other misuse
Water or ice	Contact between incompatible materials
Solvents	Destructive Testing

Chemicals
Light
Puncture
Abrasions
Heavy traffic
Soiling, staining and corrosion
Bacteria
Misalignment
Excessive weathering
Unprotected storage
Improper shipping or handling
Theft
Vandalism

The Contractor shall minimize dust and air pollution through the use of water or other devices, require the use of properly operating combustion emission control devices and by encouraging the shutdown of construction vehicles when not in use.

L. **Safety:** The completed Project shall include all necessary permanent safety devices, such as machinery guards and similar ordinary safety items as may be appropriate or required by law. Further, any feature of the Project (including City-furnished or City-selected equipment) subject to such safety regulations shall be fabricated, furnished, and installed in compliance with these requirements. Contractors and manufacturers of equipment shall be held responsible for compliance with the requirements included herein. Contractors shall notify all equipment suppliers and subcontractors of the provisions of this Article.

In selecting and/or accepting equipment for installation in the Project, neither the City nor Engineer/Architect assume responsibility for any personal injury, property damage, or any other damages or claims resulting from failure of the equipment to comply with applicable safety codes or requirements, or the safety requirements of a recognized agency, or failure due to manufacturer's faulty design concepts, or defective workmanship and materials. The Contractor shall indemnify and hold the City, Program Coordinator, and Engineer/Architect harmless against any and all liability, claims, suits, damages, costs, or expenses without limitation arising out of the installation or use of such equipment.

The Contractor shall take all necessary precautions for the safety of employees on the Project and shall comply with all applicable provisions of federal, state, and municipal safety laws and building codes to prevent accidents or injury to persons on or about or adjacent to the premises where the Project is being performed. He shall erect and properly maintain at all times, as required by conditions, and progress of the Project, all necessary safeguards for the protection of workmen and the public, and shall post danger signs warning against the hazards created by features of construction and the site.

Machinery, equipment and all hazards shall be guarded or eliminated in accordance with the State Accident Prevention in Construction provisions to the extent that such provisions are not in contravention with applicable laws.

The Contractor shall do whatever work is necessary for safety and be solely and completely responsible for conditions of the jobsite, including safety of all persons (including but by no means limited to the public, site personnel, visitors, or employees) and property during the

Contract period. The contract period shall include any subsequent warranty or other period associated with Project deficiency or repair and all hours including, and in addition to, normal working hours.

Safety provisions shall conform to the Federal and State Departments of Labor and the Occupational Safety and Health Act (OSHA), and all other applicable federal, state, county, and local laws, ordinances, codes, the requirements set forth herein, and any regulations that may be specified in other parts of these Contract Documents. Where any of these are in conflict, the more stringent requirement shall be followed. The Contractor's failure to thoroughly familiarize himself with the aforementioned safety provisions shall not relieve him from compliance with the obligations and penalties set forth therein.

The Contractor shall at all times provide proper facilities for safe access to the work by authorized government officials (federal, state, county and local) and representatives of the Owner.

M. **Traffic Control:** The Contractor shall be responsible for traffic control, including plan and devices to the extent the same is required due to work in, upon or in proximity to public right-of-way, streets, roads or vehicular traffic. The traffic control plan and all traffic control devices shall conform at a minimum to the Manual on Uniform Traffic Control Devices for Streets and Highways, Latest Edition, Federal Highway Administration. A copy of which is on file in the office of the City of Tuscaloosa Director of the Department of Transportation for examination. Copies may be obtained from the Alabama Department of Transportation. Should the appropriate public authority determine a greater degree of traffic control is required, then the Contractor shall promptly provide same. The Contractor shall submit a plan to the City Engineer for approval before commencing construction.

Reasonable means of ingress and egress by vehicular and/or pedestrian traffic to property adjacent to the Project shall be maintained at all times. The Contractor shall indemnify and hold the City harmless for any claims or causes of action including but not limited to those for inverse condemnation and/or lost profits arising out of or in any manner associated with access to or the restriction or prevention thereof to adjoining property. Traffic control and erosion control is of paramount importance during the construction of this Project and the terms and conditions in the contract documents in regard to these matters must be strictly adhered to.

N. **Responsibility to Act in Emergency:** In case of an emergency which threatens loss or damage to property, and/or safety, the Contractor shall act, without previous instructions from the City or Engineer/Architect, as the situation may warrant. The Contractor shall notify the Engineer/Architect thereof immediately thereafter. Any claim for compensation by the Contractor, together with substantiating documents in regard to expense, shall be submitted to the City through the Engineer/Architect. The claim will be handled in accordance with the provisions for extra work. However, if the emergency is created or aggravated by the Contractor, he shall be liable for the resulting damages. If the Contractor fails to take necessary action as required by such an emergency, the City may assign another Contractor or use his own forces to

perform the emergency work. Costs or damages arising from the failure of the Contractor to act in an emergency may be deducted from the Contractor's request for payment.

O. **Sanitary Regulations:** The Contractor shall provide and maintain such sanitary accommodations for the use of his employees and those of his subcontractors as may be necessary to comply with the requirements and regulations of the local and State Department of Health. At a minimum, necessary sanitary conveniences for the use of the laborers on the work shall be erected and maintained by the Contractor, in such a manner and at such points as shall be approved by the Engineer/Architect. Their use shall be strictly enforced. In the Construction Manager format, the City may provide sanitary accommodations through the Construction Manager.

P. **Cutting, Patching, etc.:** Unless otherwise stated in the contract documents, the Contractor shall do all necessary cutting, fitting and patching of the Project that may be required to properly receive the work, to make its several parts join together properly, receive and provide for the work of various trades, and be received by the work of other contractors, or as required by drawings and specifications to complete the Project. After such cutting, he shall replace or restore or repair and make good all defective or patched work as required by the Engineer/Architect. He shall not cut, excavate or otherwise alter any work in any manner or by a method or methods that will endanger the Project, adjacent property, workmen, the public or the work of any other contractor. The Contractor shall check the location of all sleeves, openings, slots, etc., for the piping, ducts, breeching, conduits, louvers, grills, fans, etc., as they are laid out on the job.

Provisions for openings, holes and clearances through walls, beams, floors, ceilings and partitions shall be made and checked by the Contractor and/or his subcontractor in advance of constructing such parts of the Project and unnecessary, superfluous or dangerous cutting shall be avoided. Pipes passing through concrete or masonry walls shall be protected by pipe sleeves two sizes larger than the pipe, plus its installation to provide free movement.

Under no condition shall structural, framing or other parts or members subjected to computed stress be cut or disturbed without the approval of the Engineer/Architect. Any plates, studs or joists, and/or rafters that are approved to be cut to execute necessary work shall be securely strapped and braced to restore their strength by approved methods.

Unless otherwise indicated in Supplemental Conditions, all road crossings and/or driveways cut by the Contractor during the performance of the Project shall be returned to service as soon as possible and replaced or repaired within seven (7) calendar days.

All major thoroughfares must be repaired the same day as cut. The Contractor shall be responsible for the safety and welfare of the traveling public while construction work is being done and until the City accepts the Project.

The Contractor will replace at his own expense, all pipe and accessories that may be broken, damaged, stolen or lost and all materials that may become damaged, lost, stolen or misused.

The Engineer/Architect's approval shall be obtained before cutting or drilling holes in concrete or masonry that tend to damage or weaken the load capacity.

Q. **Trailers:** With the approval of the City or Engineer/Architect, the Contractor may park trailers or other structures for housing men, tools, machinery and supplies, but they will be permitted only at approved places and their surroundings shall be maintained at all times in a sanitary and satisfactory manner by the Contractor. On or before the completion of the Project, all such trailers or structures shall be removed, unless the City authorizes their abandonment without removal, together with all rubbish and trash, at the expense of the Contractor.

R. **Construction Staking:** If necessary, the Engineer or the City will furnish initial lines and grades to establish the initial horizontal and vertical control points and define the beginning and ending points of the Project. The Contractor is responsible for engaging the services of a qualified Engineer or land surveyor to replace and/or re-establish in accordance with the construction plans and/or specs, all construction stakes that are disturbed, displaced or destroyed during construction. If the Contractor finds any errors or discrepancies with the construction staking or the criteria upon which it is based, he/she shall promptly notify the Owner's representative.

S. **Periodic Cleanup**: The Contractor shall periodically, at least weekly**,** or as requested during the progress of the Project, clean up and remove from the premises, all refuse, rubbish, scrap materials and debris caused by its employees or its subcontractors resulting from its work, to the end that all times the premises are sanitary, safe, reasonably clean, orderly and workmanlike. Trash and combustible materials shall not be allowed to accumulate inside buildings or elsewhere on the premises. At no time shall any rubbish be thrown from window openings, except during renovations with adequate precautions and into proper receptacles. The Contractor shall comply with all municipal litter and construction site ordinances.

Before the Project is considered as complete, all rubbish created by or in connection with the construction must be removed by the Contractor and the premises left in a condition by the Contractor satisfactory to the City. Street, curbs, crosswalks, pavements, sidewalks, fences and other public and private property disturbed shall be restored to their former condition or better, and final payment will be withheld until such work is finished by the Contractor.

Contractor shall conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws. No burning or burying of rubbish or waste materials is permitted on the Project site. The Contractor shall dispose of any hazardous material in a safe manner, off site, in accordance with applicable laws and regulations and shall not dispose of volatile or hazardous waste in storm or sanitary sewer drainage ditches, streams or waterways.

Contractor shall periodically wet down dry materials and rubbish to lay dust and prevent blowing dust; and shall provide adequate and approved containers for collection and disposal of waste

material, debris and rubbish, removing grease, dust, dirt, stains, labels, fingerprints and other foreign materials from exposed and semi-exposed surfaces.

T. **Termite Control.** If the Project involves construction of a building or if otherwise specifically required by the City, then the Contractor shall provide soil treatment for termite control under all interior slabs on grade and foundation walls, and as herein specified. Contractor shall also comply with manufacturer's instructions and recommendations for work, including preparation of substrate and application and shall engage a professional pest control operator, licensed in accordance with regulations of governing authorities for application of soil treatment solution and doing business in the state where the Project is located for a minimum of five (5) years.

Contractor shall not apply soil treatment solution until excavating, filling and grading operations are completed, except as otherwise required in construction operations. To insure penetration, the soil treatment will not be applied to frozen or excessively wet soils or during inclement weather. Contractor shall comply with all handling and application instructions of the soil toxicant manufacturer. The type of materials to be used for soil poisoning shall first be submitted to the City for approval.

The soil treatment solution shall be an emulsible concentrate insecticide for dilution with water, specially formulated to prevent infestation by termites. Fuel oil will not be permitted as a dilutant.

Contractor shall strictly comply with the Environmental Protection Agency's (EPA) rules and regulations governing chemicals and their use. Only soil treatment solutions which are not injurious to planting shall be used. Other solutions may be used as recommended by Applicator when acceptable to the EPA, local governing authorities, and the Engineer/Architect.

Contractor shall comply with the following requirements when applying the soil treatment solution:

1. Surface Preparation: Remove foreign matter which could decrease effectiveness of treatment on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and foundations. Toxicants may be applied before placement of compacted fill under slabs if recommended by toxicant manufacturer.
2. Under slab-on-grade structures, treat soil before concrete slabs are placed using either power sprayer or tank type garden sprayer.
    (A) Apply 4-gallons of chemical solution per 10 linear feet to soil in critical areas under slab, including entire inside perimeter inside of foundation walls, along both sides at interior partition walls, around plumbing pipes and electric conduit penetrating slab, and around interior column footings.
    (B) Apply one gallon of chemical solution per 10 sq. ft. as an overall treatment under slab and attached slab areas where fill is soil or unwashed gravel.

Apply 1-1/2 gallons of chemical solution to areas where fill is washed gravel or other coarse absorbent material.

(C) Apply 4 gallons of chemical solution per 10 linear feet of trench for each foot of depth from grade to footing, along outside edge of building. Dig a trench 6" to 8" wide along outside of foundation to a depth of not less than 12". Punch holes to top of footing at not more than 12" o.c. and apply chemical solution. Mix chemical solution with the soil as it is being replaced in trench.

3. Post signs in areas of application warning workers that soil poisoning has been applied. Remove signs when areas are covered by other construction.
4. Reapply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

U. **Erosion Control.**

1. To the extent there has been issued by the City Engineer a land development permit in accordance with applicable ordinances, the Contractor shall conform to and abide by all terms and conditions of such permit.
2. Erosion control measures shall be performed on all disturbed areas in accordance with the Construction Best Management Practices Plan (CBMPP) included in the Notice of Intent for coverage under ALR1000000. The CONTRACTOR will perform all erosion control measures necessary to prevent silt and soil from leaving construction area and entering private property or the "Waters of the State." Erosion control measures shall be in strict accordance with Alabama Law.
3. In accordance with the CBMPP, temporary erosion control work shall involve the construction of temporary berms, dikes, drains, fences, dams, etc. with the use of temporary seeding, mulching, erosion control netting, hay bales, sandbags, check dams, etc., as necessary in order to prevent silt and soil from leaving rights-of-way and entering private property or from washing into drainage structures located on State or County rights-of-way. CONTRACTOR shall mow grassed areas as required during the construction phase of the contract.
4. Erosion control measures shall be maintained by the CONTRACTOR through the warranty period of the contract. If additional measures are required to correct problems which might occur, these shall be performed by the CONTRACTOR at no additional cost to the OWNER.
5. Materials used for erosion control measures shall be in accordance with the Alabama Handbook and the CBMPP shall include hay bales, sandbags, silt fencing rip rap, crushed stone, mulch or other materials necessary in order to accomplish erosion control.

V. **Wastewater Containment and Management Plan.** To the extent that construction activity by the Contractor involves any wastewater infrastructure or construction activities in close proximity to any wastewater infrastructure and/or to any City sanitary sewer assets the Contractor shall submit to the City Engineer, prior to commencing construction, a wastewater

containment and management plan (the "Plan"). The Plan shall adequately address the means, methods and techniques to be employed by the Contractor for containing and transporting wastewater in a sanitary manner without, at any time, permitting the discharge of wastewater into the environment or creating the necessity of a State required sanitary sewer overflow report. The Plan shall be submitted by the Contractor to the Office of City Engineer for review and approval before commencing any construction activity. The City Engineer may waive the requirement of submitting a Plan if he/ she determines that the construction activity to which the Plan would relate does not involve any potential for the discharge of wastewater into the environment or creating the potential for the necessity of a State required sanitary sewer overflow report.

W. **Environmental Clause/Covenant.** Contractor shall not allow any toxic, hazardous or contaminated substances or gases (including, but not limited to, asbestos and raw materials which include hazardous constituents or any other similar substances or materials which are included under or regulated by any local, state, or federal law, rule or regulation pertaining to environmental regulations, contamination, clean-up or disclosure such as, without limitation, the Comprehensive Environmental Response Compensation and Liability Act of 1980 ("CERCLA"); the Clean Air Act (42 U.S.C. Sec. 7401 et seq.); the Clean Water Act (33 U.S.C. §1251 et seq.); the Resource Conservation and Recovery Act (42 U.S.C. §6901 et seq.); and the Toxic Substances Control Act (42 U.S.C. §2601 et seq.) or state environmental clean-up or disclosure acts and statutes as all such acts and statutes exist now or are hereafter amended (such acts and statutes referred to herein as "Environmental Laws")(such substances or gases referred to herein as 'Hazardous Substances') to be stored, located, or discharged on the premises without specific prior written consent of the City. Contractor shall comply with all Environmental Laws affecting the premises. Contractor covenants to hold the City, its officers, agents and employees harmless from and against any loss, costs, damage or expenses (including attorney's fees and expenses) arising out of the presence of Hazardous Substances (as hereinbefore described) on or about the premises or the violation of any Environmental Laws with respect thereto, the occurrence of which Hazardous Substances on the premises or the violation of any Environmental Laws shall have arisen solely from the acts or omissions of Contractor, its subcontractors, agents, invitees and employees. This indemnity shall survive the termination of this contract and shall inure to the benefit of the City of Tuscaloosa, its successors and assigns.

ARTICLE V. INSURANCE, LIABILITY, ETC.

A. Contractor's Insurance (Generally):

1. Insurance Required. The Contractor shall not commence work under this contract until it has obtained all insurance required by the Contract documents and such insurance has been accepted by the City. The Contractor shall maintain the required insurance during the term of the contract including any extensions of the term.

Insurance shall be written in comprehensive form by insurance companies rated A- or better by A. M. BEST and shall protect the Contractor and the City against claims for injuries to

members of the public (including City employees) or damages to property of others (including City property) arising out of any act of the Contractor or any of its agents, employees or subcontractors and shall cover both on-site and off-site operations under this contract and insurance coverage shall extend to any motor vehicles or other related equipment, irrespective of whether the same is owned, non-owned or hired.

The obtaining and maintaining by Contractor and subcontractors of the insurance required herein does not relieve the Contractor of any responsibilities, obligations or duties to the City pursuant to this contract.

2. Additional Insurance. The Contractor shall have an insurance professional review the Contractor's activities in regard to the performance of this contract and the Contractor shall obtain any further or additional insurance or greater limits as recommended by the insurance professional.

3. Insurance Limits. Neither the setting of insurance limits or requirements nor the acceptance or approval of the same by the City imply or represent that the limits or the insurance carrier is sufficient or that such insurance actually has been obtained, that being the responsibility of the Contractor.

4. Subcontractors. The Contractor shall require all subcontractors to take out and maintain the type of insurance required herein to the extent of their involvement in the Project so as to be adequate to protect against liability. In the event any work under this Contract is performed by a subcontractor(s), the Contractor shall remain responsible for any liability directly or indirectly arising out of the work performed under this Contract, regardless of whether or not such work is covered by the subcontractor's insurance. The Contractor shall not allow any subcontractor to commence work on the project until all similar insurance required of the subcontractor has been obtained. All subcontractors shall maintain required insurance during the term of the contract including any extensions of the term.

5. City's Right to Review Coverage. The City shall have the right to inspect and approve Contractor's insurance coverage herein required. Should the City deem it advisable to modify the coverage in any way, it shall so request of the Contractor in writing and should the Contractor fail to modify the coverage, then the City may pay the cost of any increased coverage or take credit for any decreases as may be appropriate. Review or acceptance of insurance by the City or representatives of the City shall not relieve or decrease the responsibility of the Contractor hereunder.

6. Waiver of Subrogation. To the extent that the Contractor is required to maintain insurance coverage for loss or damage to property or bodily injury, including Builders Risk All Risk insurance, the insurance must waive and the Contractor hereby waives subrogation of claims against the City, its officers, agents and employees.

7. City as Additional Insured. The City shall be named as additional insured, for ongoing and completed operations for up to two (2) years, on the Contractor's and any subcontractor's policies for any claims arising out of work performed under this Contract. The Contractor shall provide the City with a Certificate of Insurance naming the City as an additional insured using ISO for CG 2010 1185 (or a substitute form providing equivalent coverage) or on the combination of ISO forms CG 20 10 07 04 or CG 20 33 07 04 and CG 20 37 07 04 (or a substitute or ISO form providing equivalent coverage) naming the City as an additional insured, giving all parties a 30 day notice of cancellation or intent not to renew the insurance, a waiver of subrogation and list any and all exclusions. The coverage available to the City as an additional insured shall not be less than $1,000,000 Each Occurrence, $2,000,000 General Aggregate (subject to a per project general aggregate applicable to the project,), $2,000,000 Products/completed Operations Aggregate, and $1,000,000 Personal and Advertising injury limits. Additional insured coverage shall apply as primary, non-contributory, insurance with any other insurance afforded to the City and the Contractor.

8. Elevators, Hoist and Cranes. If the Contractor or a subcontractor will utilize in connection with the performance of the work pursuant to this contract an elevator, material hoist, crane or other equipment, or conveyor, then the Contractor shall take out and maintain or require the subcontractor to take out and maintain insurance that shall protect the Contractor and the City against claims for injuries to members of the public (including City employees) or damages to property of others (including City property) arising out of any act of the Contractor or any of its agents, employees or subcontractors resulting from the operation of such elevator, material hoist, crane or other equipment, or conveyor.

B. Insurance:

1. Workmen's Compensation Insurance: The Contractor shall take out and maintain during the term or any extensions of this contract Workmen's Compensation Insurance as required by Alabama law for all of its employees employed at the site of the Project or off-sites related to the Project and, in case any work is sublet, the Contractor shall require the subcontractor similarly to provide Workmen's Compensation Insurance for all of the latter's employees unless such employees are covered by the protection afforded by the Contractor.

In case any class of employees engaged in any work under this contract at the site of the Project is not protected under the Workmen's Compensation statute, the Contractor shall provide, and shall cause each subcontractor to provide, adequate accident insurance for the protection of its employees not otherwise protected.

Water or Navigational Exposure; Where work under this contract may trigger the requirement for Federal Longshoreman's and Harbor worker's Act and Federal Jones Act or insurance required by other applicable law or regulations, the Contractor shall obtain the same if required.

2. Comprehensive Automobile and Vehicle Liability Insurance: The Contractor shall maintain during the term or any extensions of this contract, comprehensive automobile and

vehicle liability insurance. The limits of liability shall not be less than $1,000,000 combined single limit or equivalent.

3. Commercial General Liability Insurance: The Contractor shall maintain during the term or any extensions of this contract, Commercial General Liability Insurance, including officers, agents and employees. The limits of liability shall not be less than $1,000,000 Each Occurrence, $2,000,000 General Aggregate (subject to a per project general aggregate applicable to the project), $2,000,000 Products/Completed Operations Aggregate, and $1,000,000 Personal and Advertising Injury Limits Combined Single Limit or equivalent.

4. Owner's Protective Insurance: For projects with a contract amount of $500,000.00 or greater, an Owner's Protective Policy is required in the minimum amount of $1,000,000 each occurrence. Provided; however, the City may require such insurance on projects of lesser amount if an insurance limit amount is stated herein.

5. Umbrella Excess Liability Over Primary Insurance: The Contractor shall take out and maintain during the term of this contract, and any extensions thereof, Umbrella Excess Liability Insurance. The minimum limits of coverage shall be as follows:

Each Occurrence	$ 5,000,000.00
Aggregate	$ 5,000,000.00

The coverage shall be over the required general liability insurance and automobile liability insurance as a minimum. There shall be no gaps or sublimit deductibles, etc.

6. Miscellaneous Insurance: The Contractor shall provide whatever insurance may be required of the City or the Contractor by permits or agreements, etc., with the railroad, highways, or other utilities. The Contractor shall familiarize himself with all insurance requirements contained in easements, permits, and agreements associated with this Project. The Contractor shall provide any Railroad Protective Liability and other General Liability Insurance in the amounts contained in the agreements, permits or easements or in greater amounts if higher limits are appropriate or required elsewhere. The Contractor shall bear the cost of all required insurance and shall include in his bid a sufficient amount to cover the cost of all required insurance. To the extent the City obtains permits or licenses for railroad or highway bores, crossings or other work involved in the Project, the Contractor shall obtain adequate insurance to protect itself and the City.

7. Builders Risk All Risk Insurance: To the extent applicable to the Project, the Contractor shall secure and maintain during the life of this Contract, Builder Risk All Risk Insurance coverage for 100 percent of the Contract Price. This insurance shall not exclude coverage for earthquake, landslide, tornado, flood, collapse or loss due to the result of faulty workmanship. Such insurance shall also provide for any damages caused by injury to, or destruction of, tangible property, including loss of use resulting therefrom, and shall pay all losses to the Contractor and the City as their interest may appear.

If this is a trade contract under a construction manager format, the provisions of this subsection shall not apply.

8. Proof of Carriage of Insurance: The Contractor shall furnish the City with satisfactory proof of carriage of the insurance required herein, in the form of an insurance certificate or if the City elects in the form of a policy. Insurance shall be in a form satisfactory to the City.

(A) The Contractor's and any subcontractor's general liability and automobile liability insurance shall endorse the Owner (City of Tuscaloosa), its officers, agents and employees, as additional insured's for any claims arising out of work performed under this contract.
(B) The Contractor's insurance endorsing the Owner and others as additional insured's shall be "primary" and non contributory as to such endorsed insured's.
(C) Cancellation: The certificate and policy, as the case may be, shall state that the City shall be given thirty (30) days' written notice of cancellation or any change in the insurance coverage.
(D) There shall be a statement that the Contractor and any subcontractors waive subrogation as to the City, its officers, agents, employees and Program Coordinator.
(E) There shall be a statement that full aggregate limits apply per job or contract.
(F) Agents verification of Contractor's insurance on form provided by the City or equivalent.
(G) Insurance shall contain no exclusions for x, c or u.
(H) Full aggregate limits must apply per job or contract.

C. **No Personal Liability of Public Officials:** In carrying out any of the provisions hereof in exercising any authority granted by the Contract, there will be no personal liability upon any public official.

D. **Indemnity:** To the maximum extent permitted by law, the Contractor shall save harmless, indemnify and defend the City, its officers, agents and employees from and against any and all claims and losses, cost, expense or liability including attorney's fees and litigation costs caused by, arising out of, resulting from, or occurring in connection with the performance of the work by the Contractor or any subcontractor, regardless of the fault, breach of contract, or negligence of the City, its officers, agents or employees excepting only such claims or losses that have been adjudicated to have been caused solely by the negligence of the City and regardless of whether or not the Contractor is or can be named a party in a litigation.
Contractor agrees to indemnify and/or reimburse the City for any fines, violations, charges, suits, or sums of money imposed by the Alabama Department of Environmental Management (ADEM), Environmental Protection Agency (EPA), or any administrative agency on the City of Tuscaloosa

for any sewage or contaminate discharged or Wetlands regulations violation as a result of or arising out of the work by the Contractor pursuant to this agreement.

E. **Errors and Omissions.** The Contractor does agree to release and hold harmless the City of Tuscaloosa or any of its officers, agents and employees and its Program Coordinator from any damages claimed by the Contractor or subcontractors resulting from or attributable in whole or in part to, errors in or omissions of the plans and specifications, including final drawings of the Engineer/Architect or other design professionals. As to plans, specifications or designs prepared by independent design professionals, the parties agree that any City review or approval thereof was only for overall suitability, maintenance and usability and there are no express or implied warranties by the City as to the adequacy, accuracy, correctness, or code compliance thereof.

F. **Exclusion of Contractor Claims:** In performing its obligations, the Engineer/Architect and its consultants may cause expense for the Contractor or its subcontractors and equipment or material suppliers. However, those parties and their sureties shall maintain no direct action against the City or its officers, employees, agents and program coordinator for any claim arising out of, in connection with, or resulting from the Engineering services performed or required to be performed where such services are performed in good faith to protect the City or the Public.

G. **Inadequate Surety/Insurance.** It is further mutually agreed between the parties hereto that if, at any time after the execution of this agreement, any of the surety bonds of the Contractor or subcontractors relating to the Project for its faithful performance shall be deemed by the City to be unsatisfactory, or if for any reason such bond(s) ceases to be adequate to cover the performance of the work or the surety ceases to do business by agent in Tuscaloosa County, Alabama, the Contractor shall, at its expense, within five (5) days after the receipt of notice from the City so to do, furnish an additional bond or bonds in such form and amount and with such surety or sureties as shall be satisfactory to the City. In such event, no further payment to the Contractor shall be deemed to be due under this agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the City.

H. **Changes.** When changes in the scope of work by written order or change orders aggregate in amount equal to 10 percent of the total contract, including the change order or change orders, the insurance coverage included under this heading shall be increased accordingly by the Contractor. Proof of coverage shall be established by endorsement to the original policy or by re-issue of the original policy to include the added coverage, or in accordance with any other acceptable policy with the insuring company for increasing the coverage.

ARTICLE VI. OBSERVATION OF THE PROJECT

A. **Generally:** The Contractor shall furnish the Engineer/Architect and/or the City's observer with every reasonable facility for ascertaining whether or not the work performed is in accordance with the requirements and intent of the Specifications and Contract Documents. No work shall be done without suitable inspection by the Engineer/Architect's Inspector or the City's

observer. Payment for work or failure to reject any defective work shall not in any way prevent later rejection when such defect is discovered, nor obligate the City to final acceptance. All work done when not in accordance with the Plans, specifications and contract will be rejected and, without cost to the City, shall immediately be removed and other work done in accordance therewith by the Contractor. If the Contractor fails to remove the work as above ordered, then the Engineer/Architect shall have the right and authority to stop the Contractor and his work at once and the City may correct the work as herein provided at the cost and expense of the Contractor.

Inspection is not acceptance and shall not constitute acceptance by the City. The work shall also be subject to inspection by representatives of the City of Tuscaloosa Building Inspection Department.

B. **Observation of the Project:** The Engineer/Architect, the City and its observers, agents, any agency having jurisdiction, and their representatives shall have access at all times to the Project for inspection whenever it is in preparation or progress, and the Contractor shall provide proper facilities for such access and inspection. The City or the Engineer/Architect may appoint or assign observers, with designated duties and restricted authority, to inspect the Project as may be directed, or to make special observations requested in advance by the Contractor, and to report progress of the Project, and manner of procedure, quality of the material and workmanship, and compliance with the Contract Documents.

Inspection or observation is not acceptance and shall not constitute acceptance by the City.

All materials, workmanship, equipment, processes of manufacture, and methods of construction, shall be subject to inspection, examination, and test by such persons at any and all places where such manufacture and/or construction are being carried on. The Engineer/Architect shall have the right to reject material, workmanship and/or equipment that are defective or otherwise not in accordance with the drawings and Specifications and require its correction by the Contractor. Rejected workmanship shall be satisfactorily corrected, and rejected material shall be satisfactorily replaced with proper material by the Contractor without charge therefor, and the Contractor shall promptly segregate and remove the rejected material from the premises. Provided; however, neither the presence or absence of such observers nor the giving or failure to give such advice, direction or instruction shall in any manner relieve the Contractor from any contract requirement.

Upon rejection of material and/or workmanship by the Engineer/Architect or the City, there may be occasion where such deficiencies may be corrected more economically and timely through modification of the design versus removal and replacement. In such instances, the Engineer/Architect shall provide design services on behalf of the City necessary for analysis and correction of the rejected work. Costs associated with hourly fees for these professional services shall be paid by the City and deducted from payment to the Contractor based on the actual costs incurred. Prior to beginning any analysis and accrual of associated professional service fees, the Engineer/Architect shall provide the Contractor and City notice in writing of the intent to begin,

summary of the scope of work, estimated time to complete, and estimated total fees. Any costs associated with corrective work performed by the Contractor to remedy such deficiencies shall be the sole responsibility of the Contractor.

Neither the City observers nor the Engineer/Architect, will be authorized to revoke, alter, relax, or waive any requirements of the Contract Documents; to issue instructions contrary to the drawings and Specifications; nor shall they supervise and direct work for the Contractor, nor unreasonably interfere with the Contractor's operations beyond the extent necessary to make certain that the Project is being carried out according to the contract requirements.

Any advice which they may give the Contractor shall not be construed as binding the City in any way, nor as releasing the Contractor from any of the contract requirements.

If the Contractor considers any work demanded of it to be outside the contract requirements, or any ruling of the Engineer/Architect or an inspector to be unfair, it may immediately, upon such work being demanded or ruling made, request written instructions from the Engineer/Architect, or inspector, or within ten days file an appeal to the Engineer/Architect or the City, stating clearly and in detail the basis of its objections. However, pending the decision on such appeal no work shall be done in disregard of the rulings of the Engineer/Architect or inspector or his instructions on items of work affected by such appeal.

The Contractor shall furnish promptly, without extra compensation, all reasonable facilities, labor, and material necessary for safe and convenient access, inspection, and tests that may be required by the Engineer/Architect.

C. **Authority and Duties of Observers:** If City or consultant inspectors, whether for the Engineer/Architect or Construction Manager, are being utilized, they shall be authorized and permitted to inspect all work done. The Inspector shall not be authorized to alter or waive any requirements of the Specifications. He shall have authority to call the attention of the Contractor to failure of the work to conform to the specifications and Contract. He may suspend the Project until any questions at issue can be referred to and decided by the Engineer/Architect or the City.

Neither the Engineer/Architect, Inspector, the City or other representatives for the City shall be responsible in any way for construction means, methods or techniques, nor for the safety of the construction work, progress, or employees of the Contractor or any subcontractors, except as set forth in the Construction Manager contract, if applicable.

The presence of the Inspector shall not in any manner lessen the responsibility of the Contractor pursuant to this agreement.

D. **Defective Work/Correction of Work by the City:** The inspection of the work shall not relieve the Contractor of any of its obligations to fulfill its contract and defective work shall be made good, notwithstanding that such work has been previously inspected by the Engineer/Architect and accepted or estimated for payment. The failure of the Engineer/Architect

or inspector to condemn improper workmanship shall not be considered as a waiver of any defect, whether known at the time or discovered later, or as preventing the City at any time subsequently from recovering damages for work actually defective. All work shall be guaranteed by the Contractor against defects in workmanship for a period of one year from date of final payment.

Upon failure and/or neglect by the Contractor to promptly prosecute or perform the work in accordance with the contract documents, including any requirements with respect to the construction schedule, plans or specifications, the City may, without prejudice to any other remedy it may have, correct such deficiencies and may deduct the actual cost thereof from payment, then or thereafter due to the Contractor.

E. **Disagreement:** Should any disagreement or difference arise as to the estimated quantities or classifications or as to the meaning of the drawings or specifications, or any point concerning the character, or acceptability or nature of the several kinds of work, or construction thereof, the decision of the Engineer/Architect shall be final and conclusive and binding on the Contractor.

F. **Stop Work Orders:** During unseasonable weather all work must stop when the Engineer/Architect so directs and all work must be suitably protected by Contractor at all times. However, the Engineer/Architect shall be under no obligation to stop work on the Project. If the Project is stopped, the Contractor shall not be entitled to extra compensation for delays or problems associated with the stoppage.

G. **Progress Meetings:** The Contractor shall conduct regular progress meetings during the course of the Project at least once a month or more often if requested by the City or Engineer/Architect. The meetings shall be held at a site convenient to all parties and if a site cannot be agreed upon, the City will designate a site.

The Contractor or designated representative, the Contractor's Superintendent, all subcontractors, engineers, inspectors, and the City's representative shall attend.

The Contractor shall keep accurate written minutes of the meetings and forward copies thereof to the Engineer/Architect and the City's representative before the next scheduled meeting.

If a trade contract, progress meetings will be conducted by the Construction Manager, who will keep minutes. All trade contractors shall attend unless excused by the Construction Manager.

ARTICLE VII. PROJECT COMPLETION

A. **Substantial Completion:** "Substantial completion" shall be that degree of completion of the Project or a defined portion of the Project, as evidenced by the Engineer/Architect's written notice of Substantial Completion, sufficient to provide the City, at its discretion, the full-time use of the Project or defined portion of the work for the purposes for which it was intended.

"Substantial Completion" of an operating facility or operating component of the Project shall be that degree of completion that has provided a minimum of seven (7) continuous days of successful, trouble-free operation in a "fully automatic" manner acceptable to the City and Engineer/Architect and with all redundant systems fully operational. All equipment contained in the Project, plus all other components necessary to enable the owner to operate the facility in the manner that was intended, shall be complete on the substantial completion date.

When the Contractor considers that the Project, or where acceptable to the City, a designated portion thereof is substantially complete, the Contractor shall prepare and submit to the Engineer/Architect a list of items to be completed or corrected and request an inspection for Substantial Completion. The failure by the Contractor to include any items on such list does not alter the responsibility of the Contractor to complete all work in accordance with the Contract Documents. After inspection and/or if an operating facility, after a minimum of seven (7) continuous days of successful, trouble free operation has been achieved during startup, the Engineer/Architect may, at his sole discretion, issue a written notice of substantial completion for the purpose of establishing the starting date for specific equipment guarantees or warranties, and to establish the date that the City will assume the responsibility for the cost of operating such equipment.

Said notice shall not be considered as final acceptance of any portion of the Project or relieve the Contractor from completing the remaining work, including any remaining performance or acceptance testing, within the specified time and in full compliance with the Contract Documents. Specifically, the issuance of a written notice of Substantial Completion shall not relieve the Contractor of his obligation to promptly remedy any omissions and latent or unnoticed defects in the Project covered by the written Notice of Substantial Completion.

B. **Final Inspection:** Upon notice from the Contractor that its work is complete, the Engineer/Architect and/or other representatives of the City shall make a final inspection of the work or Project and conduct test or tests if applicable. The Engineer/Architect shall notify the Contractor of all apparent and/or visible instances where the Project fails to comply with the plans and specifications and contract documents, as well as any defects he may discover (punch list). The Contractor shall immediately make such alterations as are necessary to make the Project comply with the plans and specifications and to the satisfaction of the Engineer/Architect.

Upon completion of all such repairs in a satisfactory manner, and when the Engineer/Architect has determined that the work or Project is acceptable under the contract, including this provision and after publication of final completion and all other requirements of final payment as provided for in this agreement, then he shall issue a final certificate of payment to the City stating that the balance is due the Contractor, less such amounts as may have been withheld by the City from time to time as provided in the contract documents. In recommending to the City that it make such final payment to the Contractor, the Engineer/Architect shall also issue a certificate of final acceptance wherein he shall recommend to the City that it accept the Project and/or work as final and complete pursuant to the contract documents.

Verification, approval, inspection, final inspection, issuance of final acceptance, issuance of final certificate of payment, action or approval by the City upon the final certificate of payment or final acceptance shall not in any way relieve the Contractor of responsibility for faulty materials or workmanship.

All warranty or guarantee periods shall commence and start to run from the date of substantial completion.

C. **"As Built" Drawings:** Unless waived by the City representative, the Contractor must provide to the City a set of "as built" drawings acceptable to the City as a component part of the Project prior to final payment.

D. **Final Cleanup:** Before final completion and final acceptance, the Contractor shall remove from the City's property or rights-of-ways and from all public and private property, all tools, scaffolding, false work, temporary structures and/or utilities, including the foundations thereof (except such as the City permits in writing to remain); rubbish and waste materials resulting from its operation or caused by its employees; and shall remove all surplus materials, leaving the site clean and true to line and grade, and the Project in a safe and clean condition ready for use and operation. In addition to the above, the Contractor shall be responsible for the following special cleaning for all trades as the Project shall have been completed:

1. Cleaning of all painted, enameled, stained or baked enamel work: removal of all marks, stains, fingerprints and splatters from such surfaces.
2. Cleaning of all glass: cleaning and removing of all stickers, labels, stains and paint from all glass and the washing and polishing of the same on interior and exterior.
3. Cleaning or polishing of all hardware.
4. Cleaning all tile, floor finishing of all kinds; removal of all splatters, stains, paint, dirt, and dust, the washing and polishing of all floors as recommended by the manufacturer or required by the Engineer/Architect.
5. Cleaning of all manufactured articles, materials, fixtures, appliances and equipment; removal of all stickers, rust stains, labels (except instructional and/or safety labels) and temporary covers and cleaning and conditioning of all manufactured articles, materials, fixtures, appliances, electrical, heating and air conditioning equipment as recommended or directed by the manufacturers, unless otherwise required by the Engineer/Architect; blowing out or flushing out of all foreign matter from all dust pockets, piping, tanks, pumps, fans, motors, devices, switches, panels, fixtures, boilers, similar features; and freeing identification plates on all equipment or excess paint and the polishing thereof.

In the case of failure to comply with the above requirements for any part of the Project within the time specified by the Engineer/Architect, he may cause the work to be done and deduct the cost thereof from the contract price on the next or succeeding application for payment, or in the event that the cost exceeds the balance due the Contractor, bill the Contractor for the excess.

E. **Notice of Completion:** The Contractor shall, immediately after the completion of the Project and acceptance by the Owner as provided for herein, give notice as required by Ala. Code §39-1-1.

NOTE: When maintenance periods are included in the contract for highways, bridges or similar structures, such periods shall be considered component parts of the contract.

F. **Final Payment:** Upon completion of the Project by the Contractor and acceptance by the City's representatives of all work required of the Contractor for the Project, but not until thirty (30) days after completion of the notice, the amount due the Contractor pursuant to the Contract Documents shall be paid upon the presentation by the Contractor to the City's representative of the following:

1. A properly executed and duly certified voucher for payment, verified by architect, engineer or other City representative, including therewith evidence that all payrolls and all amounts due for labor and materials, other than claims for damages due to tort, have been fully paid and satisfied and there are no outstanding claims or demands associated with the work on the Project.
2. A release of all claims and claims of lien against the City from the Contractor and all major subcontractors (the City may waive the requirement for subcontractor releases) arising under and by virtue of the contract, on the form attached, duly executed by the Contractor and with the consent of the surety. The Contractor may specifically except claims of the Contractor from the operation of the release if specifically excepted therefrom in stated amounts and the reason therefor.
   The Contractor may with the consent of the City representative, if any subcontractor refuses to furnish such a release, furnish a bond with surety satisfactory to the City representative to indemnify against such claims.
3. Proof of publication of notice of completion including affidavit of publisher and a printed copy of the notice so published, as provided by law.
4. In accordance with Ala. Code §39-2-12(c), a non-resident contractor shall satisfy the City that he or she has paid all taxes due and payable to the State, the City and all applicable political subdivisions.

G. **Acceptance of Final Payment Constitutes Release:** The acceptance by the Contractor of the final payment shall release the City, the Engineer/Architect, as representatives of the City, and their officers, employees, agents, and subconsultants from all claims and all liability to the Contractor for all things done or furnished in connection with the Project, and every act of the City and others relating to or arising out of the work except claims previously made in writing and still unsettled. No payment, however, final or otherwise, shall operate to release the Contractor or his Sureties from obligations under this Contract and the Performance Bond, Payment Bond, and other bonds, warranties and guarantees as herein provided.

ARTICLE VIII. WARRANTY AND GUARANTEES

A. **Warranty and Guarantee:**

1. Warranty: The Contractor warrants to the City and the Engineer/Architect that all materials and equipment furnished under this Contract will be new unless otherwise specified and that all work, materials and equipment will be of good quality, free from fault and defects and in conformance with the contract documents. The work must be safe, substantial and durable construction in all respects. All work, materials and equipment not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. Warranties shall commence to run from the date of substantial completion.

   The work furnished must be of first quality and the workmanship must be the best obtainable in the various trades. The Contractor hereby guarantees the Project and the work on the Project against defective materials or faulty workmanship for a minimum of one (1) year after final payment by the City and shall replace or repair any defective materials or equipment or faulty workmanship during the period of guarantee at no cost to the City.

2. Guarantee: If, within the designated warranty period or if not designated, within one (1) year from the date of substantial completion, any of the work, materials or equipment is found to be defective or not in accordance with the contract documents, the Contractor shall correct it promptly after receipt of written notice from the City to do so, unless the City has previously specifically given the Contractor a written acceptance of such specific condition. This obligation shall survive termination of the Contract. The City shall give such notice promptly after discovery of the condition.

3. Roofing Guarantee: If the Project involves a roof on a building or other structure, then the Contractor shall execute and provide the Roofing Guarantee in the form attached hereto. The guarantee shall be delivered to the City and Engineer/Architect prior to final payment.

4. Termite Warranty: If the Project involves termite treatment as required in Article IV, then the Contractor shall furnish to the City a written warranty certifying that the applied soil poisoning treatment will prevent the infestation of subterranean termites and that if subterranean termite activity is discovered during the warranty period, Contractor shall re-treat the soil and repair or replace any damage caused by termite infestation. The warranty shall be for a period of five (5) years from the date of treatment signed by Applicator and Contractor.

B. **Correction of Defective Work During Warranty/Guarantee Period:** The Contractor hereby agrees to make, at their own expense and no cost to the City, all repairs or replacements necessitated by defects in materials or workmanship, provided under the terms of this Contract, and pay for any damage to other works resulting from such defects, which become evident within 1 year after the date of substantial completion unless substantial completion is established by the Engineer/Architect only for specified items of equipment, or within such longer period of time as may be prescribed by law or by the terms of any applicable special guarantee required by the Contract Documents unless the City has previously given the Contractor a written acceptance of such defects. The Contractor shall promptly correct such defects upon receipt of a written notice from the City to do so. This obligation shall survive the termination of the Contract.

Unremedied defects identified for correction during the warranty period described herein before, but remaining after its expiration, shall be considered as part of the obligations of the warranty. Defects in material, workmanship, or equipment which are remedied as a result of obligations of the warranty shall subject the remedied portion of the Project to an extended warranty period of one (1) year after the defect has been remedied.

Repetitive malfunction of equipment shall be cause for equipment replacement and an extension of the guarantee period for the equipment to a date one (1) year following acceptable replacement.

The Contractor further assumes responsibility for a similar guarantee for all work and materials provided by subcontractors or manufacturers of packaged equipment components.

The Contractor also agrees to hold the City and the Engineer/Architect and employees harmless from liability or damages, including the Engineer/Architect's and attorneys' fees, and cost and expenses of litigation of any kind arising from damage due to said defects. The Contractor shall make all repairs and replacements promptly upon receipt of written order for same from the City. If the Contractor fails to make the repairs and replacements promptly, or in an emergency where delay would cause serious risk, or loss, or damage, the City may have the defective work corrected or the rejected work removed and replaced, and the Contractor and their Surety shall be liable for the cost thereof. The Contractor during the warranty period shall repair/replace as rapidly as possible any and all equipment, materials, etc., which are found to be defective. Should any items not be repaired/replaced within thirty (30) days from the time it is reported to the Contractor by the City, then the warranty period shall be extended on that item for a period equal to the time that the item has remained defective, incomplete, or inoperable as determined by the City. The Contractor must certify that the item has been corrected.

The City's rights under this Article shall be in addition to, and not a limitation of, any other rights and remedies available by law.

ARTICLE IX. LAWS, PERMITS, ETC.

A. Laws and Regulations/Royalties, Patents, Copyrights and Permits and Rights-of-Way: The Contractor shall comply with and keep itself fully informed of all laws, ordinances and regulations of federal, state, City and county in any manner effecting those engaged or employed in the Project, or the materials used in the Project, or in any way affecting the conduct of the Project, and of all orders and decrees of bodies or tribunals having any jurisdiction or authority over same. The Contractor shall possess all permits and licenses required by applicable law, rule or regulation for the performance of the Project. If any discrepancy or inconsistency should be discovered in this contract, or in the drawings or specifications herein referred to, in relation to any law, ordinance, regulation, order or decree, it shall forthwith report the same in writing to the Engineer/Architect. It shall at all times, itself, observe and comply with all such existing and future laws, ordinances and regulations.

The Contractor shall protect and indemnify the City, Engineer/Architect, and their respective employees, officers, subconsultants, and agents against any claim or liability arising from or based on the violation of any such laws, ordinances, or regulations. All permits, licenses, and inspection fees necessary for prosecution and completion of the Project shall be secured and paid for by the Contractor, unless otherwise specified.

The Contractor shall obtain and pay for all licenses and permits and shall pay all fees and charges for connection to outside service and the use of property required for the execution and completion of the Project.

The Contractor shall give all notices and comply with all laws, ordinances, rules, regulations, and code requirements applicable in or bearing on the conduct of the Project unless in conflict with contract requirements. If the Contractor ascertains at any time that any requirements of the Contract is at variance with applicable laws, ordinances, regulations, or building code requirements, it shall promptly notify the Engineer/Architect and any necessary adjustment of the Contract will be made as herein specified under change in orders.

The Contractor shall pay all applicable federal, state and local taxes and assessments on the Project. Wherever the law of the place of building requires a special tax, consumer, use, occupation, or other tax, the Contractor shall pay such tax.

The Contractor shall pay all royalties and license fees. The Contractor shall hold and save the City and its agents and employees harmless from liability of any nature or kind, including costs and expenses, for or on account of any patented or unpatented invention, process, article or appliance manufactured or used in the performance of the contract, including its use by the City.

To the extent that the Project has not been permitted or registered by the Engineer or City, the Contractor shall register or obtain any and all necessary National Pollutant Discharge Elimination System (NPDES) Permits required by USEPA or the Alabama Department of Environmental Management (ADEM) as well as any applicable storm water permits or registration for the

construction of the improvements specified in the Contract Documents. The Contractor shall abide by all regulations and conditions relative to the permit or registration and attachments to the permit or registration, including but not limited to sampling and monitoring. The Contractor shall fulfill for the City all the requirements made upon the City by the permit(s) or registration.

The Contractor shall be fully responsible for all aspects of erosion and sediment control. The Contractor shall utilize whatever measures are necessary to prevent pollution or siltation due to their activities. As a minimum, the Contractor shall strictly comply with the CBMPP and methods referenced in the Alabama Soil and Water Conservation Committee "Alabama Handbook for Erosion Control, Sediment Control, and Stormwater Management on Construction Sites and Urban Areas," latest edition (referred to as the "Alabama Handbook").

If the Contractor has information that any process, article or item specified or delineated by the Engineer/Architect is an infringement of a patent or a copyright, it shall promptly give such information to the Engineer/Architect.

B. Alabama Department of Transportation Rights-of-Way: If any portion of the Project involves work upon State right-of-way, the Contractor agrees to provide the Alabama Department of Transportation with a bond or certified check in the amount required, made payable to the Alabama Department of Transportation, to guarantee the faithful performance of the provisions of a permit and to guarantee that the Contractor shall maintain the work in a manner suitable to the Alabama Department of Transportation for a period of one (1) year. The Alabama Department of Transportation Bond Form must be used. At the end of one (1) year from the completion of this work, the Department of Transportation will return the certified check or bond to the applicant provided all provisions of this permit have been complied with. Otherwise, the Department of Transportation shall apply the certified check or bond to the cost of repairing the rights-of-way with State forces.

C. Tuscaloosa County Right-of-Way: If any portion of the Project involves work upon County right-of-way, the Contractor agrees to execute an application and file with Tuscaloosa County a bond or certified check in the amount required, made payable to Tuscaloosa County to guarantee the faithful performance of this provision of this work suitable to the County for a period of one (1) year. At the end of one year from the completion of this work, the County will return the certified check or bond to the applicant provided all provisions of this permit have been complied with. Otherwise, the County shall apply the certified check or bond on the cost of repairing the right-of-way with the County forces.

D. Storm Water Permit and Monitoring:

1. To the extent that the Project has not been permitted or registered by the Engineer or the City, and the Project is defined as an NPDES Construction Site per ADEM Admin. Code Chapter 335-6-12 (the Rule), the Contractor shall submit to the Alabama Department of Environmental Management (ADEM) a Notice of Intent (NOI) for coverage under ADEM General NPDES Permit No. ALR1000000.

The Contractor shall strictly adhere to all requirements of ALR1000000 and the rule regardless of which party has obtained coverage.

2. Compliance with all provisions of ADEM Admin. Code Chapter 335-6-12 and coverage under ALR1000000 is required, including but not limited to, the preparation and implementation of a Construction Best Management Practices Plan (CBMPP) and any other plans as may be required, the regular maintenance of the Best Management Practices (BMPs) to the maximum extent practicable and the submittal of required reports. As required by ALR1000000, the Contractor shall retain a Qualified Credentialed Professional (QCP) to prepare the CBMPP and to certify that it was prepared in accordance with the requirements of the "Alabama Handbook" and ALR1000000.
3. Coverage under ALR1000000 neither precludes nor negates an operator's responsibility or liability to apply for, obtain, or comply with other ADEM, federal, state, or local government permits, certifications, licenses, or other approvals.
4. The Contractor, unless application for permit coverage has already been made, will be furnished a Storm Water NOR application package when the contract is awarded. The Storm Water NOR application package will include the following:
    a. Typical transmittal letter to ADEM.
    b. NOR applications filled out with Project information.
    c. Project area map.
    d. Other data as required by the NOR for Tier 1 waters if applicable.
5. The Contractor will complete or furnish the following items and submit to ADEM within five working days of the receipt of the Notice to Proceed by the Owner.
    a. The Electronic Notice of Intent (eNOI) process shall be used to obtain coverage under ALR100000 . The eNOI shall be signed by a responsible official who is the operator, owner, the sole proprietor of a sole proprietorship, a general/controlling member or partner, or an executive officer of at least the level of vice-president for a corporation. Additionally, the QCP is required to sign the CBMPP certification part of the eNOI process.
    c. Determine applicable fee per ADEM Fee Schedule D and make payable through the eNOI process.
6. The Contractor shall not commence any construction activities until ADEM has issued the authorization number for the Project.
7. a. Payment will be made to the Contractor for obtaining coverage under ALR1000000 as specified herein for the lump sum amount as shown in the bid schedule. If there is no line item for registration, obtaining permit coverage shall be considered a subsidiary obligation of mobilization.
    b. Individual erosion and sediment control items shall be paid for at the unit prices as shown in the bid schedule. Routine inspections will be performed by the Owner's representative or Engineer to verify compliance with the CBMPP and ALR1000000 shall be the Contractor’s responsibility and shall be incidental to the storm water permit coverage.

c. If no individual erosion and sediment control items are included in the bid schedule the cost of these items shall be incidental to the lump sum amount as shown in the bid schedule for Storm Water Monitoring and Temporary Erosion and Sediment Control and payment shall be made pro rata as the Project progresses.

E. The Contractor shall perform all work in compliance with and as required by any State, Federal or Local registration, permit or license, the terms and conditions of which are adopted herein by reference. The Contractor agrees to indemnify and hold harmless the City, Engineer, and their respective officers, agents and employees from any fines, penalties, damages, claims, liability or judgment arising out of or in any manner associated with the Contractor's failure to perform work on the Project in strict accordance with all storm water registration, permit or license requirements.

ARTICLE X. MISCELLANEOUS CLAUSES

A. Notice and Service Thereof:

1. All notices, demands, requests, change orders, instructions, approvals and claims shall be in writing. Unless expressly otherwise provided elsewhere in this agreement, any election, notice or other communication required or permitted to be given under this agreement shall be in writing and deemed to have been duly given if provided in accordance with the provisions hereof.
2. Any notice to or demand upon the Contractor shall be in writing and shall be sufficiently given if addressed to the Contractor at the address stated herein and deposited in the United States mail in a sealed envelope with sufficient postage prepaid or delivered with charges prepaid. It shall also be sufficient if such notice or demand be served upon the Contractor personally or its local representative in charge of the Project or delivered at their local office. The Contractor shall, from time to time, designate to the City in writing any change of address to which such notice or demand shall be sent.
3. Any notice to or demand upon the City shall be in writing and shall be sufficiently given if delivered to the office of the City's representative or if addressed to the City representative and deposited in the United States mail in a sealed envelope with sufficient postage prepaid.
4. Addresses for Notice to Parties
   a. For the City, Notice shall be delivered as follows:

      (1) To the **City Representative**
      The City's representative on this Project is hereby designated as Bryan Gurney, PE
      P.O. Box 2089, Tuscaloosa, Alabama 35403-2089

*All references to Engineer or Architect shall be to the City representative if no Engineer or Architect is involved in the Project.

(2) To the **City Attorney**
Scott Holmes, City Attorney
City of Tuscaloosa
2201 University Boulevard
Tuscaloosa, Alabama 35401

b. For the Contractor, Notice shall be delivered as follows:

(1) To the **Contractor Representative:**
The Contractor's representative on this Project is hereby designated as _____ and whose address is _____.

D. Capacity: Each party to this agreement represents and warrants to the other as follows:

1. That it is an individual of the age of majority or otherwise a legal entity duly organized and in good standing pursuant to all applicable laws, rules and regulations.
2. That each has full power and capacity to enter into this agreement, to perform and to conclude the same including the capacity, to the extent applicable, to grant, convey and/or transfer; areas, assets, facilities, properties, (both real and personal), permits, consents and authorizations and/or the full power and right to acquire and accept the same.
3. That to the extent required, each party has obtained the necessary approval of its governing body or board and a resolution or other binding act has been duly and properly enacted by such governing body or board authorizing this agreement and said approval has been reduced to writing and certified or attested by the appropriate official of the party.
4. That each party has duly authorized and empowered a representative to execute this agreement on their respective behalf and the execution of this agreement by such representative fully and completely binds the party to the terms and conditions hereof.
5. That absent fraud, the execution of this agreement by a representative of the party shall constitute a certification that all such authorizations for execution exist and have been performed and the other party shall be entitled to rely upon the same. To the extent a party is a partnership, limited liability company or joint venture, the execution of this agreement by any member thereof shall bind the party and to the extent that the execution of agreement is limited to a manager, managing partner or specific member then the person so executing this agreement is duly authorized to act in such capacity for the party.

6. That each party represents and warrants to the other that there is no litigation, claim or administrative action threatened or pending or other proceedings to its knowledge against it which would have an adverse impact upon this transaction or upon either's ability to conclude the transaction or perform pursuant to the terms and conditions of this agreement.
7. That each party has obtained any and all required permits, approvals and/or authorizations from third parties to enable it to fully perform pursuant to this agreement.
8. Under the provisions of the Constitution and laws of the State of Alabama, each party has the power to consummate the transactions contemplated by this agreement;
9. Each party represents and warrants that the execution and delivery of this agreement and the consummation of the transactions contemplated herein will not conflict with, be in violation of, or constitute (upon notice or lapse of time, or both) a default under the laws of the State of Alabama, any resolution, agreement, or other contract agreement, or instrument to which a party is subject, or any resolution, order, rule, regulation, writ, injunction, decree or judgment of any governmental authority or court having jurisdiction over the party.
10. This agreement constitutes the legal, valid and binding obligation of each party and is enforceable against each party in accordance with its terms, except in so far as the enforceability thereof may be limited by:
    (a) Bankruptcy, insolvency or other similar laws affecting the enforcement of creditors' rights
    (b) General principles of equity, regardless of whether such enforceability is considered as a proceeding at equity or at law.
11. Neither party will enter into any agreement to do anything prohibited in this agreement or enter into any agreement or take any action which would in any way impair the ability of the other party to faithfully and fully perform its obligations hereunder.
12. Under the provisions of the Constitution and laws of the State of Alabama, each party has the power to consummate the transactions contemplated by this agreement.

E. Ownership of Contract Documents: The Contract Documents, and copies of parts thereof, are furnished and owned either by the City or the Engineer/Architect. All portions of the Contract Documents, and copies of parts thereof, are the instruments of service for this Project. They are not to be used on other work and are to be returned to the City on request at the completion of the Project. Any reuse of these materials without specific written verification or adaptation by the City will be at the risk of the user and without liability or legal expense to the City or Engineer/Architect. Such user shall hold the City, its officers, agents and employees harmless from any and all damages, including reasonable attorneys' fees, from any and all claims arising from any such reuse. Any such verification and adoption shall entitle the City to further compensation at rates to be agreed upon by the user and the City.

F. No Waiver of Rights: Neither the inspection by the City or the Engineer/Architect or any of their officers, employees, agents, or subconsultants, nor any order by the City for payment of money, nor any payment for, or acceptance of, the whole or any part of the Project by the City or Engineer/Architect, nor any extension of time or change order, nor any possession taken by the City or its employees, or non enforcement of any provision of this agreement by either party shall operate as a waiver of any provision of this agreement, or any power herein reserved to the City, or any right to damages, nor shall any waiver of any breach in this agreement be held to be a waiver of any other or subsequent breach. Acceptance or final payment shall not be final and conclusive with regards to latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the City's rights under any warranty.

G. Subletting or Assigning of Contract:

1. Limitations: The Contractor shall not sublet, assign, transfer, convey, sell or otherwise dispose of any portion of the agreement, their obligations, right, or interest therein, or its power to execute such agreement, to any person, firm or corporation without written consent of the City and such written consent shall not be construed to relieve the Contractor of any duty or responsibility for the fulfillment of the agreement. A sale, conveyance or transfer of 50% or more of the stock or ownership of the Contractor shall be considered an assignment. Provided; however, in no event shall any portion of this agreement be assigned to an unsuccessful bidder whose bid was rejected because he or she was not a responsible or responsive bidder. Use of subcontracts up to a combined (total) value of 50 percent of the value of all work will not be construed as an assignment. Unless otherwise stipulated in the proposal or general conditions, the Contractor shall perform, with its own organization, work with the value not less than fifty (50) percent of the value of all work embraced in the contract.

2. Subcontractor's Status: A subcontractor shall be recognized only in the capacity of an employee or agent of the Contractor.

H. Third Party Beneficiaries: It is the intent of the parties hereto that there shall be no third party beneficiaries to this agreement.

I. Final Integration: This Agreement constitutes the entire agreement of the parties, as a complete and final integration thereof with respect to its subject matter. All written or oral understandings and agreements heretofore had between and among the parties are merged into this Agreement, which alone fully and completely expresses their understandings. No representation, warranty, or covenant made by any party which is not contained in this Agreement or expressly referred to herein has been relied on by any party in entering into this Agreement.

J. Force Majeure: Neither party to this Agreement shall hold the other party responsible for damages or delay in performance caused by acts of God, strikes, lockouts or other circumstances beyond the reasonable control of the other or the other party's employees, agents or contractors.

K. Amendment in Writing: This Agreement may not be amended, modified, altered, changed, terminated, or waived in any respect whatsoever, except by a further agreement in writing, properly executed by all of the parties.

L. Binding Effect: This agreement shall bind the parties and their respective personal representatives, heirs, next of kin, legatees, distributees, successors, and assigns.

M. Captions: The captions of this Agreement are for convenience and reference only, are not a part of this Agreement, and in no way define, describe, extend, or limit the scope or intent of this Agreement.

N. Construction: This Agreement shall be construed in its entirety according to its plain meaning and shall not be construed against the party who provided or drafted it.

O. Mandatory and Permissive: "Shall", "will", and "agrees" are mandatory; "may" is permissive.

P. Governing Laws: The laws of the State of Alabama shall govern the validity of this Agreement, the construction of its terms, the interpretation of the rights, the duties of the parties, the enforcement of its terms, and all other matters relating to this Agreement.

Q. Liability of the City or City Officials. Notwithstanding any provision hereof to the contrary, the parties agree and acknowledge that the liability and obligations of the City, City officials or City employees as set forth herein are subject to the limitations imposed on municipalities by the Constitution and laws of the State of Alabama. No present or future official, officer or employee of the City shall ever be personally liable for the performance of any obligations hereunder.

R. Non Discrimination: The Contractor agrees that in performing the work and services as required herein under this agreement, not to discriminate against any person on the basis of race color, religion, sex, age or disability. (The Contractor shall fully comply with the Americans with Disabilities Act), the Fair Labor Standards Act and all other applicable laws and regulations).

S. Fines and Penalties: The Contractor shall be solely liable for any and all fines or penalties which may be levied by any governmental authority against the Owner and/or Contractor which are related to the Contractor's operations. The Owner shall deduct the amount of the levied fine or penalty from the Contract amount.

T. Agreement Date/Counterparts: The date of this Agreement is intended as and for a date for the convenient identification of this Agreement and is not intended to indicate that this Agreement was necessarily executed and delivered on said date. This instrument may be executed in any number of counterparts, each of which so executed shall be deemed an original, but all such counterparts shall together constitute but one and the same instrument.

U. Use of Words and Phrases. The following words and phrases, where used in this document, shall be given the following and respective interpretations: "Herein," "hereby," "hereunder," "hereof," and other equivalent words refer to this document as an entirety and not solely to the particular portion hereof in which any such word is used.

The definitions set forth in any portion of this Agreement unless the text or context indicates differently shall be deemed applicable whether the words defined are herein used in the singular or the plural. Wherever used herein any pronoun or pronouns shall be deemed to include both singular and plural and to cover all genders.

V. Severability. Each provision of this agreement shall be considered to be severable and, if for any reason, any such provision or any part thereof, is determined to be invalid and contrary to any existing or future applicable law, such invalidity shall not impair the operation of or affect those portions of this agreement that are valid, but this agreement shall be construed and enforced in all respects as if the invalid or unenforceable provision or part thereof had been omitted.

SIGNATURE PAGE TO FOLLOW:

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed by their undersigned duly authorized representative on the dates set forth below:

CITY OF TUSCALOOSA, A Municipal Corporation	**CONTRACTOR:**
BY: _____	**BY:** _____
Walter Maddox, Mayor	**TITLE:** _____
DATE: _____	**DATE:** _____
ATTEST:	
_____	
Clerk, City of Tuscaloosa	

[END OF SECTION FIVE- CONTRACT]

CITY OF TUSCALOOSA
SECTION SIX- PERFORMANCE BONDS

Project Name: **Hilliard N. Fletcher WRRF Headworks Improvements**
File Number: **A19-1146** **Engineering Project Number:** **2024.714.001**

STATE OF ALABAMA)
TUSCALOOSA, COUNTY)

KNOWN ALL MEN BY THESE PRESENTS, that we, _____ as principal and _____ (hereinafter called the "Surety"), as surety, do hereby acknowledge ourselves indebted and firmly bound and held unto the City of Tuscaloosa, Alabama, (hereinafter called the "City") a municipal corporation existing under and by virtue of the laws of the State of Alabama, for the use and benefit of those entitled thereto, in the penal sum of _____
for the payment of which well and truly be made in lawful money of the United States, we do hereby bind ourselves, our successors and assigns and personal representatives, jointly and severally, firmly by the presents.

BUT THE CONDITION OF THE FOREGOING OBLIGATION OR BOND IS THIS:

WHEREAS, the City has entered into a certain written contract with said Contractor for the _____ in accordance with contract documents therefore on file in the Office of the _____ at the price of, to-wit: _____ ($_____) as more fully appears in said written contract bearing the date of _____ 20___, which contract is hereby referred to and made a part hereof to the same extent as if set out herein in full.

NOW, THEREFORE, if the Contractor shall fully and faithfully perform all the undertakings and obligations under the said agreement or contract herein before referred to and shall fully indemnify and save harmless the said City from all costs and damages whatsoever which it may suffer by reason of any failure on the part of said Contractor so to do, and shall fully reimburse and repay the said City any and all outlay and expense which it may incur in making good any such default, and shall guarantee all workmanship against defects for a period of one year, this obligation or bond shall be null and void, otherwise it shall remain in full force and effect.

And, for value received it is hereby stipulated and agreed that no change, extension of time, alteration or addition to the terms of said agreement or contract or in the work to be performed thereunder or the specifications accompanying the same shall in any wise affect the obligations of the principal or of the surety under this bond, and notice is hereby waived of any such change, extension of time, alternative of or addition to the terms of the agreement or contract or to the work or to the specifications.

IN WITNESS WHEREOF, the said Contractor has hereunder affixed its signature and said Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers on the __ day of _____, 20____.

_____
Principal

_____
Title

_____
Surety

ATTEST: By _____

_____ _____

_____
Title

[END OF SECTION SIX- PERFORMANCE BONDS]

CITY OF TUSCALOOSA
SECTION SEVEN- LABOR AND MATERIAL BOND

Project Name: **Hilliard N. Fletcher WRRF Headworks Improvements**
File Number: **A19-1146** **Engineering Project Number:** **2024.714.001**

KNOWN ALL MEN BY THESE PRESENTS, that we, _____ (hereinafter called the "Contractor") of _____ as principal and _____ (hereinafter called the "Surety"), as surety, do hereby acknowledge ourselves indebted and firmly bound and held unto the City of Tuscaloosa, Alabama, (hereinafter called the "City"), a municipal corporation, existing under and by virtue of the Laws of the State of Alabama, for the use and benefit of those entitled thereto, in the penal sum of _____ _____($_____) for the payment of which well and truly to be made in lawful money of the United States, we do hereby bind ourselves, or successors, assigns and personal representatives, jointly and severally, firmly by these presents.

BUT THE CONDITION OF THE FOREGOING OBLIGATION OR BOND IS THIS:

WHEREAS: the City has entered into a certain written contract with said Contractor for the _____, in accordance with contract documents therefore on file in the Office of the _____ at the price of, to-wit: _____ ($_____) as more fully appears in said written contract bearing date of _____, 20___, which contract is hereby referred to and made a part hereof to the same extent as if set out herein in full.

NOW, THEREFORE, if said Principal and all subcontractors to whom any portion of the work provided for in said contract is sublet and all assignees of said Principal and of such subcontractors shall promptly make payment to all persons supplying them with labor, foodstuffs, or supplies for or in the prosecution of the work provided for in such contract, or in any amendment or extension of or addition to said contract, and for the payment of reasonable attorney fees, incurred by the claimant or claimants in suits on said bond, then the above obligation shall be void; otherwise, it shall remain in full force and effect.

PROVIDED, however, that this bond is subject to the following conditions and limitations:

(a) Any person, firm or corporation that has furnished labor, foodstuffs, or supplies for or in the prosecution of the work provided for in said contract, payment for which has not been made, shall have a direct right of action in their name or names against the principal and surety on this bond, which right of action shall be asserted in a proceeding, instituted in the county in which the work provided for in said contract is to be performed and in any county in which said Principal or Surety does business. Such right of action shall be asserted in a proceeding

instituted in the name of the claimant or claimants for their use and benefit against said Principal and Surety or either of them (but not later than one year after the final settlement of said Contract) in which action such claim or claims shall be adjudicated and judgment rendered thereon.

(b) In addition to any other legal mode of service, service of summons and other process in suits on this bond brought in Tuscaloosa County may be had on the Principal or the Surety in accordance with Title 27, Chapter 3, Section 24 of the Ala. Code (1975) by serving a copy of the summons and complaint or other pleading or process, with the Commissioner of Insurance of the State of Alabama or his/ her designee and the Principal and Surety agree to be bound by such mode of service above described and consents that such service shall be the same as personal service on the Principal or Surety.

(c) The Surety shall not be liable hereunder for any damages or compensation recoverable under any workmen's compensation or employer's liability statute.

(d) In no event shall the Surety be liable for a greater sum than the penalty of this bond, or subject to any suit, action or proceeding thereon that is instituted later than one year after the final settlement of said contract.

(e) This bond is given pursuant to the terms of Title 39, Chapter 1, Section 1 of the Ala. Code (1975), and all the provisions of law with reference to this character of bond as set forth in said section or as may hereinafter be enacted are hereby made a part hereof to the same extent as if set out herein in full.

IN WITNESS WHEREOF, the said Contractor has hereunder affixed its signature and said Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers on the _____ day of _____, 20___.

_____
Principal

By: _____

_____
Title

_____
Surety

ATTEST: By: _____

_____ _____
Title

[END SECTION SEVEN-LABOR AND MATERIAL BOND]

CITY OF TUSCALOOSA
CONTRACTOR'S RELEASE OF LIENS AND CLAIMS

Project Name: Hilliard N. Fletcher WRRF Headworks Improvements
File Number: A19-1146 **Engineering Project Number: 2024.714.001**

THIS Contractor's Release of Liens and Claims is made in accordance with that certain contract between the CITY OF TUSCALOOSA, ALABAMA, a Municipal Corporation, (hereinafter the "City") and _____ (hereinafter the "Contractor" or undersigned), for a project known as _____ in regard to which the undersigned warrants and certifies to the City as follows:

1. That there are no amounts owed by the undersigned or any tier of subcontractor or supplier of the undersigned which could become the basis for a lien or suit against the properties of the Contractor or the property of the City or any funds held by or in the possession of the City in regard to the Project.

2. That the undersigned has satisfied all claims and indebtedness of every nature in any way connected with the work, including (but not limited to) all payrolls, amounts due to subcontractors, accounts for labor performed and materials furnished, incidental services, liens and judgments.

3. In consideration of the receipt by the undersigned from the City of final payment under the above mentioned contract, the undersigned hereby waives and relinquishes all liens and claims of lien which the undersigned may have against the aforesaid property or funds; and further, undersigned also hereby remises, releases and forever discharges the City, its officers, agents and employees, of any and all claims, demands and causes of action whatsoever which the undersigned has, might have or could have against the City by reason of or arising out of the above-mentioned contract. The undersigned further agrees to indemnify and hold the City, its officers, agents and employees harmless against any and all claims or demands from subcontractors or suppliers arising out of the aforementioned contract.

IN WITNESS WHEREOF, the undersigned has duly executed this release this the __ day of _____ _____, 20_____.

CONTRACTOR:

_____

BY: _____
TITLE: _____

I, _____, after being duly sworn, depose and say as follows: That I am the _____ of the _____

Corporation and hereby certify that I am duly authorized to execute this Contractor's Release of Liens and Claims.

STATE OF ALABAMA)
TUSCALOOSA COUNTY)
Sworn to and subscribed before me on this the _____ day of _____, 20_____.

_____
Notary Public

_____
CONSENT OF SURETY:

_____
SURETY

BY:_____
ATTORNEY-IN-FACT FOR SURETY

CITY OF TUSCALOOSA
ROOFING GUARANTEE

Project Name: Hilliard N. Fletcher WRRF Headworks Improvements
File Number: A19-1146 **Engineering Project Number: 2024.714.001**

Address of Project: _____

Owner City of Tuscaloosa

General Contractor _____

Address _____

Date of Acceptance _____ Date of Expiration _____

1. The General Contractor does hereby certify to the City of Tuscaloosa that the roofing work included in this contract was installed in strict accordance with all requirements of the plans and specifications.
2. The General Contractor does hereby guarantee the roofing and associated work including all flashing, both composition and metal, against leaks due to faulty workmanship for a period of five (5) years and against leaks due to faulty or defective materials for twenty (20) years, starting on the date of acceptance of the Project by the City.
3. Subject to the terms and conditions listed below, the General Contractor guarantees that during the Guarantee Period he will at their own cost and expense, make or cause to be made such repairs to, or replacements of said work, as are necessary to correct faulty and defective work and materials as are necessary to maintain said work in watertight conditions, and further, to respond on or within three (3) calendar days upon proper notification of leaks or defects by the City or Architect.

A. Specifically excluded from this Guarantee are damages to the work, other parts of the building and building contents caused by: Lightning, windstorm, hail storm and other unusual phenomena of elements; and, Fire. When the work has been damaged by any of the foregoing causes, the Guarantee shall be null and void until such damage has been repaired by the General Contractor, and until the cost and expense thereof has been paid by the City or by the responsible party so designated.

B. During the Guarantee Period, if the City allows alteration of the work by anyone other than the General Contractor, including cutting, patching and maintenance in connection with penetrations, and positioning of anything on the roof, this Guarantee shall become null and void upon the date of said alterations. If the City engages the General Contractor to perform said alterations, the Guarantee shall not become null and void, unless the General Contractor, prior to proceeding with said work, shall have notified the City in writing, showing reasonable cause for claim that said alterations would likely damage or deteriorate the work, thereby reasonably justifying a termination of this Guarantee.

C. Future building additions will not void this guarantee, except for that portion of the future addition that might affect the work under this contract at the point of connection of

the roof areas, and any damage caused by such addition. If this contract is for roofing of an addition to an existing building, then this guarantee covers the work involved at the point of connection with the existing roof.

D. During the Guarantee Period, if the original use of the roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray cooled surface, flooded basin, or other use of service more severe than originally specified, this Guarantee shall become null and void upon the date of said change.

E. The City shall promptly notify the General Contractor of observed, known or suspected leaks, defects or deterioration, and shall afford reasonable opportunity for the General Contractor to inspect the work, and to examine the evidence of such leaks, defects or deterioration.

IN WITNESS THEREOF, this instrument has been duly executed this the___ day of _____ _____, 20___.

_____

General Contractor's Authorized Signature

NAME _____

TITLE _____

CITY OF TUSCALOOSA
ASBESTOS AFFIDAVIT

Project Name: **Hilliard N. Fletcher WRRF Headworks Improvements**
File Number: **A19-1146** **Engineering Project Number:** **024.714.001**

DATE: _____

BUILDING OWNER: CITY OF TUSCALOOSA, ALABAMA

TO WHOM IT MAY CONCERN:

The undersigned certifies that to the best of their knowledge, no products containing asbestos have been included in the construction of the captioned Project. Special care was exercised to avoid asbestos-containing products, including reviewing product data sheets, reviewing product labels, and visually verifying products in the field. Special care to avoid asbestos has been used in the selection, purchase, and installation of products, including, but not limited to, the following: concrete, batt insulation, roof insulation, building felts, mastics, waterproofing products, adhesives, resilient flooring products, ceiling tiles, interior coatings, exterior coatings, roofing, pipe insulation, duct insulation, and pre-assembled items of equipment.

Respectfully submitted,

_____
Signature

_____ _____
Typed Name Title

_____
Firm Name

_____
Address

_____

Sworn to and subscribed before me on this the ____
day of _____, 20_____.

_____ _____
Notary Public County, State

My Commission Expires:
_____

CITY OF TUSCALOOSA
AGENT'S VERIFICATION OF CONTRACTOR'S INSURANCE

Project Name: Hilliard N. Fletcher WRRF Headworks Improvements
File Number: A19-1146 **Engineering Project Number: 2024.714.001**

This is to certify to the City of Tuscaloosa, Alabama, a Municipal Corporation, that the Contractor in the above referenced Project does possess a policy or policies of insurance reflected on the Certificate of Insurance issued for the Project by the undersigned agency of which I am an authorized representative. I have read the contract document as it relates to insurance requirements and said Contractor's insurance is effective as of the dates stated in the certificate and meets or exceeds all ratings, limits, and amounts as required by the same.

This the _____ day of _____, 20_____.

AGENCY: _____

_____

_____

BY: _____

ITS: _____

CITY OF TUSCALOOSA
NOTICE OF CONDITIONAL BID AWARD

Project Name: Hilliard N. Fletcher WRRF Headworks Improvements
File Number: A19-1146 **Engineering Project Number: 2024.714.001**

TO: _____:

You are here notified pursuant to Ala. Code §39-2-6 (1975), that the City of Tuscaloosa has made a conditional bid award to you in regard to the above-referenced Project based upon your proposal of $_____.

The above bid award ☐ Does ☐ Does Not include the following additive and/or deductive alternates as requested in the bid documents:

Additive Alternates	**Deductive Alternates**
1._____($_____)	1. _____ ($_____)
2._____($_____)	2. _____ ($_____)
3._____($_____)	3. _____ ($_____)

Pursuant to Ala. Code §39-2-8 (1975), you are required to enter into a written contract on the form included in the proposal, plans and specifications, furnish a performance bond and a payment bond executed by a surety company authorized and qualified to make such bonds in the State of Alabama, in the amount required in the bid documents, and present evidence of insurance also as required by the bid documents, within the period of time stated therein or, if no period of time is stated, within thirty (30) days after the prescribed forms have been presented to you for signature.

Pursuant to Ala. Code §39-2-11 (1975), if you fail to execute the contract and furnish acceptable contract securities and evidence of insurance as required by the bid documents within the period of time as set forth, the awarding authority may retain all or a part of the proposal guarantee and may award the contract to the second lowest responsible responsive bidder. Under such circumstances, the owner will be entitled to consider all rights arising out of its acceptance of your proposal as abandoned.

DONE this _____ day of _____, 20___.

CITY OF TUSCALOOSA, ALABAMA
A MUNICIPAL CORPORATION

By:_____

City's Representative

By:_____

City's Engineer/Architect

ACCEPTANCE OF NOTICE

I, on behalf of the above named contractor, do hereby accept receipt of the above notice of conditional bid award and acknowledge the contents of the same on this the _____ day of _____ 20_____.

CONTRACTOR:

_____

By its:_____

CITY OF TUSCALOOSA
NOTICE TO PROCEED

Project Name: Hilliard N. Fletcher WRRF Headworks Improvements
File Number: A19-1146 **Engineering Project Number: 2024.714.001**

TO: _____

_____

_____

Pursuant to Ala. Code §39-2-10 (1975), you are hereby notified to immediately commence work in full accordance with the terms and conditions of the Contract Documents in the above referenced Project, dated _____, 20___, on or before _____, 20___ and you are to complete the work within the time specified therein.

CITY OF TUSCALOOSA, ALABAMA
A MUNICIPAL CORPORATION
Post Office Box 2089
Tuscaloosa, Alabama 35403-2089

By: _____
City's Representative

By: _____
City's Engineer/Architect

ACCEPTANCE OF NOTICE

I, on behalf of the above named contractor, do hereby accept receipt of the above notice to proceed with the referenced Project and acknowledge the contents of the same on this the _ day of _____ 20____.

CONTRACTOR:

_____

By Its: _____

CITY OF TUSCALOOSA
CHANGE ORDER NO. _____

Project Name: Hilliard N. Fletcher WRRF Headworks Improvements
File Number: A19-1146 **Engineering Project Number: 2024.714.001**

TO: _____
(Contractor)

TERMS: You are hereby authorized, subject to the provisions of your Contract for this Project, to make the following changes thereto in accordance with the attached Change Order Request and supporting documents and to:

FURNISH the necessary labor, materials and equipment to:

_____
_____
_____
_____

TOTAL ADDITION OR REDUCTION TO CONTRACT PRICE:

(Note: Numbers in parentheses are deductions).

ORIGINAL CONTRACT PRICE	$_____
LESS CONTINGENCY/ALLOWANCE	$_____
NET ORIGINAL CONTRACT PRICE	$_____
Net total of previous Change Orders	$_____
Previous revised Contract Price	$_____
This Change Order No. _____ ☐Add ☐Deduct	$_____
Revised Contract Price this date	$_____

Extension of time resulting from this Change Order _____ (Indicate number of calendar days).

The amount of this Change Order will be the responsibility of _____

This Contract Modification constitutes full and mutual accord and satisfaction for all time and all cost related to this change. By acceptance of this Contract Modification, the Contractor hereby agrees that the modification represents an equitable adjustment to the Contract, and further, agrees to waive all right to file any further claims or changes arising out of or as a result of this change, or the accumulation of executed Contract Modifications on this Contract.

The Contractor and Owner(s) hereby agree to the terms of this Change Order as contained herein.

CONSENT OF SURETY

_____
(Company)

By: _____

CONTRACTING PARTIES

_____
(Contractor)

By: _____
(Authorized Representative)

RECOMMENDED

By: _____

_____
(Design Engineer or Architect)

CITY OF TUSCALOOSA

By: _____
(Mayor)

CITY OF TUSCALOOSA
CHANGE ORDER REQUEST

Project Name: Hilliard N. Fletcher WRRF Headworks Improvements
File Number: A19-1146 **Engineering Project Number:** 2024.714.001

OWNER: CITY OF TUSCALOOSA

ARCHITECT/ENGINEER: Garver, LLC

CONTRACTOR: _____

CHANGE ORDER REQUEST NO. _____ **DATE:** _____

---

1. DESCRIPTION OF CHANGE:

2. CHANGE ORDER COSTS: _____

Proposal Attached _____ **Cost Estimated/Proposal Required**

Item	*Quantity*	*Material Unit Price*	*Labor (Hours)*	*Labor Unit Price*	*Sub-Total Cost*
a.					
b.					
c.					
d.					
e.					
f.*					
			TOTAL:		

*****If more than 6 items, provide attachments.

3. INSTITUTED BY:

4. JUSTIFICATION OF NEED:

5. JUSTIFICATION OF CHANGE ORDER VERSUS COMPETITIVE BIDDING:

6. COSTS REVIEW:

7. THIS CHANGE ORDER IS SUBMITTED FOR REVIEW AND APPROVAL AND IS CLASSIFIED AS THE FOLLOWING TYPE:

- ☐ Minor change of a total monetary value less than required for competitive bidding.
- ☐ Changes for matters relatively minor and incidental to the original contract necessitated by unforeseeable circumstances arising during the course of work.
- ☐ Emergencies arising during the course of work.
- ☐ Change or alternates provided for in the original bidding where there is no difference in price of the Change Order from the original best bid on the Alternate.
- ☐ Change of relatively minor terms not contemplated when the plans and specifications were prepared and the Project was bid and which are in the public interest and do not exceed 10% of the Contract Price.

8. EXTENSION OF TIME REQUESTED: Calendar Days:

RECOMMENDED:

BY:_____
Tuscaloosa's Consulting Engineer/Architect

BY:_____
City Representative

APPROVED:

BY:_____
Contractor

BY:_____
Owner's Legal Advisor

BY:_____
Owner's Authorized Representative

STATE OF ALABAMA)
COUNTY OF TUSCALOOSA)

LEGAL NOTICE
NOTICE OF COMPLETION OF PUBLIC WORKS PROJECT
(Over $100,000)

Date of this Notice: _____

Pursuant to Code of Alabama §39-1-1(f), this Notice of Completion is hereby given by the following Contractor: _____.

Said Contractor completed its contract with the City of Tuscaloosa, Alabama, for the following Project: _____located at this address: _____.

This Notice shall be published for a period of three (3) successive weeks in the following manner:

_____ In a newspaper of general circulation in Tuscaloosa County; or
_____ On a website maintained by a newspaper of general circulation in Tuscaloosa County; or
_____ On the City of Tuscaloosa website utilized by the City for publishing notices.

A final settlement will not be made upon the contract until the expiration of thirty (30) days after completion of this notice. Proof of publication of this Notice shall be made to the City of Tuscaloosa by affidavit of the publisher or website owner and a printed copy of this Notice as published. Any person or firm having claims on said Project for materials or labor should contact the Contractor in the time and manner as required by law at:

_____

_____

(Address of Contractor)

CITY OF TUSCALOOSA
OFFICE OF THE CITY ATTORNEY
P. O. BOX 2089
TUSCALOOSA, ALABAMA 35403

CITY OF TUSCALOOSA
SPECIAL CONDITIONS FOR FEDERALLY FUNDED CONTRACTS

I. DEFINITIONS

"Construction Contract" means a contract for construction, rehabilitation, alteration, and/or repair, including painting and decorating.

Contractor" means an entity that has entered into an agreement with the local government for the performance of specific work on a project or activity, the provision of professional services, or for the supply of equipment and/or materials.

"_____" means _____ (Federal Agency).

"Local Government" means the City of Tuscaloosa.

"Program" means the _____ _____ (Federal Program) operated under the provisions of _____ _____

"Projects/Activities" means those undertakings that are included in the Program and are funded wholly or in part by _____ _____

"Project Area" means the corporate limits of the City of Tuscaloosa.

"Subcontractor" means a person, firm or corporation supplying services or labor and materials or only labor or only materials for work at the site of the project, for and under contract or agreement with the Contractor.

II. CONFLICT OF INTEREST

A. Interest of Members of the Local Government. No officer, employee or agent of the local government who exercises any function or responsibilities in connection with the planning and carrying out of the program, or any other person who exercises any functions or responsibilities in connection with the program, shall have any personal financial interest, direct or indirect, in this contract, and the Contractor shall take appropriate steps to assure compliance.

B. The Contractor agrees that it will incorporate into every subcontract required in writing the following provision: Interest of Contractor and Employees. The Contractor agrees that no person who presently exercises any functions or responsibilities in connection with the program, has any personal financial interest, direct or indirect, in this contract. The Contractor further covenants that he presently has no interest and shall not acquire any interest, direct or indirect, which would conflict in any manner or degree with the performance of his services hereunder.

The Contractor further covenants that in the performance of this contract no person having any conflicting interest shall be employed. Any interest on the part of the Contractor or

their employees must be disclosed to the City. Provided, however, that this paragraph shall be interpreted in such a manner so as not to unreasonably impede the statutory requirement that maximum opportunity be provided for employment of and participation by low income residents of the area.

C. Provisions of the Hatch Act. Neither the funds provided by this agreement nor the personnel employed in the administration of the agreed upon work shall be in any way or to any extent engaged in the conduct of political activities in contravention of Chapter 15 of Title 5, U. S. Code.

III. EQUAL OPPORTUNITY REQUIREMENTS: During the performance of this contract, the Contractor agrees as follows:

A. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, age, or disability. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, national origin, age, or disability. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment, or recruitment advertising; layoff or termination; rates of pay or other forms of compensations; and selection of training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this non-discrimination clause.

B. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, age, or disability.

C. The Contractor will send to each labor union or representative of workers with which he has collective bargaining agreement or other contract or understanding, a notice advising the said labor union or workers' representatives of the Contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

D. The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

E. The Contractor will furnish to the local government all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to their books, records, and accounts by the local government, HUD, other federal agencies and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules regulations, and orders.

F. In the event of the Contractor's non-compliance with the nondiscrimination clauses of this agreement or with any of the said rules, regulations, or orders, this agreement may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further local government contracts in accordance with procedures authorized in Executive Order 11246 of September 24 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the City, Secretary of Labor, or as otherwise provided by law.

G. The Contractor will include the provisions of paragraph 1 through 6 above in every subcontract or purchase order unless exempted by rules, regulations, or orders of the local government or the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246

of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as may be directed as a means of enforcing such provisions, including sanctions for noncompliance: Provided however, that in the event a Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the City, the Contractor may request the local government to enter into such litigation to protect the interests of the local government.

H. The Contractor agrees that it will assist and cooperate actively with the local government and the Secretary of Labor in obtaining the compliance of subcontractors with the equal opportunity clause and the rules, regulations, and relevant orders of the Secretary of Labor, that it will furnish the local government and the Secretary of Labor such information as they may require for the supervision of such compliance, and that it will otherwise assist the local government in the discharge of its primary responsibility for securing compliance.

I. The Contractor further agrees that it will refrain from entering into any contract or contract modification subject to Executive Order 11246 of September 24, 1965, with a Contractor debarred from, or who has not demonstrated eligibility for, Government contracts and federally assisted construction contracts pursuant to the Executive Order. In addition, the agency agrees that if it fails or refuses to comply with these undertakings, the local government may take any or all of the following actions: terminate or suspend in whole or in part this contract; refrain from extending any further assistance to the Contractor under the program with respect to which the failure or refusal occurred until satisfactory assurance of future compliance has been received from such Contractor.

J. Non-segregated Facilities. The Contractor certifies that he does not maintain or provide for their employees any segregated facilities at any of their establishments and that he does not permit their employees to perform their services at any location, under their control, where segregated facilities are maintained. The Contractor covenants that he will not maintain or provide for their employees any segregated facilities at any of their establishments, and that he will not permit their employees to perform their services at any location, under their control, where segregated facilities are maintained. As used in this paragraph, the term “segregated facilities” means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise.

K. No person in the United States shall, on the ground of race, color, religion, sex, or national origin, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity made possible by or resulting from this contract. The agency and each employer will comply with all requirements imposed by or pursuant to Title VI of the Civil Rights Act of 1964.

L. The Contractor shall maintain data which records its affirmation action in equal opportunity employment, including but not limited to employment, upgrading, demotions, transfers, recruitment or recruitment advertising, layoffs or terminations, pay or other compensation, and selection for training.

IV. LABOR STANDARDS PROVISIONS - CONSTRUCTION CONTRACTS ONLY

A. Contract Work Hours and Safety Standards Act (40 U.S.C. 327 through 333)

1. Where applicable, all contracts that involve the employment of mechanics or laborers must comply with 40 U.S.C. 3702 and 3704 of the Contract Work Hours and Safety Standards Act, as supplemented by Department of Labor regulations, 29 CFR Part 5, et.al.
2. Overtime Requirements. Under Section 3702 of the Act, each Contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall be required to compute the wages of every mechanic or laborer on the bases of a standard work week of forty (40) hours. Work in excess of forty hours in any work-week unless such laborer or mechanic receives compensation at a rate not less than one and one-half times their basic rate of pay for all hours worked in excess of forty hours in any work-week.
3. The requirements of 40 U.S.C. 3704 are applicable to construction work and provides that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous.
4. Violations; Liability for Unpaid Wages; Liquidated Damages. In the event of any violation of the clause set forth in subparagraph 1, the Contractor and any subcontractor responsible therefore shall be liable to any affected employee for their unpaid wages. In addition, such Contractor and subcontractor shall be liable to the City for liquidated damages.
5. Withholding for Unpaid Wages and Liquidated Damages. The local government may withhold or cause to be withheld, from any monies payable on account of work performed by the Contractor or subcontractor, such sums as may administratively be determined to be necessary to satisfy any liabilities of such Contractor or subcontractor for unpaid wages and liquidated damages.

B. Employment of Certain Persons Prohibited. No person under the age of sixteen years and no person who at the time, is serving sentence in a penal or correctional institution shall be employed on the work covered by this contract.

C. Complaints, Proceedings, or Testimony by Employees. No laborer or mechanic to whom the labor standards provisions of this contract are applicable shall be discharged or in any other manner discriminated against by the Contractor or any subcontractor because such employee has filed any complaint or instituted or caused to be instituted any proceedings or has testified or is about to testify in any proceedings under or relating to the labor standards applicable under this contract.

D. Questions Concerning Certain Federal Statutes and Regulations. All questions arising under this contract which relate to the application or interpretation of the aforesaid Contract Work Hours and Safety Standards Act, the regulations issued by the Secretary of Labor, United States Department of Labor, pursuant to said Act, or the labor standards provisions of any other pertinent Federal statute, shall be referred, through the City of Tuscaloosa and the Secretary of Housing and Urban Development, to the Secretary of Labor, United States Department of Labor, for said Secretary's appropriate ruling or interpretation which shall be authoritative and may be relied upon for the purpose of this contract.

V. ENVIRONMENTAL PROTECTION REQUIREMENTS

A. The Contractor hereby agrees that any facility to be utilized in the performance of any nonexempt contract or subcontract shall not be a facility included on the list of Violating Facilities issued by the Environmental Protection Agency (EPA) pursuant to 40 CFR 15.20.

B. The Contractor also agrees to comply with all the requirements of Section 114 of the Clean Air Act, as amended, (42 USC 1857c-8) and Section 308 of the Federal Water Pollution Control Act, as amended, (33 USC 1318) relating to inspection, monitoring, entry, reports and information, as well as all other requirements specified in said Section 114 and Section 308, and all regulations and guidelines issued thereunder.

C. As a condition of the award of the contract, the Contractor agrees to give prompt notice to the City of any notification received from the Director, Office of Federal Activities, EPA, indicating that a facility utilized or to be utilized for the contract is under consideration to be listed on the EPA List of Violating Facilities.

D. The Contractor agrees that it will include or cause to be included the criteria and requirements in subparagraph A through D of this section in every nonexempt subcontract and that it will take such action as the City or the EPS may direct as a means of enforcing such provisions.

VI. FINANCIAL MANAGEMENT: The Contractor shall maintain effective control over and accountability for all funds, property, and other assets that are provided for by this agreement. The Contractor shall adequately safeguard all such assets and shall assure that they are used solely for authorized purposes.

A. Ineligible Costs. In addition to any costs that are ineligible under other criteria included herein the following costs are specifically ineligible:

1. Bad Debts. Any loses arising from uncollected accounts and other claims, and related costs.
2. Contingencies. Contributions to a contingency reserve or any similar provisions for unforeseen events.
3. Contributions and Donations.
4. Entertainment. Costs of amusements, social activities, and incidental costs, such as meals, beverages, lodgings, and gratuities, relating to entertainment.
5. Fines and Penalties. Costs resulting from violations of or failure to comply with Federal, State, and local laws and regulations.
6. Interest and Other Financial Costs. Interest on borrowing (however represented), bond discounts, cost of financing and refinancing operations, and legal and professional fees paid in connection herewith.
7. Legislative Expenses. Salaries and other expenses of local government bodies such as county supervisors, city councils, school boards, etc., whether incurred for purposes of legislation or executive direction.
8. Membership Expenses. Cost of membership in an organization which devotes a substantial part of its activities to influencing legislation.
9. Travel. Costs in excess of those allowed by the Contractor for its equivalent employees. In any case, the difference in cost between first-class air accommodations and less-than-first-class air accommodations are not

available and is so documented.

10. Meeting Attendance. Costs of attending meetings which are not open for attendance on a non-segregated basis.

B. Property Management Standards. The Contractor's property management standards for non-expendable personal property acquired under this contract shall include the following procedural requirements:

1. Property records shall be maintained accurately and provide for: a description of the property; manufacturer's serial number or other identification number; acquisition data, cost, and source of property; percentage of Federal funds used in the purchase of property; location, use and condition of the property; and ultimate disposition data including sales price or the method used to determine current fair market value.
2. A physical inventory of property shall be taken and the results reconciled with the property records at least once each year to verify the existence, current utilization, and continued need for the property.
3. A control system shall be in effect to ensure adequate safeguards to prevent loss, damage, or theft to the property. Any loss, damage, or theft of non-expendable property shall be investigated and fully documented.
4. Adequate maintenance procedures shall be implemented to keep the property in good condition.

C. Procurement Standards

1. The Contractor shall maintain a code or standard of conduct which shall govern the performance of its officers, employees, or agents in contracting with and expending grant funds. Local government officers, employees, or agents shall neither solicit nor accept gratuities, favors, or anything of monetary value from Contractors or potential Contractors.
2. All procurement transactions regardless of whether negotiated or advertised and without regard to dollar value shall be conducted in a manner so as to provide maximum open and free competition.

VII. CERTIFICATION REGARDING LOBBYING

A. The Contractor agrees and certifies, to the best of their knowledge and belief, that pursuant to 31 CFR Part 21 (Restrictions on Lobbying):
   1. No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with the award of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
   2. If any funds other than the Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, any member of Congress, an officer or employee of a ember of Congress, or an employee of a member of Congress in connection with this contract or related

Federal contract, grant, loan, or cooperative agreement, the undersigned Contractor shall complete and submit Standard Form-LLL "Disclosure Form to Report Lobbying," in accordance with its instructions.

3. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequestie for making orentering into this transaction imposed by Section 1352, Title 31 U.S.C. et al. Any person who fails to file the required certification shall be subject to any civil or criminal penalties available under the laws of the United States of America.

VIII. GENERAL REQUIREMENTS

A. Retention of Records. All records maintained by the Contractor that pertain to this agreement shall be retained by the Contractor for a period of three years or such longer period as the local government, HUD, or other federal agencies may require in specific cases.

B. Reports and Information. The Contractor, at such times as the local government may require, shall furnish such statements, reports, records, data and information, as may be requested pertaining to matters covered by this agreement.

C. Audit Requirements. The local government, the Comptroller General of the United States, and/or _____ (Federal Agency), or any of the duly authorized representatives shall have access to all tasks, accounts, records, reports, files and other papers or property of the Contractor pertaining to funds provided under this agreement for the purpose of making surveys, audits, examinations, excerpts, and transcripts. The Contractor's financial management system shall be audited at least once a year. Audits may be made at less frequency considering the nature, size and complexity of the activity. The Contractor shall implement a systematic method to assure timely and appropriate resolution of audit findings and recommendations.

D. Breach of Contract Terms and Conditions. In the event of the Contractor's noncompliance with the terms and conditions of this contract or with any of the said rules, regulations or orders, this contract may be canceled, terminated or suspended in whole or in part. Provided, that the right of the Contractor to proceed with this contract shall not be terminated or the Contractor charged with liquidated damages because of delays in the completion of the work due to unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted, to acts of God, or of the public enemy, acts of the Government, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather or delays of subcontractors due to such causes, if the Contractor shall within ten days from the beginning of any such delay notify the City in writing of the cause of the delay. The City shall ascertain the facts and the extent of the delay and extend the time for completing the work when, in the City's judgment, the findings of fact justify such an extension, and the City's findings of fact thereon shall be final and conclusive on the parties hereto, subject only to appeal, within thirty days, by the Contractor to the City whose decision on such appeal as to the facts of delay and the extension of time for completing the work shall be final and conclusive on the parties hereto.

E. Safety Standards. No Contractor or subcontractor contracting for any part of a construction contract shall require any laborer or mechanic employed in the performance of the contract to work in surroundings or under working conditions which are unsanitary, hazardous,

or dangerous to their health or safety, as determined under construction safety and health standards promulgated by the Secretary of Labor.

F. Lead-based Paint Regulations. The construction or rehabilitation of residential structures with assistance provided under this contract is subject to the HUD Lead-based Paint regulations, 24 CFR part 35. Should this contract include activities involving the construction or rehabilitation of residential structures, the Contractor hereby agrees to comply with the regulations of 24 CFR part 35.

G. Subcontracts. The Contractor shall insert in any subcontracts all of the terms and conditions set forth in this contract and also a clause requiring the subcontractors to include these terms and conditions in any lower tier subcontracts which they may enter into, together with a clause requiring this insertion in any further subcontracts that may in turn be made.

H. Davis-Bacon. As applicable, Contractors shall comply with the Davis-Bacon Act (40 U.S.C. 276a to 276a-7) as supplemented by Department of Labor regulations (29 CFR Part 5), the provisions of which are incorporated by reference into this contract as if contained herein.

I. Debarment of contactors/subcontractors / City's right to monitor. All contracting and subcontracting agencies shall be actively registered in the sam.gov system and have a non-debarred status to perform work. The City of Tuscaloosa shall have all rights to any and all documentation related to the project. Periodic monitoring visits will be performed by City of Tuscaloosa staff to ensure all federal and contract requirements are followed.

J. Green Building Standard for Replacement and New Construction of Residential Housing. Contractors must meet the Green Building Standard in this subparagraph for: (i) all new construction of residential buildings; and (ii) all replacement of substantially-damaged residential buildings. Replacement of residential buildings may include reconstruction (i.e., demolishing and re-building a housing unit on the same lot in substantially the same manner) and may include chances to structural elements such as flooring systems, columns or load bearing interior or exterior walls. For purposes of this Notice, the Green Building Standard means the contractor will require that all construction covered by subparagraph, above, meet an industry-recognized standard that has achieved certification under at least one of the following programs (i) ENERGY STAR (Certified Homes or Multifamily High Rise); (ii) Enterprise Green Communities; (iii) LEED (NC, Homes, Midrise, Existing Buildings O&M, or Neighborhood Development); (iv) ICC-700 National Green Building Standard; (v) EPA Indoor AirPlus (ENERGY STAR a prerequisite); or (vi) any other equivalent comprehensive green building program, including regional programs. Standards for rehabilitation of non-substantially-damaged residential buildings: For rehabilitation other than that described in subparagraph, above, contractors must follow the guidelines specified in the HUD CPD Green Building Retrofit Checklist, available on the CPD Disaster Recovery Web site. Contractors must apply these guidelines to the extent applicable to the rehabilitation work undertaken, including the use of mold resistant products when replacing surfaces such as drywall. When older or obsolete products are replaced as part of the rehabilitation work, rehabilitation is required to use ENERGY STAR- labeled, WaterSense labeled, or federal Energy Management Program (FEMP)- designated products and appliances. Implementation: For construction projects completed under construction, or under contract prior to the date that federal assistance was approved for the project the contractor is encouraged to apply the applicable standards to the extent feasible but the Green Building Standard is not required; (ii) for specific which an ENERGY STAR-or-WaterSense-labeled or FEMP-designated product does not exist, the requirement to use such products does not apply. The City encourages contractors to implement green infrastructure policies to the extent practicable.

K. Buy USA- Domestic Preference for certain procurements using federal funds

1. Contractor should, to the greatest extent practicable, provide for the purchase, acquisition, or use of goods, products or materials produced in the United States (including, but not limited to: iron; aluminum; steel; cement; or other manufactured products. The requirements of this section must be included in all subawards including all contracts and purchase orders for work products under this award. For purposes of this section:

a. "Produced in the United States" means for iron and steel products that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States,

b. "Manufactured Products" means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.

VIII. ADECA-FUNDED CONTRACTS: The Contractor shall include the following provisions in all construction contracts funded by the Alabama Department of Economic and Community Affairs (ADECA). For all ADECA-funded construction contracts, in the event the provisions contained in this section conflict with provisions contained elsewhere in this document, the provisions contained in this section shall prevail.

A. Section 109 Clause, Housing and Community Development Act of 1974. No person in the United States shall on the grounds of race, color, national origin or sex be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity funded in whole or in part with funds made available under this title.

B. Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246) (applicable to contract/subcontracts exceeding $10,000). Contractor's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for Minority Participation (Insert Goals)	Goals for Female Participation (Insert Goals)

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or Federally assisted) performed in the covered area. If the Contractor performs construction work in a geographic area located outside of the covered area, it shall apply the goals established for such geographic area where the work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both its Federally involved and non-Federally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals established for the geographical area where the contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the Contractor shall make a good faith effort to employ minorities and women evenly on each of its

projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the Contract, the Executive Order and the regulations in 41 CFR 60-4. Compliance with the goals will be measured against the total work hours performed.

C. "Section 3" Compliance in the Provision of Training, Employment and Business Opportunities.

1. The work to be performed under this Contract is a project assisted under a program providing direct Federal financial assistance from the Department of Housing and Urban Development and is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended, 12, U.S.C. 1701u. Section 3 requires that to the greatest extent feasible, opportunities for training and employment be given lower income residents of the project area and contracts for work in connection with the project be awarded to business concerns which are located in, or owned in substantial part by, persons residing in the area of the project.
2. The parties to this Contract will comply with the provisions of said Section 3 and the regulations issued pursuant thereto by the Secretary of Housing and Urban Development set forth in 24 CFR 135, and all applicable rules and orders of the Department issued thereunder prior to the execution of this Contract. The parties to this Contract certify and agree that they are under no contractual or other disability which would prevent them from complying with these requirements.
3. The Contractor will send to each labor organization or representative of workers with which he has a collective bargaining agreement or other contract or understanding, if any, a notice advising the said labor organization or workers' representative of this commitment under this Section 3 clause and shall post copies of the notice in conspicuous places available to employees and applicants for employment or training.
4. The Contractor will include this Section 3 clause in every subcontract for work in connection with the project and will, at the direction of the applicant for or recipient of Federal financial assistance, take appropriate action pursuant to the subcontract upon a finding that the Subcontractor is in violation of regulations issued by the Secretary of Housing and Urban Development, 24 CFR Part 135. The Contractor will not subcontract with any Subcontractor where it has notice or knowledge that the latter has been found in violation of regulations under 24 CFR Part 135 and will not let any subcontract unless the Subcontractor has first provided it with a preliminary statement of ability to comply with the requirements of these regulations.
5. Compliance with the provisions of Section 3, the regulations set forth in 24 CFR Part 135, and all applicable rules and orders of the Department issued hereunder prior to the execution of the Contract, shall be a condition of the Federal financial assistance provided to the project, binding upon the applicant or recipient for such assistance, its successors and assigns. Failure to fulfill these requirements shall subject the applicant or recipient, its contractors and subcontractors, its successors and assigns to those

sanctions specified by the grant or loan agreement or contract through which Federal assistance is provided, and to such sanctions as are specified in 24 CFR Part 135.

D. Section 402 Veterans of the Vietnam Era (if $10,000 or over). Affirmative Action for Disabled Veterans and Veterans of the Vietnam Era.

1. The Contractor will not discriminate against any employee or applicant for employment because he or she is a disabled veteran or veteran of the Vietnam era in regard to any position for which the employee or applicant for employment is qualified. The Contractor agrees to take affirmative action to employ, advance in employment and otherwise treat qualified disabled veterans and veterans of the Vietnam era without discrimination based on their disability or veteran status in all employment practices such as the following: employment upgrading, demotion or transfer, recruitment, advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.

2. The Contractor agrees that all suitable employment openings of the Contractor which exist at the time of the execution of this Contract and those which occur during the performance of this Contract, including those not generated by this Contract and including those occurring at an establishment of the Contractor other than the one wherein the Contract is being performed but excluding those of independently operated corporate affiliates, shall be listed at an appropriate local office of the State employment service system wherein the opening occurs. The Contractor further agrees to provide such reports to such local office regarding employment openings and hires as may be required. State and local government agencies holding Federal contracts of $10,000 or more shall also list all their suitable openings with the appropriate office of the State employment service, but are not required to provide those reports set forth in paragraphs 4 and 5.

3. Listing of employment openings with the employment service system pursuant to this clause shall be made at least concurrently with the use of any other recruitment source or effort and shall involve the normal obligations which attach to the placing of a bona fide job order, including the acceptance of referrals of veterans and non-veterans. The listing of employment openings does not require the hiring of any particular job applicant or from any particular group of job applicants, and nothing herein is intended to relieve the Contractor from any requirements in Executive Orders or regulations regarding nondiscrimination in employment.

4. The reports required by paragraph 2 of this clause shall include, but not be limited to, periodic reports which shall be filed at least quarterly with the appropriate local office or, where the Contractor has more than one hiring location in a State, with the central office of that State employment service. Such reports shall indicate for each hiring location (1) the number of individuals hired during the reporting period, (2) the number of nondisabled veterans of the Vietnam era hired, (3) the number of disabled

veterans of the Vietnam era hired, and (4) the total number of disabled veterans hired. The reports should include covered veterans hired for on-the-job training under 38 U.S.C.1787. The Contractor shall submit a report within 30 days after the end of each reporting period wherein any performance is made on this Contract identifying data for each hiring location copies of the reports submitted until the expiration of one year after final payment under the Contract, during which time these reports and related documentation shall be made available, upon request, for examination by any authorized representatives of the contracting officer or of the Secretary of Labor. Documentation would include personnel records respecting job openings, recruitment and placement.

5. Whenever the Contractor becomes contractually bound to the listing provisions of this clause, it shall advise the employment service system in each State where it has establishments of the name and location of each hiring location in the State. As long as the Contractor is contractually bound to these provisions and has so advised the State system, there is no need to advise the State system of subsequent contracts. The Contractor may advise the State system when it is no longer bound by the contract clause.
6. This clause does not apply to the listing of employment openings which occur and are filled outside of the 50 states, the District of Columbia, Puerto Rico, Guam and the Virgin Islands.
7. The provisions of paragraphs 2, 3, 4 and 5 of this clause do not apply to openings which the Contractor proposes to fill from within their own organization or to fill pursuant to a customary and traditional employer-union hiring arrangement. This exclusion does not apply to a particular opening once an employer decides to consider applicants outside of their own organization or employer-union arrangement for that opening.
8. As used in this clause:
    a. “All suitable employment openings” includes, but is not limited to, openings which occur in the following .job categories: production and nonproduction; plant and office; laborers and mechanics; supervisory and nonsupervisory; technical; and executive, administrative, and professional openings that are compensated on a salary basis of less than $25,000 per year. This term includes full-time employment, temporary employment of more than three days’ duration, and part—time employment. It does not include openings which the Contractor proposes to fill from within their own organization or to fill pursuant to a customary and traditional employer—union hiring arrangement nor openings in an educational institution which are restricted to students of that institution. Under the most compelling circumstances an employment opening may not be suitable for listing, including such situations where the needs of the Government cannot reasonably be otherwise supplied, where listing would be contrary to national security, or where the requirement of listing would otherwise not

be for the best interest of the Government.

b. "Appropriate office of the State employment service system" means the local office of the Federal-State national system of public employment offices with assigned responsibility for serving the area where the employment opening is to be filled, including the District of Columbia, Guam, Puerto Rico and the Virgin Islands.

c. "Openings which the Contractor proposes to fill from within their own organization" means employment openings for which no consideration will be given to persons outside the Contractor's organization (including any affiliates, subsidiaries, and the parent companies) and includes any openings which the Contractor proposed to fill from regularly established "recall" lists.

d. "Openings which the Contractor proposes to fill pursuant to customary and traditional employer-union hiring arrangements" means employment openings which the Contractor proposes to fill from union halls, which is part of the customary and traditional hiring relationship which exists between the Contractor and representatives of their employees.

9. The Contractor agrees to comply with the rules, regulations and relevant orders of the Secretary of Labor issued pursuant to the Act.

10. In the event of the Contractor's non-compliance with the requirements of this clause, actions for non-compliance may be taken in accordance with the rules, regulations and relevant orders of the Secretary of Labor issued pursuant to the Act.

11. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices in a form to be prescribed by the Director, provided by or through the contracting officer. Such notice shall state the Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified disabled veterans and veterans of the Vietnam era for employment, and the rights of applicants and employees.

12. The Contractor will notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of the Vietnam Era Veterans Readjustment Assistance Act, and is committed to take affirmative action to employ and advance in employment qualified disabled veterans and veterans of the Vietnam era.

13. The Contractor will include the provisions of this clause in every subcontract or purchase order of $10,000 or more unless exempted by rules, regulations or orders of the Secretary issued pursuant to the Act, so that such provisions will be binding upon each Subcontractor or vendor. The Contractor will take such action with respect to any subcontractor or purchase order as the Director of the Office of Federal Contract Compliance Programs may direct to enforce such provisions, including action for non-compliance.

E. <u>Certification of Compliance with Air and Water Acts (applicable to Federally</u>

assisted construction contracts and related subcontracts exceeding $100,000). Compliance with Air and Water Acts. During the performance of this Contract, the Contractor and all Subcontractors shall comply with the requirements of the Clean Air Act, as amended, 42 USC 1857 et seg., the Federal Water Pollution Contract Act, as amended, 33 USC 1251 et seq., and the regulations of the Environmental Protection Agency with respect thereto, at 40 CFR Part 15, as amended. In addition to the foregoing requirements, all nonexempt Contractors and Subcontractors shall furnish to the Owner, the following:

1. A stipulation by the Contractor or Subcontractors that any facility to be utilized in the performance of any nonexempt contract or subcontract is not listed on the List of Violating Facilities issued by the Environmental Protection Agency (EPA) pursuant to 40 CFR 15.20.
2. Agreement by the Contractor to comply with all the requirements of Section 114 of the Clean Air Act, as amended, (42 USC 1857c-8) and Section 308 of the Federal Water Pollution Control Act, as amended, (33 USC 1318) relating to inspection, monitoring, entry, reports and information, as well as all other requirements specified in said Section 114 and Section 308, and all regulations and guidelines issued thereunder.
3. A stipulation that as a condition for the Contract, prompt notice will be given of any notification received from the Director, Office of Federal Activities, or EPA indicating that a facility utilized, or to be utilized for the Contract, is under consideration to be listed on the EPA List of Violating Facilities.
4. Agreement by the Contractor that he will include, or cause to be included, the criteria and requirements in paragraphs A through D of this section in every nonexempt subcontract and requiring that the Contractor will take such actions as the Government may direct as a means of enforcing such provisions.

F. Compliance with Copeland Act Requirements. The contractor shall comply with the requirements of 29 CFR Part 3 which are incorporated by reference in this contract.

G. Drug-Free Workplace Requirements. The Drug-Free Workplace Act of 1988 (42 U.S.C. 701) requires grantees (including individuals) of federal agencies, as a prior condition of being awarded a grant, to certify that they will provide drug-free workplaces. Each potential recipient must certify that it will comply with drug-free workplace requirements in accordance with the Act and with the federal agency in question or HUD's rules at 24 CFR part 24, subpart F.

H. Byrd Anti-Lobbying Amendment (31 U.S.C. 1352). Contractors who apply or bid for an award of $100,000 or more shall file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient.

IV. DISASTER RECOVERY FUNDED CONTRACTS: The Contractor shall include the following provisions in all Disaster Recover (DR) funded construction contracts. For all DR-funded construction contracts, in the event the provisions contained in this section conflict with

provisions contained elsewhere in this document, the provisions contained in this section shall prevail.

A. The Contractor agrees to abide by all applicable Federal regulations in receiving, disbursing and accounting for Community Development Block Grant funds including, but not limited to all applicable sections of 24 CFR 570.

B. ADA Compliance. The Contractor hereby covenants and agrees that, in performing its responsibilities and obligations hereunder, the Contractor, its officers, agents or employees will not, on the grounds of race, color, sex, religion, national origin, disability or age, discriminate or permit discrimination against any person or groups of persons in any manner. The Contractor further agrees to comply with all applicable State and Federal ordinances and regulations, including but not limited to, the Rehabilitation Act of 1973, the Americans with Disabilities Act (ADA), the Civil Rights Act of 1964 and any regulations promulgated there under.

C. Section 3 Compliance. The work to be performed under this contract is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 1701u (Section 3). The purpose of section 3 is to ensure that employment and other economic opportunities generated by HUD assistance or HUD-assisted projects covered by section 3, shall, to the greatest extent feasible, be directed to low- and very low-income persons, particularly persons who are recipients of HUD assistance for housing. The parties to this contract agree to comply with HUD's regulations in 24 CFR Part 135, which implement section 3. As evidenced by their execution of this contract, the parties to this contract certify that they are under no contractual or other impediment that would prevent them from complying with the part 135 regulations. Contractor agrees to send to each labor organization or representative of workers with which the Contractor has a collective bargaining agreement or other understanding, if any, a notice advising the labor organization or workers' representative of the Contractor's commitments under this section 3 clause, and will post copies of the notice in conspicuous places at the work site where both employees and applicants for training and employment positions can see the notice. The notice shall describe the section 3 preference, shall set forth minimum number and job titles subject to hire, availability of apprenticeship and training positions, the qualifications for each; and the name and location of the person(s) taking applications for each of the positions; and the anticipated date the work shall begin. Contractor agrees to include this section 3 clause in every subcontract subject to compliance with regulations in 24 CFR Part 135, and agrees to take appropriate action, as provided in an applicable provision of the subcontract or in this section 3 clause, upon a finding that the subcontractor is in violation of the regulations in 24 CFR Part 135. Contractor will not subcontract with any subcontractor where the Contractor has notice or knowledge that the subcontractor has been found in violation of the regulations in 24 CFR Part 135. Contractor will certify that any vacant employment positions, including training positions, that are filled (1) after Contractor is selected by before the contract is executed, and (2) with persons other than those to whom the regulations of 24 CFR part 135 require employment opportunities to be directed, were not filled to circumvent the Contractor’s obligations under 24 CFR part 135. Noncompliance with HUD's regulations in 24 CFR Part 135 may result in sanctions, termination of this contract for default, and debarment or suspension from future HUD assisted contracts.

D. Section 109 Compliance. No person in the United States will, on the ground of race, color, national origin, religion, or sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity administered of provided under this Agreement, pursuant to Section 109 of title I of the Housing and Community

Development Act of 1974 (Title I) (42 U.S.C. 5309).

E. Section 402 Compliance. Contractors and subcontractors shall take affirmative action to employ and advance in employment qualified covered veterans. Disabled veterans, recently separated veterans (veterans within 3 years of their discharge or release from active duty), veterans who served on active duty during a war or in a campaign or expedition for which a campaign badge has been authorized (referred to as "other protected veterans"), and Armed Forces service medal veterans are covered veterans under VEVRAA, pursuant to the Vietnam Era Veterans' Readjustment Assistance Act of 1974, as amended (VEVRAA).

F. Copeland Anti-Kickback Act Compliance. Pursuant to The Copeland "Anti-Kickback" Act, 40 USC §3145 and 18 USC §874, no contractor or subcontractor operating under this agreement shall induce an employee to give up any part of the compensation to which he or she is entitled under his or her contract of employment. Contractors and subcontractors shall submit a weekly statement of the wages paid to each employee performing on covered work during the preceding payroll period.

G. Affirmative Action. During the performance of this contract, the contractors and subcontractors operating under this agreement shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Contractors and subcontractors operating under this agreement shall comply with Affirmative Action laws and regulations to ensure equal employment opportunities, including, but not limited to 41 CFR Part 60-1; 41 CFR Part 60-2; 41 CFR Part 60-250; 41 CFR Part 60-741; compliance with E.O. 11246, "Equal Employment Opportunity," as amended by E.O. 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity."

H. Compliance with Goals for Minority and Female Participation. The City of Tuscaloosa has voluntarily adopted a Minority / Disadvantaged Business Enterprise ("MBE/DBE/WBE") Program designed to encourage the participation and development of minority and disadvantaged business enterprises and to promote equal business opportunities to the fullest extent allowed by state and federal law. It is the intent of the City to foster competition among contractors, suppliers, and vendors that will result in better quality and more economical services rendered to the City. Under this policy, the City of Tuscaloosa has established a goal of ten to twenty percent (10-20%) inclusion of minority and disadvantaged business enterprises for all services required to deliver City projects. In no case shall the stated percentage be the determining factor in contract awards. Rather, contractors must demonstrate a good faith effort to attain the desired percentage goal. The Developer is encouraged to adopt corresponding goals to those of the City's Minority / Disadvantaged Business Enterprise ("MBE/DBE/WBE") Program.

I. Compliance with Environmental Laws; including The Clean Air Act and Clean Water Act. Contractors and subcontractors operating under this agreement shall be responsible for ensuring compliance with Federal, State, or local pollution control laws and related requirements, including but not limited to the Clean Air Act (42 U.S.C. 7401 et seq.) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251 et seq.). If a contracting officer becomes aware of noncompliance with clean air or water standards in facilities used in

performing nonexempt contracts, that contracting officer shall notify the agency head, or a designee, who shall promptly notify the EPA Administrator or a designee in writing.

J. Byrd Anti-Lobbying Agreement. Contractors operating under this agreement shall file the required certification under the Byrd Anti-Lobbying Amendment (31 U.S.C. 1352). Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient.

K. HUD Form 4010 See next page.

Applicability

The Project or Program to which the construction work covered by this contract pertains is being assisted by the United States of America and the following Federal Labor Standards Provisions are included in this Contract pursuant to the provisions applicable to such Federal assistance.

A. 1. (i) **Minimum Wages.** All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of 29 CFR 5.5(a)(1)(iv); also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period.

Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under 29 CFR 5.5(a)(1)(ii) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible, place where it can be easily seen by the workers.

(ii) (a) Any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. HUD shall approve an additional classification and wage rate and fringe benefits therefor only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(b) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and HUD or its designee agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by HUD or its designee to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB control number 1215-0140.)

(c) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and HUD or its designee do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), HUD or its designee shall refer the questions, including the views of all interested parties and the recommendation of HUD or its designee, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise HUD or its designee or will notify HUD or its designee within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

(d) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (1)(ii)(b) or (c) of this paragraph, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part

of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

2. Withholding. HUD or its designee shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract In the event of failure to pay any laborer or mechanic, including any apprentice, trainee or helper, employed or working on the site of the work, all or part of the wages required by the contract, HUD or its designee may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased. HUD or its designee may, after written notice to the contractor, disburse such amounts withheld for and on account of the contractor or subcontractor to the respective employees to whom they are due. The Comptroller General shall make such disbursements in the case of direct Davis-Bacon Act contracts.

3. (i) Payrolls and basic records. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in Section l(b)(2)(B) of the Davis-bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5 (a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section l(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs. (Approved by the Office of Management and Budget under OMB Control Numbers 1215-0140 and 1215-0017.)

(ii) (a) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to HUD or its designee if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant sponsor, or owner, as the case may be, for transmission to HUD or its designee. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i) except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at *http://www.dol.gov/esa/whd/forms/wh347instr.htm* or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to HUD or its designee if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant sponsor, or owner, as the case may be, for transmission to HUD or its designee, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this subparagraph for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to HUD or its designee. (Approved by the Office of Management and Budget under OMB Control Number 1215-0149.)

(b) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under 29 CFR 5.5 (a)(3)(ii), the appropriate information is being maintained under 29 CFR 5.5(a)(3)(i), and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(c) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph A.3.(ii)(b).

(d) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under subparagraph A.3.(i) available for inspection, copying, or transcription by authorized representatives of HUD or its designee or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, HUD or its designee may, after written notice to the contractor, sponsor, applicant or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant ',to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by

the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under 29 CFR Part 5 shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

5. Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR Part 3 which are incorporated by reference in this contract

6. Subcontracts. The contractor or subcontractor will insert in any subcontracts the clauses contained in subparagraphs 1 through 11 in this paragraph A and such other clauses as HUD or its designee may by appropriate instructions require, and a copy of the applicable prevailing wage decision, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in this paragraph.

7. Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act Requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this contract

9. Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and HUD or its designee, the U.S. Department of Labor, or the employees or their representatives.

10. (i) Certification of Eligibility. By entering into this contract the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded HUD contracts or participate in HUD programs pursuant to 24 CFR Part 24.

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001. Additionally, U.S. Criminal Code, Section 1 01 0, Title 18, U.S.C., "Federal Housing Administration transactions", provides in part: "Whoever, for the purpose of . . . influencing in any way the action of such Administration..... makes, utters or publishes any statement knowing the same to be false..... shall be fined not more than $5,000 or imprisoned not more than two years, or both."

11. Complaints, Proceedings, or Testimony by Employees. No laborer or mechanic to whom the wage, salary, or other labor standards provisions of this Contract are applicable shall be discharged or in any other manner discriminated against by the Contractor or any subcontractor because such employee has filed any complaint or instituted or caused to be instituted any proceeding or has testified or is about to testify in any proceeding under or relating to the labor standards applicable under this Contract to his employer.

B. Contract Work Hours and Safety Standards Act. The provisions of this paragraph B are applicable where the amount of the prime contract exceeds $100,000. As used in this paragraph, the terms "laborers" and "mechanics" include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which the individual is employed on such work to work in excess of 40 hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of 40 hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in subparagraph (1) of this paragraph, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in subparagraph (1) of this paragraph, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by the clause set forth in sub paragraph (1) of this paragraph.

(3) Withholding for unpaid wages and liquidated damages. HUD or its designee shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contract, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act which is held by the same prime contractor such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in subparagraph (2) of this paragraph.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in subparagraph (1) through (4) of this paragraph and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in subparagraphs (1) through (4) of this paragraph.

C. Health and Safety. The provisions of this paragraph C are applicable where the amount of the prime contract exceeds $100,000.

(1) No laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health and safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation.

(2) The Contractor shall comply with all regulations issued by the Secretary of Labor pursuant to Title 29 Part 1926 and failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act, (Public Law 91-54, 83 Stat 96). 40 USC 3701 et seq.

(3) The contractor shall include the provisions of this paragraph in every subcontract so that such provisions will be binding on each subcontractor. The contractor shall take such action with respect to any subcontractor as the Secretary of Housing and Urban Development or the Secretary of Labor shall direct as a means of enforcing such provisions.

L. Davis Bacon-Wage Rates

"General Decision Number: AL20230119 01/06/2023

Superseded General Decision Number: AL20220119

State: Alabama

Construction Type: Heavy

Counties: Hale, Pickens and Tuscaloosa Counties in Alabama.

HEAVY CONSTRUCTION PROJECTS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	.Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least $16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least $12.15 per hour (or the applicable wage rate listed

	on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number Publication Date
0 01/06/2023

SUAL2015-047 08/02/2017

	Rates	Fringes
CARPENTER, Includes Form Work....	$ 20.26	8.59
CEMENT MASON/CONCRETE FINISHER, Includes Water Sewer Lines.....	$ 13.71 **	0.00
ELECTRICIAN.....	$ 19.98	5.53
LABORER: Common or General, Includes Water Sewer Lines.....	$ 11.48 **	0.00
LABORER: Pipelayer, Includes Water Sewer Lines.....	$ 13.91 **	2.04
OPERATOR: Backhoe/Excavator/Trackhoe, Includes Water Sewer Lines.....	$ 19.31	0.00

OPERATOR: Bulldozer, Includes Water and Sewer Lines.....	$ 12.00 **	0.00
OPERATOR: Loader, Includes Water Sewer Lines.....	$ 17.64	2.14
TRUCK DRIVER: Dump Truck, Includes Water Sewer Lines.....	$ 12.25 **	2.58

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 ($16.20) or 13658 ($12.15). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates

the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for

the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

==========

END OF GENERAL DECISION"

M. Sales and Use Tax:

The project will be administered in compliance with Alabama state law regarding sales and use taxes. The Contractor shall be responsible for obtaining a certificate of exemption from the Alabama Department of Revenue for purchases of materials and other tangible property made part of the project. Any subcontractors purchasing materials or other tangible personal property as part of the project shall also be responsible for obtaining a certificate of exemption.

https://www.revenue.alabama.gov/wp-content/uploads/2017/05/ST-EXC-01.pdf

Exhibit A

THE CITY OF TUSCALOOSA
MINORITY ENTERPRISE/DISADVANTAGED BUSINESS ENTERPRISE
(MBE/DBE/WBE) POLICY FOR PUBLIC WORKS PROJECTS OVER $100,000

General Mission Statement

THE CITY OF TUSCALOOSA (hereinafter, "City") has voluntarily adopted a Minority/Disadvantaged Business Enterprise (MBE/DBE/WBE") Program designed to encourage the participation and development of minority and disadvantaged business enterprises and to promote equal business opportunities in the City to the fullest extent allowed by state and federal law.

It is the intent of the City to foster competition among contractors, suppliers, and vendors that will result in better quality and more economical services rendered to the City. Under this policy, the City of Tuscaloosa has established a goal of ten to twenty percent (10-20%) inclusion of minority and disadvantaged business enterprise (hereinafter sometimes "MBE/DBE/WBE") for all services required to deliver City projects. In no case shall the stated percentage be the determining factor in contract awards. Rather, contractors must demonstrate a good faith effort to attain the desired percentage goal.

Program Goals

It is the goal of this program:

- To ensure non-discrimination in the award and administration of City contracts.
- To help to remove barriers to the participation of DBE/MBE/WBE's in competing for City contracts.
- To ensure a level playing field exists on which DBE/MBE/WBE's can compete fairly for City contracts.

Definition

1. "Minority Business Enterprise" ("MBE") means a business which is an independent and continuing enterprise for profit, performing a commercially useful function and is at least fifty-one percent (51%) owned and controlled by an African American, or Black American.

2. "Women-owned Business Enterprise" ("WBE") means a business which is an independent and continuing enterprise for profit, performing a commercially useful function and is at least fifty-one percent (51%) owned, operated and controlled on a daily basis by one or more female American citizens.

3. ”Disadvantaged Business Enterprise” (DBE”) means a business which is an independent and continuing enterprise for profit, performing a commercially useful function and is owned by a majority of persons who are United States citizens or permanent resident aliens (as defined by the Immigration and Naturalization Service) of the United States, and who are Asian, Black, Hispanic or Native Americans, according to the following definitions:

“Asian” – means persons having origins in any of the original people of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands.

“African American” or “Black American” means persons having origins in any black racial group of Africa.

“Hispanic” means persons of Spanish or Portuguese culture with origins in Mexico, South of Central America, or the Caribbean Islands regardless of race.

“Native American” means persons having origins in any of the original people of North America, including American Indians, Eskimos and Aleuts.

Equal Business Opportunity

It is the policy of the City to promote full and equal business opportunities for all persons doing business with the City, regardless of race, sex or national origin. It is the ultimate goal of this policy to promote an equitable business climate district. The City will seek to increase minority and women participation for contracts that require formal bids. These efforts will be for contracts above $100,000 as allowed by the Alabama Public Works law. These efforts are designed to help prevent discrimination against minorities and disadvantaged businesses and promote more completion among vendors, suppliers, and contractors of the City of Tuscaloosa.

The City has established a goal of ten to twenty percent (10-20%) of the total construction related expenditures to be provided by minority and disadvantaged business enterprises. While the policy provides for voluntary participation by the City and is dependent upon race-neutral and gender-neutral considerations, contractors are encouraged to comply with the City’s policy. The City of Tuscaloosa shall periodically review the policy, including race/gender-neutral remedies, to determine its effectiveness.

Good Faith Effect

The City require contractors to demonstrate a good faith effort to attain the goal of 10-20% participation of MBE/DBE/WBE’s in all levels of the Public Works contracting process. Contractors shall document their efforts to obtain minority and disadvantaged business participation in the bid documents. Contractors should note that failure to document a good

faith effort to the satisfaction of the City may subject the contractor to bid rejection for non-responsiveness.

The following process shall constitute a good faith effort under the City's policy:

(1) Contractors deciding to bid on a City project shall submit the MBE/DBE/WBE Documentation Statement and Acknowledgement (Form1). Submission of Form 1 confirms the commitment of the contractor to participate in the inclusion effort for the project. Form 1 must be submitted to the City of Tuscaloosa Community Development Program Manager with Infrastructure and Public Services/Tuscaloosa Builds no later than seven (7) days prior to the bid, or at the pre-bid conference, whichever is earlier. The City reserves the right to modify the submittal deadline as-needed.

(2) Contractors shall submit MBE/DBE/WBE Bid Solicitation Notice (Form 2). Form 2 must be submitted to the City of Tuscaloosa Community Development Program Manager with Infrastructure and Public Services/Tuscaloosa Builds no later than seven (7) days prior to the bid, or at the pre-bid conference, whichever is earlier. The City reserves the right to modify the submittal deadline as-needed.

(3) Contractors shall submit a brief plan for achieving the stated MBE/DBE/WBE Participation Goal for his/her trade (Form 3). Form 3 must be submitted in the contractor's sealed bid.

(4) Contractor shall submit a listing of all MBE/DBE/WBE contractors that submitted bids (Form 4). Form 4 must be submitted in the contractor's sealed bid. (Note: In the event a MBE/DBE/WBE contractor submits a bid after the general contractor has sealed the bid, contractors should write on the envelope the name(s) and scope of work of the MBE/DBE/WBE contractor who submitted the bid.)

(5) Contractor shall submit a list of all MBE/DBE/WBE firms the contractor proposes to utilize during the execution of the contract (Form 5). In addition, the contractor shall include on Form 5 all firms that the major subcontractors propose to utilize. Form 5 must be submitted in the contractor's sealed bid.

(6) Contractors shall be required to work in cooperation with the City's consultant in the implementation of this program. Failure to do so, in the discretion of the City, may result in a rejection of bid due to non-responsiveness.

Following compliance with item (6) above, submission of Form 1, Form 2, Form 3, Form 4, and Form 5 at the above-prescribed times shall satisfy the good faith effort requirement. Failure to do so may result in rejection of bid due to non-responsiveness.

Additional Administrative Requirements/Procedure

(1) If the successful contractor will be subcontracting less than the started percentage goal, the Contractor must complete a "MBE/DBE/WBE Unavailability Certification" (Form 6). Form 6 is due once a tentative contract award has been made.

(2) Contractors shall obtain the listing of certified MBE/DBE/WBE business by contacting the City of Tuscaloosa Community Development Program Manager with Infrastructure and Public Services/Tuscaloosa Builds to assist in soliciting MBE/DBW/WBE participation for the project.

(3) Contractors shall not be required to use a MBE/DBE/WBE subcontractor who cannot display reasonable technical and financially qualifications to perform the work in question.

(4) In addition to the above requirements, contractors should note that the City reserves the right to periodically audit payroll records to ensure compliance with the program. The City employs the services of a Compliance Director.

(5) Upon completion of the project and prior to release of retainage or final payment, the contractor shall submit a Project Closeout Report (Form 7) that includes final accounting of all MBE/DBE/WBE firms utilized on the project.

(6) On a monthly basis, contractors shall submit updated MBE/DBE/WBE reports (Monthly Report Form) to identify any changes in MBE/DBE/WBE firm utilization (Form 8). Contractors shall submit Form 8 directly to the City of Tuscaloosa Community Development Program Manager with Infrastructure and Public Services/Tuscaloosa Builds.

Race/Gender – Neutral Remedies

The City recognizes that race/gender – neutral remedies may be effective tools used to increase MBE/DBE/WBE participation. Therefore, the City will continue to explore these remedies. The remedies will include, but will not be limited to, the following:

1. Technical assistance techniques to identify and increase the participation of MBE/DBE/WBE's in the City's contracting, subcontracting and purchasing opportunities.
2. Continuation of the certification process.

The City will periodically review the success of these measures in order to determine the extent to which the measures provide equitable access to the City's contracting, subcontracting and purchasing opportunities.

The City has determined that this policy complies with all applicable local, state and national laws concerning the contracting and purchasing process. The City shall not sacrifice product quality for lower pricing, but shall make all awards in accordance with applicable law. It shall be the primary responsibility of the City to insure that this policy is followed, and that all

actions regarding the contracting and purchasing process comply with all applicable statues as well as the defined goals relative to MBE/DBE/WBE participation on all construction projects.

Contact Information:

Caramyl Drake
Community Development Program Manager
Community & Neighborhood Services
City of Tuscaloosa
Phone: (205) 248-5725
cdrake@tuscaloosa.com

Form 1 (one page)
Documentation Statement and Acknowledgement

(Due no later than seven (7) days prior to the bid, or at the pre-bid conference, whichever is earlier)

PROJECT NAME: **Hilliard N. Fletcher WRRF Headworks Improvements**
FILE NO.: **A19-1146** ENGINEERING PROJECT NO.: **2024.714.001**

The City of Tuscaloosa has adopted a program to encourage the participation of Minority Business Enterprises/Disadvantaged Business Enterprises (MBE/DBE/WBE) on its public works construction projects. The signed statement serves as a commitment by the undersigned company to comply with this program as outlined by the City, relative to the involvement of MBE/DBE/WBE firm in City guidelines.

The undersigned Company will adhere to City program guidelines set forth to utilize MBE/DBE/WBE businesses in all construction projects, and all program forms (1-8) have been reviewed and understood.

Company Representative (Signature)	Date
Company Representative (Printed)	Title
Company Name	Telephone Number
City, State, Zip	Fax Number

Form 2 (6 pages)
Bid Solicitation Notice

(Due no later than seven (7) days prior to the bid, or at the pre-bid Conference, whichever is earlier)

BID DATA

1. GENERAL CONTRACTOR:_____

   ADDRESS: _____

   _____

   CONTACT (S):_____

   PHONE:_____

   FAX:_____

   E-MAIL:_____

2. OWNER:_____

3. NAME OF PROJECT:_____

4. FILE NO.: _____ ENGINEERING PROJECT NO.:_____

5. SCHEDULE PRE-BID MEETING

   DATE/TIME: _____
   LOCATION: _____

6. DATE/TIME FOR RECEIPT OF BIDS:_____

7. SCHEDULE BID OPENING

   DATE/TIME:_____
   LOCATION:_____

8. ESTIMATED JOB START DATE:_____

9. ESTIMATED COMPLETION DATE:_____

PROJECT: _____

_____

LOCATION: _____

BID DATE: _____

GENERAL CONTRACTOR CONTACT:

NAME_____

ADDRESS: _____

_____

TELEPHONE: ( ) _____

FAX: ( ) _____

EMAIL: ( ) _____

_____

DEADLINE FOR PROPOSALS

_____
DATE/TIME

* Estimated Contract Opportunity Value:
{1} 0-25,000 {2} 25,000-50,000 {3} 50,000-100,000 {4} 100,000 - 500,000 {5} over 500,000

DIVISION 02 – EXISTING CONDITIONS
{1} {2} {3} {4} {5} *

[___] 02 21 SURVEYS
[___] 02 32 GEOTECHNICAL INVESTIGATIONS
[___] 02 41 DEMOLITION
[___] 02 42 REMOVAL and SALVAGE of CONSTRUCTION MATERIALS
[___] 02 43 STRUCTURE MOVING
[___] 02 56 SITE CONTAINMENT
[___] 02 65 UNDERGROUND STORAGE TANK REMOVAL
[___] 02 81 TRANSPORTATION and DISPOSAL of HAZARDOUS MATERIALS
[___] 02 82 ASBESTOS REMEDIATION
[___] 02 83 LEAD REMEDIATION
[___] 02 85 MOLD REMEDIATION
[___] 02 91 CHEMICAL SAMPLING, TESTING and ANALYSIS
[___] 02 __ _____
(Please fill-in other opportunity)

DIVISION 3 - CONCRETE {1} {2} {3} {4} {5}
[___] 03 01 MAINTENANCE OF CONCRETE
[___] 03 11 CONCRETE FORMING
[___] 03 15 CONCRETE ACCESSORIES
[___] 03 21 REINFORCING STEEL
[___] 03 22 WELDED WIRE FABRIC REINFORCING
[___] 03 30 CAST–IN-PLACE CONCRETE
[___] 03 31 STRUCTURAL CONCRETE
[___] 03 35 CONCRETE FINISHING
[___] 03 37 SPECIALTY PLACED CONCRETE
[___] 03 39 CONCRETE CURING
[___] 03 41 PRECAST STRUCTURAL CONCRETE
[___] 03 45 PRECAST ARCHITECTURAL CONCRETE
[___] 03 47 SITE-CAST CONCRETE
[___] 03 62 NON-SHRINK GROUTING
[___] 03 63 EPOXY GROUTING
[___] 03 81 CONCRETE CUTTING
[___] 03 82 CONCRETE BORING
[___] 03 __ _____
(Please fill-in for other opportunity)

DIVISION 4 - MASONRY {1} {2} {3} {4} {5}
[___] 04 21 CLAY UNIT MASONRY
[___] 04 22 CONCRETE UNIT MASONRY
[___] 04 28 UNIT MASONRY PANELS
[___] 04 30 MULTIPLE-WYTHE MASONRY
[___] 04 43 STONE MASONRY
[___] 04 57 MASONRY FIREPLACES
[___] 04 71 MANUFACTURED BRICK MASONRY
[___] 04 73 MANUFACTURED STONE MASONRY
[___] 04 __ _____
(Please fill-in for other opportunity)

DIVISION 5 - METALS {1} {2} {3} {4} {5}
[___] 05 12 STRUCTURAL STEEL FRAMING
[___] 05 14 STRUCTURAL ALUMINUM FRAMING
[___] 05 15 WIRE ROPE ASSEMBLIES
[___] 05 21 STEEL JOIST FRAMING
[___] 05 31 STEEL DECKING
[___] 05 35 RACEWAY DECKING ASSEMBLIES
[___] 05 41 STRUCTURAL METAL STUD FRAMING
[___] 05 42 COLD-FORMED METAL JOIST FRAMING
[___] 05 44 COLD-FORMED METAL TRUSSES
[___] 05 51 METAL STAIRS
[___] 05 52 METAL RAILINGS
[___] 05 53 METAL GRATINGS
[___] 05 55 METAL STAIR TREADS & NOSING
[___] 05 58 METAL CASTINGS
[___] 05 59 FORMED METAL FABRICATIONS
[___] 05 71 DECORATIVE METAL STAIRS
[___] 05 73 DECORATIVE METAL RAILINGS
[___] 05 75 DECORATIVE FORMED METAL
[___] 05 __ _____
(Please fill-in for other opportunity)

DIVISION 6 – WOODS, PLASTICS & COMPOSITIES
{1} {2} {3} {4} {5}

[___] 06 11 WOOD FRAMING

[___] 06 12 STRUCTURAL PANELS
[___] 06 15 WOOD DECKING
[___] 06 16 SHEATING
[___] 06 17 SHOP FABRICATED STRUCTURAL WOOD
[___] 06 22 MILLWORK
[___] 06 25 PREFINISHED PANEL
[___] 06 26 PANELING
[___] 06 43 WOOD STAIRS & RAILINGS
[___] 06 44 ORNAMENTAL WOODWORK
[___] 06 48 WOOD FRAMES
[___] 06 __ _____
(Please fill-in for other opportunity)

DIVISION 7 – THERMAL & MOISTURE PROTECTION {1} {2} {3} {4} {5}
[___] 07 11 DAMPPROOFING
[___] 07 12 BUILT-UP BITUMINOUS WATERPROOFING
[___] 07 13 SHEET WATERPROOFING
[___] 07 16 CEMENTIOUS & REACTIVE WATERPROOFING
[___] 07 19 WATER REPELLANTS
[___] 07 21 THERMAL INSULATION
[___] 07 22 ROOF & DECK INSULATION
[___] 07 24 EXTERIOR INSULATION & FINISH SYSTEMS
[___] 07 25 WEATHER BARRIERS
[___] 07 26 VAPOR RETARDERS
[___] 07 31 SHINGLES & SHAKES
[___] 07 32 ROOF TILES
[___] 07 33 NATURAL ROOF COVERINGS
[___] 07 41 ROOF PANELS
[___] 07 42 WALL PANELS
[___] 07 46 SIDING
[___] 07 51 BUILT-UP BITUMINOUS ROOFING
[___] 07 52 MODIFIED BIITUMINOUS MEMBRANE ROOFING
[___] 07 53 ELASTOMETRIC MEMBRANE ROOFING
[___] 07 54 THERMOPLASTIC MEMBRANE ROOFING
[___] 07 56 FLUID APPLIED ROOFING
[___] 07 58 ROLL ROOFING
[___] 07 61 SHEET METAL ROOFING
[___] 07 65 FLEXIBLE FLASHING

[___] 07 71 ROOF SPECIALTIES
[___] 07 72 ROOF ACCESSORIES
[___] 07 81 APPLIED FIREPROOFING
[___] 07 84 FIRESTOPPING
[___] 07 91 PREFORMED JOINT SEALS
[___] 07 92 JOINT SEALANTS
[___] 07 95 EXPANSION CONTROL
[___] 07 __ _____
(Please fill-in for other opportunity)

DIVISION 8 - OPENINGS {1} {2} {3} [4} {5}
[___] 08 11 METAL DOORS & FRAMES
[___] 08 12 METAL FRAMES
[___] 08 13 METAL DOORS
[___] 08 14 WOOD DOORS
[___] 08 16 COMPOSITE DOORS
[___] 08 17 INTEGRATED DOOR OPENING ASSEMBLIES
[___] 08 31 ACCESS DOORS & PANELS
[___] 08 32 SLIDING GLASS DOORS
[___] 08 33 COILING DOORS & GRILLES
[___] 08 34 SPECIAL FUNCTION DOORS
[___] 08 36 PANEL DOORS
[___] 08 38 TRAFFIC DOORS
[___] 08 41 ENTRANCES & STOREFRONTS
[___] 08 42 ENTRANCES
[___] 08 43 STOREFRONTS
[___] 08 44 CURTAIN WALL & GLAZED ASSEMBLIES
[___] 08 51 METAL WINDOWS
[___] 08 52 WOOD WINDOWS
[___] 08 53 PLASTIC WINDOWS
[___] 08 54 COMPOSITE WINDOWS
[___] 08 56 SPECIAL FUNCTION WINDOWS
[___] 08 62 UNIT SKYLIGHTS
[___] 08 63 METAL-FRAMED SKYLIGHTS
[___] 08 71 DOOR HARDWARE
[___] 08 74 ACCESS CONTROL HARDWARE
[___] 08 75 WINDOW HARDWARE
[___] 08 79 HARDWARE ACCESSORIES
[___] 08 81 GLASS GLAZING
[___] 08 83 MIRRORS
[___] 08 84 PLASTIC GLAZING
[___] 08 88 SPECIAL FUNCTION GLAZING
[___] 08 91 LOUVERS
[___] 08 95 VENTS
[___] 08 __ _____
(Please fill-in for other opportunity)

DIVISION 9 - FINISHES {1} {2} {3} {4} {5}
[___] 09 21 PLASTER & GYPSUM ASSEMBLIES
[___] 09 22 SUPPORTS FOR PLASTER & GYPSUM
[___] 09 23 GYPSUM PLASTERING
[___] 09 24 CEMENT PLASTERING
[___] 09 26 VENEER PLASTERING
[___] 09 28 BACKING S & UNDERLAYMENTS
[___] 09 29 GYPSUM
[___] 09 30 TILING
[___] 09 51 ACOUSTICAL CEILINGS
[___] 09 54 SPECIALTY CEILINGS
[___] 09 62 SPECIALTY FLOORING
[___] 09 63 MASONRY FLOORING
[___] 09 64 WOOD FLOORING

[___] 09 65 RESILIENT FLOORING
[___] 09 66 TERRAZZO FLOORING
[___] 09 68 CARPETING
[___] 09 72 WALL COVERINGS
[___] 09 77 SPECIAL WALL SURFACING
[___] 09 91 PAINTING
[___] 09 93 STAINING & TRANSPARENT FINISHING
[___] 09 96 HIGH PERFORMANCE COATINGS
[___] 09 97 SPECIAL COATINGS
[___] 09 __ _____
(Please fill-in for other opportunity)

DIVISION 10 - SPECIALTIES {1} {2} {3} {4} {5}
[___] 10 11 VISUAL DISPLAY UNITS
[___] 10 14 SIGNAGE
[___] 10 22 PARTITIONS
[___] 10 26 WALL & DOOR PROTECTION
[___] 10 28 TOILET, BATH & LAUNDRY ACCESSORIES
[___] 10 44 FIRE PROTECTION SPECIALTIES
[___] 10 51 LOCKERS
[___] 10 71 EXTERIOR PROTECTION
[___] 10 74 MANUFACTURED EXTERIOR SPECIALTIES
[___] 10 75 FLAGPOLES
[___] 10 81 PEST CONTROL DEVICES
[___] 10 88 SCALES
[___] 10 __ _____
(Please fill-in for other opportunity)

DIVISION 11 - EQUIPMENT {1} {2} {3} {4} {5}
[___] 11 11 VEHICLE SERVICE EQUIPMENT
[___] 11 12 PARKING CONTROL EQUIPMENT
[___] 11 13 LOADING DOCK EQUIPMENT
[___] 11 14 PEDESTRIAN CONTROL EQUIPMENT
[___] 11 24 MAINTENANCE EQUIPMENT
[___] 11 31 RESIDENTIAL APPLIANCES
[___] 11 33 RETRACTABLE STAIRS
[___] 11 41 FOODSERVICE STORAGE EQUIPMENT
[___] 11 42 FOOD PREPARATION EQUIPMENT
[___] 11 43 FOOD DELIVERY CARTS AND CONVEYORS
[___] 11 44 FOOD COOKING EQUIPMENT
[___] 11 46 FOOD DISPENSING EQUIPMENT
[___] 11 47 ICE MACHINES
[___] 11 48 CLEANING & DISPOSAL EQUIPMENT
[___] 11 52 AUDIO-VISUAL EQUIPMENT
[___] 11 53 LABORATORY EQUIPMENT
[___] 11 66 ATHLETIC EQUIPMENT
[___] 11 67 RECREATIONAL EQUIPMENT
[___] 11 82 SOLID WASTE HANDLING
[___] 11 __ _____
(Please fill-in for other opportunity)

DIVISION 12 - FURNISHINGS {1} {2} {3} {4} {5}
[___] 12 21 WINDOW BLINDS
[___] 12 22 CURTAINS & DRAPES
[___] 12 23 INTERIOR SHUTTERS
[___] 12 24 WINDOW SHADES
[___] 12 32 MANUFACTURED CASEWORK
[___] 12 35 SPECIALTY CASEWORK
[___] 12 36 COUNTERTOPS
[___] 12 46 FURNISHING ACCESSORIES
[___] 12 48 RUGS & MATS
[___] 12 51 OFFICE FURNITURE
[___] 12 52 SEATING
[___] 12 54 HOSPITALITY FURNITURE
[___] 12 56 INSTITUTIONAL FURNITURE
[___] 12 61 FIXED AUDIENCE SEATING
[___] 12 63 STADIUM & ARENA SEATING
[___] 12 67 PEWS & BENCHES
[___] 12 92 INTERIOR PLANTERS & ARTIFICAL PLANTS
[___] 12 93 SITE FURNISHINGS
[___] 12 __ _____
(Please fill-in for other opportunity)

DIVISION 13 - SPECIAL CONSTRUCTION {1} {2} {3} {4} {5}
[___] 13 11 SWIMMING POOLS
[___] 13 17 TUBS & POOLS
[___] 13 18 ICE RINKS
[___] 13 21 CONTROLLED ENVIRONMENT ROOMS
[___] 13 24 SPECIAL ACTIVITY ROOMS
[___] 13 28 ATHLETIC & RECREATIONAL SPECIAL CONSTRUCTION
[___] 13 31 FABRIC STRUCTURES
[___] 13 34 FABRICATED ENGINEERED STRUCTURES
[___] 13 36 TOWERS
[___] 13 42 BUILDING MODULES
[___] 13 48 SOUND, VIBRATION, & SEISMIC CONTROL
[___] 13 49 RADIATION PROTECTION
[___] 13 __ _____
(Please fill-in for other opportunity)

DIVISION 14 - CONVEYING SYSTEMS {1} {2} {3} {4} {5}

[___] 14 11 MANUAL DUMBWAITERS
[___] 14 12 ELECTRIC DUMBWAITERS
[___] 14 21 ELECTRIC TRACTION ELEVATORS
[___] 14 24 HYDRAULIC ELEVATORS
[___] 14 27 CUSTOM ELEVATOR CABS & DOORS
[___] 14 28 ELEVATOR EQUIPMENT & CONTROLS
[___] 14 31 ESCALATORS

[___] 14 32 MOVING WALKS
[___] 14 42 WHEELCHAIR LIFTS
[___] 14 51 CORRESPNDENCE & PARCEL LIFTS
[_ _] 14 91 FACILITY CHUTES
[___] 14 92 PNEUMATIC TUBE SYSYTEMS
[___] 14 __ _____
(Please fill-in for other opportunity)

DIVISION 21 –FIRE SUPPRESSION {1} {2} {3} {4} {5}
[___] 21 11 FIRE-SUPPRESSION WATER SERVICE PIPING &METHODS
[___] 21 12 FIRE SUPPRESSION STANDPIPES
[___] 21 13 FIRE SUPPRESSION SPRINKLER SYSTEMS
[___] 21 21 CARBON-DIOXIDE FIRE EXTINGUISHING SYSTEMS
[___] 21 22 CLEAN AGENT FIRE EXTINGUISHING SYSTEMS
[___] 21 31 CENTIFUGAL FIRE PUMPS
[___] 21 __ _____
(Please fill-in for other opportunity)

DIVISON 22-PLUMBING {1} {2} {3} {4} {5}
[___] 22 07 PLUMBING INSULATION
[___] 22 11 FACILITY WATER DISTRIBUTION
[___] 22 13 FACILITY SANITARY SEWERAGE
[___] 22 14 FACILITY STORM DRAINAGE
[___] 22 41 COMMERICAL PLUMBING FIXTURE

[___] 22 42 COMMERICAL PLUMBING FIXTURES
[___] 22 45 EMERGENCY PLUMBING FIXTURES
[___] 22 47 DRINKING FOUNTAINS & WATER COOLERS
[___] 22 51 SWIMMING POOL PLUMBING SYSTEMS
[___] 22 66 CHEMICAL-WASTE SYSTEMS FOR LAB & HEALTHCARE FACILITIES
[___] 22 __ _____
(Please fill-in for other opportunity)

DIVISON 23-HEATING VENTILATION AIR CONDITIONING {1} {2} {3} {4} {5}

[___] 23 07 HVAC INSULATION
[___] 23 09 INSTRUMENTATION & CONTROL FOR HVAC
[___] 23 13 FACILITY FUEL-STORAGE TANKS
[___] 23 21 HYDRONIC PIPING & PUMPS
[___] 23 22 STEAM & CONDENSATE PIPING & PUMPS
[___] 23 31 HVAC DUCTS & CASINGS
[___] 23 33 AIR DUCT ACCESSORIES
[___] 23 34 HVAC FANS
[___] 23 37 AIR OUTLETS & INLETS
[___] 23 38 VENTILATION HOODS
[___] 23 41 PARTICULATE AIR FILTRATION
[___] 23 52 HEATING BOILERS
[___] 23 54 FURNACES
[___] 23 56 SOLAR ENERGY HEATING EQUIP.
[___] 23 57 HEAT EXCHANGES FOR HVAC
[___] 23 62 PACKAGED COMPRESSOR & CONDENSOR UNITS
[___] 23 63 REFRIGERANT CONDENSORS
[___] 23 64 PACKAGED WATER CHILLERS
[___] 23 65 COOLING TOWERS
[___] 23 73 INDOOR CENTRAL-STATION AIR-HANDLING UNITS
[___] 23 74 PACKAGED OUTDOOR HVAC EQUIP

[___] 23 82 CONVECTION HEATING & COOLING UNITS
[___] 23 84 HUMIDITY CONTROL EQUIPMENT
[___] 23 __ _____
(Please fill-in for other opportunity)

DIVISON 26-ELECTRICAL {1} {2} {3} {4} {5}
[___] 26 09 INSTRUMENTATION & CONTROL FOR ELECTRICAL SYSTEMS
[___] 26 12 MEDIUM VOLTAGE TRANSFORMERS
[___] 26 22 LOW VOLTAGE TRANSFORMERS
[___] 26 24 SWITCHS & PANELS
[___] 26 25 ENCLOSED BUS ASSEMBLIES
[___] 26 27 LOW VOLTAGE DISTRIBUTION EQUIPMENT
[___] 26 28 LOW VOLTAGE CIRCUIT PROTECTIVE DEVICES
[___] 26 29 LOW VOLTAGE CONTROLLERS
[___] 26 32 PACKAGED GENERATOR ASSEMBLIES
[___] 26 35 POWER FILTERS & CONDITIONERS
[___] 26 42 CATHODIC PROTECTION
[___] 26 51 INTERIOR LIGHTING
[___] 26 52 EMERGENCY LIGHTING
[___] 26 53 EXIT SIGNS
[___] 26 54 CLASSIFIED LOCATION LIGHTING
[___] 26 55 SPECIAL PURPOSE LIGHTING
[___] 26 56 EXTERIOR LIGHTING
[___] 26 61 LIGHTING SYSTEMS & ACCESSORIES
[___] 26 71 ELECTRICAL MACHINES
[___] 26 __ _____
(Please fill-in for other opportunity)

COMMUNICATIONS- 27 {1} {2} {3} {4} {5}
[___] 27 13 COMMUNICATIONS BACKBONE CABLING
[___] 27 41 AUDIO-VIDEO SYSTEMS
[___] 27 51 DISTRIBUTED AUDIO VIDEO
[___] 27 52 HEALTHCARE COMMUNICATIONS & MONITORING SYSTEMS
[___] 27 53 DISTRIBUTED SYSTEMS

[___] 27 __ _____
(Please fill-in for other opportunity)

ELECTRONIC SAFETY & SECURITY- 28 {1} {2} {3} {4} {5}
[___] 28 13 COMMUNICATIONS BACKBONE CABLING
[___] 28 16 INTRUSION DETECTION
[___] 28 23 VIDEO SURVEILLANCE
[___] 28 31 FIRE DETECTION
[___] 28 33 FUEL-GAS DETECTION
[___] 28 39 MASS NOTIFICATION SYSTEMS
[___] 28 __ _____
(Please fill-in for other opportunity)

EARTHWORK-31 {1} {2} {3} {4} {5}
[___] 31 06 SCHEDULES FOR EARTHWORK
[___] 31 11 CLEARING & GRUBBING
[___] 31 13 SELECTIVE TREE & SHRUB REMOVAL & TRIMMING
[___] 31 14 EARTH STRIPPING & STOCKPILING
[___] 31 22 GRADING
[___] 31 23 EXCAVATION & FILL
[___] 31 25 ERSION & SEDIMENTATION
[___] 31 31 SOIL TREATMENT
[___] 31 32 SOIL STABILIZATION
[___] 31 33 ROCK STABILIZATION
[___] 31 36 GABIONS
[___] 31 37 RIPRAP
[___] 31 41 SHORING
[___] 31 43 CONCRETE RAISING
[___] 31 45 VIBROFLORATION & DENSIFICATION
[___] 31 46 NEEDLE BEAMS
[___] 31 48 UNDERPINNING
[___] 31 52 COFFERDAMS
[___] 31 56 SHURRY WALLS
[___] 31 62 DRIVEN PILES
[___] 31 63 BORED PILES
[___] 31 __ _____
(Please fill-in for other opportunity)

EXTERIOR IMPROVEMENTS- 32 {1} {2} {3} {4} {5}
[___] 32 11 BASE COURSES
[___] 32 12 FLEXIBLE PAVING
[___] 32 13 RIGID PAVING
[___] 32 16 CURBS, GUTTERS SIDEWALKS & DRIVEWAYS
[___] 32 17 PAVING SPECIALTIES
[___] 32 18 ATHLETIC & RECREATIONAL SURFACING
[___] 32 31 FENCES & GATES
[___] 32 32 RETAINING WALLS
[___] 32 34 FABRICATED BRIDGES
[___] 32 35 SCREENING DEVICES
[___] 32 84 PLANTING IRRIGATION
[___] 32 91 PLANTING PREPARATION
[___] 32 92 TURF & GRASSES
[___] 32 93 PLANTS
[___] 32 94 PLANTING ACCESSORIES
[___] 32 96 TRANSPLANTING
[___] 32 __ _____
(Please fill-in for other opportunity)

UTILITIES-33 {1} {2} {3} {4} {5}
[___] 33 11 WATER UTILITY DISTRIBUTION PIPING
[___] 33 12 WATER UTILITY DISTRIBUTION EQUIPMENT
[___] 33 16 WATER UTILITY STORAGE TANKS
[___] 33 21 WATER SUPPLY WELLS
[___] 33 31 SANITARY UTILITY SEWERAGE PIPING
[___] 33 36 UTILITY SEPTIC TANKS
[___] 33 41 STORM UTILITY DRAINAGE PIPING
[___] 33 42 CULVERTS
[___] 33 44 STORM UTILITY WATER DRAINS
[___] 33 46 SUBDRAINAGE
[___] 33 49 STORM DRAINAGE STRUCTURES
[___] 33 51 NATURAL GAS DISTRIBUTION
[___] 33 52 LIQUID FUEL DISTRIBUTION
[___] 33 71 ELECTRICAL UTILITY TRANSMISSION & DISTRIBUTION
[___] 33 81 COMMUNICATIONS & STRUCTURES
[___] 33 __ _____
(Please fill-in for other opportunity)

TRANSPORATION-34 {1} {2} {3} {4} {5}
[___] 34 11 RAIL TRACKS
[___] 34 41 ROADWAY SIGNALING AND CONTROL EQUIPMENT
[___] 34 71 ROADWAY CONSTRUCTION
[___] 34 72 RAILWAY CONSTRUCTION
[___] 34 __ _____
(Please fill-in for other opportunity)

MATERIAL PROCESSING & HANDLING EQUIPMENT-41 {1} {2} {3} {4} {5}
[___] 41 21 CONVEYORS
[___] 41 22 CRANES & HOISTS
[___] 41 __ _____
(Please fill-in for other opportunity)

POLLUTION CONTROL EQUIP-44 {1} {2} {3} {4} {5}
[___] 44 11 PARTICULATE CONTROL EQUIPMENT
[___] 44 __ _____
(Please fill-in for other opportunity)

WATER & WASTEWATER EQUIPMENT-46 {1} {2} {3} {4} {5}
[___] 46 07 PACKAGED WATER & WASTEWATER TREATMENT EQUIPMENT
[___] 46 __ _____
(Please fill-in for other opportunity)

FORM 3 (1page)

PARTICIPATION GOAL

(Must be submitted inside the contractor's sealed bid)

General Contractor:_____

Contact:_____

Name of Project:_____

File No.: _____ Engineering Project No. _____

Date Submitted:_____

The project has a goal of ten to twenty percent (10-20%) MBE/DBE/WBE participation. Provide a brief summary of how this goal will be achieved. Failure to submit this form may result in a bid being rejected for non-responsiveness.

My goal for this project is _____%.

I plan on achieving this goal by:_____

Form 4

Contractors Submitting Bids

(Must be submitted inside the contractor's sealed bid)

General Contractor:_____

Contact:_____

Name of Project:_____

File No.: _____ Engineering Project No.:_____

Date Submitted:_____

All MBE/DBE/WBE Firms Submitting Bids	Scope of Work

FORM 5

CONTRACTORS SUBMITTING BIDS

(Must be submitted inside the contractor's sealed bid)

General Contractor: _____

Contact: _____

Name of Project: _____

File No.: _____ Engineering Project No.: _____

Total Contract Amount: $ _____

Total Amount of All Subcontractors: $ _____

Date Submitted: _____

All MBE/DBE/WBE firms to be utilized	Scope of Work	Contract Amount

(Use additional pages if necessary)

Form 6
Unavailability Certification
(Must be submitted following tentative bid award)

I, _____(Name/Title), of _____ (Company) certify that on _____ (Date) I contacted the following Minority/Disadvantaged Business Enterprise to obtain proposals/bids for the following work items:

MDE/DBE/WBE Firm	Work Items Sought	Form of Proposal Sought

To the best of my knowledge and belief, said Minority/Disadvantaged Business Enterprises were unavailable for work on this project, or unable to prepare a proposal/bid for the following reason(s):_____

_____

_____

(This form to be completed by each MBE/DBE/WBE listed, which was contacted, but did not submit a bid/proposal)

_____ (Name of MBE/DBE/WBE) was offered an opportunity to submit a proposal on the above identified work on _____ (Date) by _____ (Company Name).

(Use additional pages if necessary)

The above statement is a true and accurate account of why I did not submit a proposal/bid on this project.

_____ (Signature of MBE/DBE/WBE)
_____ (Date)
_____ (Title)

Form 7

Project Closeout Report

(To be submitted upon completion of project)

General Contractor: _____

Contact: _____

Name of Project: _____

File No.: _____ Engineering Project No.: _____

Total Contract Amount: $ _____

Final Contract Amount: $ _____

Date Submitted: _____

All MBE/DBE/WBE firms verified	Original subcontract amount	Final subcontract amount

Form 8

Monthly Report Form

(To be submitted monthly directly to the City's consultant)

General Contractor:_____

Contact:_____

Name of Project:_____

File No.: _____ Engineering Project No.: _____

Total Contract Amount: $_____

Date Submitted:_____

Billings

Each MBE/DBE/WBE Contractor utilized	Original subcontract amount	Previous amount	This period amount	Total Amount

(Use additional pages if necessary)

DIVISION 1

GENERAL REQUIREMENTS

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Project information.
2. Summary of Work.
3. Work by Owner or others.
4. Owner-furnished products.
5. Contractor's use of Site and premises.
6. Future work.
7. Owner's product Purchase contracts.
8. Work restrictions.
9. Owner occupancy.
10. Permits.
11. Specification conventions.
12. Project Design Criteria

B. Related Requirements:
1. Section 01 20 00 - Price and Payment Procedures.
2. Section 01 32 16 - Construction Progress Schedule.
3. Section 01 50 00 - Temporary Facilities and Controls.
4. Section 01 70 00 - Execution Requirements.

1.2 PROJECT INFORMATION

A. Name: Hilliard N Fletcher WRRF Headworks Improvements.
1. Project Location: Tuscaloosa, Alabama.

B. Owner: City of Tuscaloosa.
1. Owner's Representative: Kimberly Michael, P.E. Executive Director Water & Sewer.

C. Project Engineer: Garver.
1. Engineer's Representative: Wes Cardwell, P.E.

D. Work of the Project generally includes headworks improvements. More specifically, the Work includes, but is not limited to, construction of the following:
1. Replacement of Existing Mechanical Screens
a. Demolition of existing mechanical screens
b. Installation of new mechanical screening units
2. Replacement of Screening Conveyance Equipment and Associated Controls
a. Demolition and relocation of existing washer compactor
b. Rehabilitation of existing slide gates
c. Installation of new motorized slide gate actuators

1.3 WORK BY OWNER OR OTHERS

A. Owner, utilities, and others may perform activities within the project site and premises while the Work is in progress. Schedule the Work with Owner, utilities, and others to minimize interference or delays. Owner, utilities, and others may perform activities within the project site and premises while the Work is in progress. Schedule the Work with Owner, utilities, and others to minimize interference or delays.

B. If Owner-awarded contracts interfere with each other due to Work being performed at the same time or at the same Site, Owner will determine the sequence of Work under all contracts according to WORK SEQUENCE and CONTRACTOR'S USE OF SITE AND PREMISES Articles in this Section.

1.4 OWNER-FURNISHED PRODUCTS

A. Owner's Responsibilities:
1. Arrange for and deliver Owner-reviewed Shop Drawings, Product Data, and Samples to Contractor.
2. Arrange and pay for delivery to Site.
3. Upon delivery, inspect products jointly with Contractor.
4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:
1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.
2. Receive and unload products at Site; inspect for completeness or damage jointly with Owner.
3. Repair or replace items damaged after receipt.
4. Handle, store, install, and finish products.

1.5 SUBSURFACE UTILITY CONDITIONS

A. Coordinate Work with utilities of Owner and public or private agencies. Verify locations of utilities and facilities which may exist by contacting the utility locating service for the state where Work is performed. Provide advance notice to and utilize services of Alabama 811 for location and marking of underground utilities operated by utility agencies other than the Owner.
1. Contact information: Alabama 811
   a. Address: 3104 Bates Lane, Fultondale, AL 35067
   b. Phone number: 800-292-8525 or 205-731-3200
   c. Website: www.al1call.com
2. In addition, the contractor shall notify the plant superintendent at least two working days prior to excavation in order to allow for proper marking of existing utilities.
3. Maintain electrical, telephone, water, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.

B. Exercise reasonable care to verify location of existing subsurface facilities and utilities.

C. Areas immediate and adjacent to planned excavations shall be thoroughly checked by means of visual examination and with electronic metal and pipe detection equipment for indications of underground utilities and facilities.

D. Make exploratory excavation where existing underground facilities or utilities may potentially conflict with proposed excavations and facilities, or where there is reasonable cause to verify the presence or absence of underground facilities or utilities. Expose sanitary and storm sewers, water, gas, electric, communication lines, and other underground facilities to permit survey location prior to commencement of Work in affected area:
1. Conduct exploratory excavations prior to proceeding with major excavation in the area, and sufficiently in advance of construction to avoid possible delays to the Work. Promptly take measurements, photographs, and obtain survey data.
2. Notify the Owner when Work will be in progress. Make arrangements for potential emergency repairs in accordance with standards of utility owners, including individual or residential facilities.
3. Assume responsibility for repair of facilities damaged by performance of the Work.

E. Relocation of Existing Utilities: During construction it is expected that minor relocations of existing utilities, beyond those explicitly indicated on drawings, will be necessary as part of the Work.
   1. When relocation of utilities is required as part of the Work, perform in accordance with the standards of affected utility owner. Match materials of existing utilities unless otherwise directed.
   2. Adjustment to contract price and contract time for concealed conditions, if any, will be made as stipulated in conditions of the Contract.

F. Construction Plan: Before start of construction, post electronic file to web-based project management software of construction plan regarding access to Work, use of Site, and utility outages for acceptance by Owner. After acceptance of plan, construction operations shall comply with accepted plan unless deviations are accepted by Owner in writing.

1.6 OWNER OCCUPANCY

A. Schedule and substantially complete designated portions of the Work, as designated in Specification 01 14 00 – Work Restrictions, for Owner's use and occupancy before Substantial Completion of the entire Work.
   1. Owner's use and occupancy of designated areas before Substantial Completion of entire Project do not relieve Contractor of responsibility to maintain specified insurance coverages on a 100 percent basis until date of final payment.

B. Owner will occupy Site during entire period of construction for conduct of normal operations. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

C. Schedule Work to accommodate Owner occupancy.

1.7 PERMITS

A. Secure and pay for all necessary permits for construction of Work, including but not limited to the following:
   1. Building permits including plumbing, mechanical, and electrical.
   2. Stormwater permit. It is the Contractor's responsibility to maintain the required controls and record keeping complying with the SWPPP and associated stormwater permit.
   3. OSHA excavation permit.
   4. Department of Transportation permits.

B. Comply with codes, ordinances, regulations, orders, and other legal requirements of public authorities having bearing on the performance of the Work.

1.8 SPECIFICATION CONVENTIONS

A. Specification Arrangement: Specification section numbers and formatting are in CSI Three-Part Section format, and in accordance with CSI MasterFormat™, except where departures have been deemed necessary.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
   2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.

3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. "Provide" means to manufacture, fabricate, deliver, furnish, install, complete, assemble, erect in place, test, render ready for use or operation, including necessary related material, labor, appurtenances, services, and incidentals.
5. Related documents and sections: the Contract Documents are complementary; what is called for by one is as binding as if called for by all.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.9 DESIGN CRITERIA

A. Project Design Criteria: All equipment and materials for the project are to be suitable for performance in the **Hilliard N Fletcher WRRF** environment and under the following conditions:
1. Outdoor temperatures: 0 to 105 degrees F.
2. Indoor process area temperatures: 50 to 105 degrees F.
3. Indoor conditioned spaces: 50 to 90 degrees F.
4. Design groundwater elevation: 40 Ft El.
5. Frost line is assumed 7.0 below grade.
6. Moisture conditions: Defined in Specification Sections.
7. Site elevation: Generally ranges from 148.0to 166.0 feet above mean sea level.
8. Use anchor bolts, bolts, or welded studs for anchors for resisting seismic and wind forces. Anchor bolts used to resist seismic and wind forces shall have a standard hex bolt head embedded in the concrete. Do not use anchor bolts fabricated from rod stock with an L or J shape.
9. Do not use chemical anchors, concrete anchors, flush shells, powder actuated fasteners, sleeve anchors, or other types of anchors unless indicated on the Drawings or accepted in writing by the Engineer.
10. Seismic and wind forces must be resisted by direct bearing on the fasteners used to resist seismic and wind forces.
11. Complete shop drawings, seismic calculations, and wind calculations signed and sealed by a civil or structural engineer licensed in the state where the Project is located.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 10 14 – WORK RESTRICTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Work restrictions.
   2. Work sequencing.

B. Related Requirements:
   1. Section 01 20 00 - Price and Payment Procedures.
   2. Section 01 32 16 - Construction Progress Schedule.
   3. Section 01 50 00 - Temporary Facilities and Controls
   4. Section 01 70 00 - Execution Requirements
   5. Section 01 77 00 - Closeout Procedures

1.2 GENERAL WORK RESTRICTIONS

A. Wastewater Treatment Facilities
   1. The existing Hilliard N. Fletcher WRRF facility is the City of Tuscaloosa's only means of treating domestic and industrial wastewater prior to discharge. Impairing the operational capabilities of this facility will result in serious environmental damage and monetary fines.
   2. Contractor shall bear the cost of penalties imposed on the Owner for discharge violations or other violations caused by actions of the Contractor.
   3. Conduct work in a manner that will not impair the operational capabilities of essential elements of the treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quality of raw wastewater to the water quality limitations specified in the discharge permit.
   4. The status of the treatment plant shall be defined as "operational" when it is capable of treating the entire quantity of wastewater received to the water quality limits specified in the discharge permit.

B. Time Restrictions for Performing Work: Regular operating hours as determined by the Owner are from 7 am to 5 pm Monday through Friday.

C. On-Site Work Day Restrictions: Do not perform Work on Site during Work blackout days indicated by Owner.

D. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction (AHJ).

E. Provide safe, continuous access to process control equipment for plant operations personnel.

F. Noise, Vibration, Dust, and Odors: Coordinate with Owner operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy.
   1. Notify Engineer or Owner not less than two days in advance of proposed disruptive operations.
   2. Obtain Engineer's or Owner's written permission before proceeding with disruptive operations.

G. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, marijuana, and other controlled substances on Project Site, premises, or on Owner's property is not permitted.

H. Employee Identification: Provide identification tags for Contractor personnel working on Project Site. Require personnel to use identification tags at all times.

I. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project Site.
   1. Maintain list of approved screened personnel with Owner's representative.

1.3 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor shall have limited use of Project Site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Limits on Use of Site: Limit use of Project Site to Work in areas indicated. Do not disturb portions of Project Site beyond areas in which the Work is indicated.

C. Limits on Use of Site:
   1. Limit use of Site and premises to allow:
      a. Owner occupancy.
      b. Work by Owner.
      c. Work by Others.
      d. Use by the public where required.
   2. Driveways, Walkways, and Entrances: Keep driveways, parking areas, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
      a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
      b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on Site.

D. Construction Operations: Limited to areas indicated on Drawings.
   1. Noisy and Disruptive Operations (such as Use of Jack Hammers and Other Noisy Equipment): Not allowed in close proximity to existing building during regular hours of operation. Coordinate and schedule such operations with Owner to minimize disruptions.

E. Sound Level Restrictions: Sound pressure level measured at boundary of Site shall not exceed levels required by local ordinances or codes, and at no time shall exceed **40** dBA

1.4 FACILITY OPERATIONS

A. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions, and only after arranging for temporary utility services according to requirements indicated:
   1. Notify Engineer and Owner not less than seven days in advance of proposed utility interruptions.
   2. Submit outage request plan to Engineer and Owner itemizing dates, times, and duration of each requested outage.
   3. Obtain Owner’s written permission before proceeding with utility interruptions.

B. Existing Operations Interruptions: Do not shutdown, interrupt, or otherwise impair the operational capability of treatment facilities or processes unless permitted under the following conditions. A facility or process shall be considered operational when it can achieve its defined treatment or process objective as defined by the Owner or Engineer.

1. Indicate required shutdowns of existing facilities or interruptions of existing operations on Construction Progress Schedule.
2. Where required to minimize interruptions or impairments to systems operations while complying with specified work constraints, provide temporary treatment equipment, pumping, bypass systems, connections, power, lighting, controls, instrumentation, and safety devices.
3. Do not remove or demolish systems required to keep the existing facilities operational at the capacities specified until the existing systems are replaced by temporary or new systems.

C. Shutdown Constraints: Perform work within the following critical operational constraints:
1. Contractor shall coordinate all scheduled outages with the Engineer, the Plant Superintendent, and Chief Operator in accordance with 01 31 00, PROJECT MANAGEMENT AND COORDINATION

D. Shutdown Definitions
1. Minor Shutdown: Any shutdown requiring less than **four** (4) hours.
2. Major Shutdown: Any shutdown other than a minor shutdown.
3. Dry Weather Period: Generally, **June 1** to **October 1**. Final determination made by Owner based on weather, flows entering the plant, and plant operation requirements.
4. Wet Weather Period: Any time not within the defined dry weather period.
5. Low Flow Period: **2:00am** to **6:00am**.

E. Shutdown Procedures
1. Notify Engineer and Owner not less than **fourteen** (14) days in advance of proposed minor shutdowns.
2. Notify Engineer and Owner not less than **thirty** (30) days in advance of proposed major shutdowns.
3. Contractor shall schedule a shutdown coordination meeting with Owner and Engineer one week prior to each shutdown.
4. Any and all plant shutdowns shall require a shutdown plan, including detailed schedule, backup tools and equipment, personnel involved, contingency plan, and any procedures involved in restarting the process or facility.
5. Obtain Engineer's or Owner's written permission before proceeding with proposed shutdowns.
6. Shutdowns will only be allowed in dry weather periods. Shutdowns may be limited to low flow periods.

1.5 WORK SEQUENCE

A. Use identified work sequences in this section as a guideline for scheduling and performing work. Perform work in a manner that will not prevent the facility from achieving the final treated water quality requirements established by regulation.

B. Work sequence and constraints presented do not include all items affecting completion of the Work. They are intended to describe critical events necessary to minimize disruption to existing operations and to ensure compliance with treatment regulations and permit requirements.

C. Construct Work in phases during construction period. Coordinate construction schedule and operations with **Engineer** and **Owner**:
1. Replacement of Screening Conveyance Equipment and Associated Controls
a. Contractor to install:
1) New shaftless screw conveyor
2) Relocate existing washer/compactor to new location as indicated on the drawings.

3) Install new flush water feed and drain piping for relocated washer/compactor.
4) Install all control panels and appurtenances as required
5) Install new electric motor actuators on the existing slide gates indicated in the drawings.

2. Mechanically cleaned bar screens:
   a. Contractor shall only work in one channel at a time.
      1) Prior to replacing mechanically cleaned bar screens, Contractor shall remove any debris, trash, or material that may clog the 6-inch drain pipe directly underneath screening channels.
      2) Contractor shall install 6-inch channel drain piping and valves. The 4-inch plug valve on the drain pipe associated with 101SCR2 shall be installed at this time.
      3) Contractor shall coordinate temporary shutdown of the influent pump station and screening channel draining with the Owner to install temporary bulkheads at the start and end of each screening channel. The influent pump station can only be taken down for a maximum of 45 minutes.
      4) Replace existing slide gate seals.
      5) Demolish existing bar screen.
      6) Install new owner-furnished mechanically cleaned bar screen.
   b. Contractor to coordinate with the Owner to bring channel back online.
   c. Contractor to performance test new mechanically cleaned bar screen in accordance with Specification Section 44 42 27.19 Mechanically Cleaned Bar Screen.

1.6 SEQUENCING OF CONSTRUCTION PLAN

A. Before start of construction, post electronic file to Project website of construction plan regarding phasing of project and new Work for acceptance by Owner. After acceptance of plan, comply with accepted plan when coordinating construction sequencing unless deviations are accepted by Owner in writing.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
1. Cash allowances.
2. Contingency allowances.
3. Testing and inspection allowances.
4. Schedule of Values.
5. Application for Payment.
6. Partial Payments.
7. Defect assessment.
8. Unit prices.
9. Alternates.

1.2 BID ITEM DESCRIPTIONS

A. The Basis of Payment will be as established in the Contract Documents and as described below:
1. Base Bid

Base Bid Item No.	Item	Unit	Description
1.	Mobilization/ Demobilization	LS	The Work shall consist of the mobilization and demobilization of the Contractor's forces, equipment, and performance and payment bonding necessary for performing the work required under this Contract. Mobilization shall include temporary facilities as specified in Section 01 50 00. Demobilization shall include removal of temporary facilities and completion of closeout procedures as specified in Section 01 77 00. Total payment for this bid item will not exceed 5 percent of the contractor's base bid price. Payments for mobilization shall not exceed 75% of the total item. A minimum of 25% will be retained until such time that demobilization is complete, and the areas disturbed have been fully restored and accepted by the Owner.
2.	Facility 10- Headworks Improvements	LS	Work item includes all materials, labor, equipment, and appurtenance costs including but not limited to the installation the Owner furnished mechanically cleaned bar screens and shaftless screw conveyor systems, associated process piping, selective demolition as required, replacement of channel grating, handrail, control panel mounting, rehabilitation of the existing channel isolation gates, retrofit of existing gates with electric motor operators, relocation of existing washer/compactor and associated modifications to discharge chute, electrical and SCADA integration as indicated on the drawings and specifications herein.

3.	Contingency Allowance	Allowance	This allowance provides for the costs associated with any additional work as directed by the Owner/Engineer. No work to be billed from the allowance shall be started without prior authorization in writing from either the Owner or Engineer.

1.3 CONTINGENCY ALLOWANCES

A. Refer to the Bid Form for Contingency Allowance schedule.

B. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead, and profit will be included in Change Orders authorizing expenditure of funds from this contingency allowance.

C. Funds will be drawn from contingency allowance only by Change Order.

D. At closeout of Contract, funds remaining in contingency allowance will be credited to Owner by Change Order.

1.4 SCHEDULE OF VALUES

A. Submit electronic file to Project website of schedule on Progress Estimate schedule on EJCDC C-620 or form approved by Engineer and Owner. Document shall be a Microsoft Excel file type.

B. Apparent “low-bidder” shall submit a preliminary Schedule of Values as electronic file within 2 days after bid opening.

C. Submit complete Schedule of Values as electronic file to Project website within 10 days after date of Owner-Contractor Agreement.

D. Format: Use Table of Contents of this Project Manual. Identify each line item with number and title of major Specification Section. Also identify mobilization, bonds and insurance, progress schedule development, startup and commissioning, contract close-out, and demobilization as separate line items.

E. Include in each line item amount of allowances as specified in this Section. For unit cost allowances, identify quantities taken from Contract Documents multiplied by unit cost to achieve total for each item.

F. Include within each line item, direct proportional amount of Contractor's overhead and profit.

G. Revise schedule to list approved Change Orders with each Application for Payment.

H. An unbalanced or front-loaded schedule of values, or a schedule of values substantially different than the preliminary schedule, will not be accepted.

I. Summation of the complete schedule of values representing all Work shall equal the Contract Price.

1.5 APPLICATION FOR PAYMENT

A. Submit electronic file to project management website of each Application for Payment on EJCDC C-620 - Contractor's Application for Payment or similar form approved by Engineer and Owner.

B. Content and Format: Use Schedule of Values for listing items in Application for Payment.

C. Submit updated construction schedule with each Application for Payment.

D. Payment Period: Submit at intervals stipulated in the Agreement.

E. Submit submittals with transmittal letter as specified in Section 01 33 00 - Submittal Procedures.

F. Substantiating Data: When Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
   1. Current construction photographs specified in Section 01 33 00 - Submittal Procedures.
   2. Partial release of liens from major Subcontractors and vendors.
   3. Record Documents as specified in Section 01 77 00 - Closeout Procedures, for review by Owner, which will be returned to Contractor.
   4. Affidavits attesting to off-Site stored products.
   5. Construction Progress Schedule, revised and current as specified in Section 01 33 00 - Submittal Procedures.

1.6 PARTIAL PAYMENTS FOR STORED MATERIALS

A. No payments will be made for materials and equipment delivered or stored unless shop drawings and preliminary operations and maintenance manuals are accepted by Engineer. Thereafter, partial payments for materials and equipment delivered and stored, but not yet incorporated into the Work, shall not exceed 90% of the material value.

B. Storage must meet the requirements of the General Conditions, be deemed acceptable by the Engineer and Owner, be located on the Site or a location agreed to by the Engineer and Owner, and meet the documented storage recommendations from the material manufacturer.

1.7 PARTIAL PAYMENTS FOR UNDELIVERED FABRICATED EQUIPMENT

A. No partial payments will be made for project-specific fabricated equipment except those specifically listed below and under the terms listed herein. Undelivered “Off the shelf” or catalog items are not eligible for partial payment.

B. Payment shall not exceed 15% of the equipment value, not including shipping and handling charges.

C. Payment will only be made when the following conditions are met:
   1. Shop drawing and preliminary operations and maintenance manual acceptance by Engineer.
   2. Equipment is adequately insured, maintained, stored, and protected by appropriate security measures.
   3. Each equipment items is clearly marked and segregated from other items to permit inventory and accountability.
   4. Authorization has been provided access to storage site for Engineer and Owner.

1.8 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of Engineer or Owner, it is not practical to remove and replace the Work, Engineer or Owner will direct appropriate remedy or adjust payment. Potential remedies may include:
   1. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Engineer or Owner.
   2. Defective Work will be partially repaired according to instructions of Engineer or Owner, and unit sum/price will be adjusted to new sum/price at discretion of Engineer or Owner.

C. Individual Specification Sections may modify these options or may identify specific formula or percentage sum/price reduction.

D. Authority of Engineer or Owner to assess defects and identify payment adjustments is final.

E. Nonpayment for Rejected Products: Payment will not be made for rejected products for any of the following reasons:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from transporting vehicle.
   4. Products placed beyond lines and levels of the required Work.
   5. Products remaining on hand after completion of the Work.
   6. Loading, hauling, and disposing of rejected products.

1.9 UNIT PRICES

A. Engineer will take measurements and compute quantities accordingly. Provide assistance in taking of measurements.

B. Unit Quantities: Quantities and measurements indicated on Bid Form are for Contract purposes only. Quantities and measurements supplied or placed in the Work shall determine payment. Actual quantities provided shall determine payment.
   1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at contracted unit sum/prices.
   2. When actual Work requires 25 percent or greater change in quantity than those quantities indicated, Owner or Contractor may claim a Contract Price adjustment.

C. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application, or installation of item of the Work; overhead and profit.

D. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.

E. Measurement of Quantities:
   1. Weigh Scales: Inspected, tested, and certified by applicable Alabama weights and measures department within past year.
   2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
   3. Metering Devices: Inspected, tested, and certified by applicable Alabama department within past year.

4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel, or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
5. Measurement by Volume: Measured by cubic dimension using mean length, width, and height or thickness.
6. Measurement by Area: Measured by square dimension using mean length and width or radius.
7. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
8. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Quality assurance.
   2. Product options.
   3. Product substitution procedures.

1.2 QUALITY ASSURANCE

A. Contract is based on products and standards established in Contract Documents without consideration of proposed substitutions.

B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.

C. Substitution Proposals: Permitted for specified products except where specified otherwise. Do not substitute products unless substitution has been accepted and approved in writing by Owner.

1.3 PRODUCT OPTIONS

A. See Section 01 60 00 - Product Requirements.

1.4 PRODUCT SUBSTITUTION PROCEDURES

A. Document 00 21 00 - Instructions to Bidders specifies time restrictions for submitting requests for substitutions during Bidding period.

B. Engineer will not consider requests for substitutions prior to the date of the Owner-Contractor Agreement.

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

D. Document each request with complete data, substantiating compliance of proposed substitution with Contract Documents, including:
   1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.
   2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance, and other pertinent characteristics.
   3. Reference to Article and Paragraph numbers in Specification Section.
   4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.
   5. Impact to Contract time.
   6. Changes required in other Work.
   7. Availability of maintenance service and source of replacement parts as applicable.
   8. Certified test data to show compliance with performance characteristics specified.
   9. Samples when applicable or requested.
   10. Other information as necessary to assist Engineer's evaluation.

E. A request constitutes a representation that Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
2. Will provide same warranty for substitution as for specified product.
3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension that may subsequently become apparent.
5. Will coordinate installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.
6. Will reimburse Owner, and Engineer if applicable, for review or redesign services associated with reapproval by authorities having jurisdiction.

F. 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.

G. Substitution Submittal Procedure:
1. Submit requests for substitutions on form approved by Engineer and Owner.
2. Submit electronic files to Project website of Request for Substitution for consideration. Limit each request to one proposed substitution.
3. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
4. Engineer will notify Contractor in writing of decision to accept or reject request.

1.5 INSTALLER SUBSTITUTION PROCEDURES

A. Engineer will consider requests for substitutions within 30 days after date of Owner-Contractor Agreement. Requests received after that time may be considered or rejected at discretion of Engineer.

B. Document each request with:
1. Installer's qualifications.
2. Installer's experience in work similar to that specified.
3. Other information as necessary to assist Engineer's evaluation.

C. Substitution Submittal Procedure:
1. Submit electronic files to Project website of Request for Substitution for consideration. Limit each request to one proposed substitution.
2. Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 26 00 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Field Orders
   2. Change Proposals.
   3. Work Change Directives
   4. Change Orders.

1.2 CHANGE PROCEDURES

A. Submittals: Submit name of individual who is authorized to receive change documents and is responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. Carefully study and compare Contract Documents before proceeding with fabrication and installation of Work. Promptly advise Engineer of any error, inconsistency, omission, or apparent discrepancy.

C. Requests for Interpretation (RFI) and Clarifications: Allot time in construction scheduling for liaison with Engineer; establish procedures for handling queries and clarifications.
   1. Use form and method acceptable to Engineer for requesting interpretations.
   2. Engineer may respond with a direct answer on the Request for Interpretation form, or within the project management website used for submittals and RFIs according to Section 013300 – Submittal Procedures.

1.3 FIELD ORDERS

A. Engineer will advise of minor changes in the Work not involving adjustment to Contract Price or Contract Time by issuing supplemental instructions on EJCDC C-942 or other similar form.

B. Contractor shall acknowledge receipt by signing and returning one electronic copy to Engineer.

1.4 CHANGE PROPOSALS

A. Engineer may, in anticipation of ordering a revision to the Work, issue to the Contractor a Proposal Request including a detailed description and/or supplementary drawings and specifications.

B. Proposal Requests are not instructions either to stop work in progress or to execute the proposed change.

C. Contractor will prepare and submit, within 10 days, a detailed response to the Proposal Request with a detailed breakdown of proposed change in Contract Price and Contract Time. The proposed change in cost and time shall remain firm for a minimum period of 30 days after receipt by Engineer or Owner.

D. Contractor may submit a Change Proposal to the Engineer without receipt of a Proposal Request, describing proposed change and its full effect on the Work. Include a statement describing reason for the change and the effect on Contract Price and Contract Time with full documentation and a statement describing effect on the Work by separate or other Contractors.

1.5 WORK CHANGE DIRECTIVES

A. Work Directive Change**:** Engineer may issue directive, on EJCDC C-940 - Work Change Directive or similar form signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work and designate method of determining any change in Contract Price or Contract Time. A Work Change Directive is not a Change Order.

B. Promptly execute the change described in the Work Change Directive.

C. Contractor shall keep detailed records of work performed as a result of a Work Change Directive to substantiate resulting change in Contract Time or Contract Price. Detailed records may include but are not limited to the following:
   1. Date the work was performed
   2. Parties performing the work
   3. Time records, wage rates paid, and equipment rental rates
   4. Invoices and receipts for materials, equipment, and subcontracts.

1.6 CHANGE ORDERS

A. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

B. Change Order Forms: EJCDC C-941 - Change Order or similar form.

C. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation.

D. Unit Price Change Order: For Contract unit prices and quantities, the Change Order will be executed on a fixed unit price basis. For unit costs or quantities of units of that which are not predetermined, execute Work under Work Directive Change. Changes in Contract Price or Contract Time will be computed as specified for Time and Material Change Order.

E. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Engineer will determine change allowable in Contract Price and Contract Time as provided in Contract Documents.

F. Maintain detailed records of Work done on time and material basis. Provide full information required for evaluation of proposed changes and to substantiate costs for changes in the Work.

G. Document each quotation for change in Project Cost or Time with sufficient data to allow evaluation of quotation.

H. Correlation of Contractor Submittals:
   1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Price.
   2. Promptly revise Progress Schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of Work affected by the change and resubmit.
   3. Promptly enter changes in Record Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 30 00 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Coordination and Project conditions.
   2. Requests for Information.
   3. Construction safety plan.
   4. Web-based project management software.
   5. Project meetings.

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various Sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Verify that 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 operating equipment in service.

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

D. Coordination Drawings
   1. Prepare as required to coordinate all portions of Work. Show relationship and integration of different construction elements that require coordination during fabrication or installation to fit in space provided or to function as intended. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important.
   2. Content shall be drawn to scale and large enough to indicate and resolve conflicts.
   3. Indicate functional and spatial relationships of architectural, structural, civil, mechanical, and electrical systems.
   4. Indicate space requirements for code or maintenance required clearances.

E. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.

F. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of Work of separate Sections in preparation for Substantial Completion and for portions of Work designated for Owner's occupancy.

H. After Owner's occupancy of premises, coordinate access to Site for correction of defective Work and Work not complying with Contract Documents, to minimize disruption of Owner's activities.

1.3 REQUESTS FOR INFORMATION

A. Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

B. Coordinate and submit RFIs in a prompt manner to avoid delays in Work.

C. RFI Content: Include detailed description of item needing information or interpretation and the following:
   1. Project name
   2. Owner name
   3. Owner project number
   4. Engineer name
   5. Engineer project number
   6. Date
   7. Contractor name
   8. RFI number
   9. RFI subject
   10. Specification section number, title, and related paragraphs, as appropriate
   11. Drawing number and detail references, as appropriate
   12. Field dimensions and pictures, as appropriate
   13. Contractor suggested resolution. If suggested resolution impacts Contract Time or Contact Price, it shall be explicitly stated in the RFI.

D. Engineer will review and response to RFIs. Incomplete, inaccurate, or frivolous RFIs will be returned without response.

E. Engineer's response may result in a change to the Contract Time or Contract Price. If Contractor believes response warrants this change, notify the Engineer in writing no more than 5 days from receipt of RFI response, and submit Change Proposal according to Section 01 26 00 – Contract Modification Procedures.

F. RFI shall be submitted through the web-based project management software system.

1.4 CONSTRUCTION SAFETY PLAN

A. Detail the methods and procedures to comply with federal, state, and local health and safety laws, rules, and requirements for the duration of the Contract Times. Include the following:
   1. Identification of the Certified or Licensed Safety Consultant, who will prepare, initiate, maintain, and supervise safety programs, and procedures.
   2. Procedures for providing workers with an awareness of safety and health hazards expected to be encountered during construction.
   3. Safety equipment appropriate to the safety and health hazards expected to be encountered during construction. Include warning devices, barricades, safety equipment in public right-of-way and protected areas, and safety equipment used in multi-level structures.
   4. Methods for minimizing employees' exposure to safety and health hazards expected during construction.
   5. Procedures for reporting safety or health hazards.
   6. Procedures to follow to correct a recognized safety and health hazard.
   7. Procedures for investigation of accidents, injuries, illnesses, and unusual events that have occurred at the construction site.
   8. Periodic and scheduled inspections of general work areas and specific workstations.
   9. Training for employees and workers at the jobsite.
   10. Methods of communication of safe working conditions, work practices and required personal protection equipment.

B. Assume responsibility for every aspect of health and safety on the jobsite, including the health and safety of subcontractors, suppliers, and other persons on the jobsite:
   1. Forward available information and reports to the Safety Consultant who shall make the necessary recommendations concerning worker health and safety at the jobsite.

2. Employ additional health and safety measures specified by the Safety Consultant, as necessary, for workers in accordance with OSHA guidelines.

C. Transmit to Owner and Engineer copies of reports and other documents related to accidents or injuries encountered during construction.

1.5 WEB-BASED PROJECT MANAGEMENT SOFTWARE PACKAGE

A. Web-Based Project Management Software Package: Use Engineer's Newforma web-based Project management software package for purposes of hosting and managing Project communication and documentation until final completion.
   1. Web-based Project management software includes, at a minimum, the following features:
      a. Compilation of Project data, including Contractor, Subcontractors, Engineer, Engineer's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
      b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
      c. Document workflow planning, allowing customization of workflow among Project entities.
      d. Create, log, track, and notify Project members of Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, minor changes in the Work, Construction Change Directives, and Change Orders.
      e. Track status of each Project communication in real time, and log time and date when responses are provided.
      f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
      g. Process and track payment applications.
      h. Process and track contract modifications.
      i. Create and distribute meeting minutes.
      j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
      k. Management of construction progress photographs.
      l. Mobile device compatibility, including smartphones and tablets.

1.6 DIGITAL PROJECT DATA LICENSING

A. Engineer's Data Files Not Available: Engineer will not provide Engineer's BIM model or CAD drawing digital data files for Contractor's use during construction.

1.7 PRECONSTRUCTION MEETING

A. Engineer will schedule a preconstruction meeting at a mutually agreeable time after Notice of Award.

B. Attendance Required: Engineer, Owner, Resident Project Representative, any appropriate governmental agency representatives, major Subcontractors, Contractor, and others necessary to agenda.

C. Minimum Agenda: Attendees shall be prepared to discuss the following:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of Subcontractors, list of products, schedule of values, and Progress Schedule.
   5. Designation of personnel representing parties in Contract, and Engineer.

6. Communication procedures.
7. Procedures and processing of requests for interpretations, field decisions, field orders, submittals, substitutions, Applications for Payments, proposal request, Change Orders, and Contract closeout procedures.
8. Scheduling.
9. Critical Work sequencing.
10. Scheduling activities of Surveyors.
11. Construction waste management plan.
12. Safety plan.
13. Use of premises by Owner and Contractor.
14. Owner's requirements and partial occupancy.
15. Construction facilities and controls provided by Owner.
16. Temporary utilities provided by Owner.
17. Survey and building layout.
18. Security and housekeeping procedures.
19. Procedures for testing.
20. Procedures for maintaining record documents.
21. Requirements for startup of equipment.
22. Inspection and acceptance of equipment put into service during construction period

D. Engineer: Will preside over meeting and record minutes and distribute copies to participants, with one electronic copy each to Engineer, Owner, Contractor, and those affected by decisions made.

1.8 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at weekly intervals. Meetings to take place in Contractor’s field office, Engineer’s field office, or mutually agreed upon place.

B. Contractor will make arrangements for meetings and prepare agenda with copies for participants.

C. Attendance Required: Job superintendent, major Subcontractors, Contractors and suppliers, and Engineer and Owner as appropriate to agenda topics for each meeting.

D. Minimum 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 submittal 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.

E. Contractor: Record minutes and distribute copies to participants within seven days after meeting, with one electronic copy each to Engineer, Owner, and those affected by decisions made.

1.9 PREINSTALLATION MEETINGS

A. Scheduled by Contractor on a regular basis and as necessary to coordinate with manufacturers and installers before starting Work of major units of construction.

B. Require attendance of parties directly affecting, or affected by, the Work.

C. Notify Engineer and subcontractors seven days in advance of meeting date.

D. Prepare agenda and preside over meeting:
   1. Review conditions of installation, preparation, and installation procedures.
   2. Review coordination with related Work.

E. Record minutes and distribute copies to participants within three days after meeting, with an electronic copy each to Engineer, Owner, and those affected by decisions made.

1.10 FACILITY STARTUP MEETINGS

A. Schedule and preside over facility startup meetings prior to startup and testing of major process equipment. Prepare a facility startup plan for each process facility as specified in Specification 01 75 00 – Startup Testing and Training.

B. Agenda shall include discussion of the facility startup plan including coordination needed between various parties and identified risks with proposed mitigation action plan.

C. Attendees will include Contractor, Engineer's representative, Owner, subcontractors and equipment manufacturers, and others deemed necessary.

1.11 CLOSEOUT MEETING

A. Schedule Project closeout meeting with sufficient time to prepare for requesting Substantial Completion. Preside over meeting and be responsible for minutes.

B. Attendance Required: Contractor, major Subcontractors, Engineer, Owner, and others appropriate to agenda.

C. Notify Engineer seven days in advance of meeting date.

D. Minimum Agenda:
   1. Start-up of facilities and systems.
   2. Operations and maintenance manuals.
   3. Testing, adjusting, and balancing.
   4. System demonstration and observation.
   5. Operation and maintenance instructions for Owner's personnel.
   6. Contractor's inspection of Work.
   7. Contractor's preparation of an initial "punch list."
   8. Procedure to request Engineer inspection to determine date of Substantial Completion.
   9. Completion time for correcting deficiencies.
   10. Inspections by authorities having jurisdiction.
   11. Certificate of Occupancy and transfer of insurance responsibilities.
   12. Partial release of retainage.
   13. Final cleaning.
   14. Preparation for final inspection.
   15. Closeout Submittals:
      a. Project record documents.
      b. Operating and maintenance documents.
      c. Operating and maintenance materials.
      d. Affidavits.
   16. Final Application for Payment.
   17. Contractor's demobilization of Site.

18. Maintenance.

E. Record minutes and distribute copies to participants within two days after meeting, with one electronic copy each to Engineer, Owner, Construction Manager, and those affected by decisions made.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 16 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Project schedules.
   2. Review and evaluation.
   3. Updating schedules.
   4. Adjustment of Contract Times

1.2 QUALITY ASSURANCE

A. The Contractor shall provide a schedule for the project based on the Critical Path Method (CPM).

B. Scheduler: Contractor's personnel specializing in CPM scheduling with two years' minimum experience in scheduling construction work of complexity comparable to the Project and having use of computer facilities capable of delivering detailed graphic printout within 48 hours of request.

C. Software: Prepare computerized schedule using Primavera or Microsoft Project, most current versions. Provide one licensed copy of the software to the Engineer for the duration of the project.

D. Make all schedule submittals as electronic files using the web-based project management software specified in 01 30 00 – Administrative Requirements.

1.3 PRELIMINARY SCHEDULE

A. Within 10 days after date of Owner-Contractor Agreement, and at least 7 days prior to the preconstruction meeting, submit proposed preliminary schedule in Gannt chart format defining planned operations for first 60 days of Work, with general outline for remainder of Work. Work activities depicted on the schedule shall include, but are not limited to:
   1. Notice to Proceed
   2. Permits
   3. Submittals
   4. Early procurement activities
   5. Site work
   6. Work sequences
   7. Contract milestones and completion dates
   8. Major facility Work
   9. System start-up summary
   10. Project close-out summary

B. Preliminary schedule shall be accompanied by a list of all shop drawings and submittals anticipated for the project. Acceptance of submittal schedule is required for payment application approval.

C. Participate in review of preliminary schedule jointly with Engineer within 10 calendar days of submission.

D. Within 20 days after joint review of proposed preliminary schedule, submit draft of proposed complete schedule for review. Include written certification that major Subcontractors have reviewed and accepted proposed schedule.

E. An accepted preliminary schedule, in conjunction with the schedule of values specified in 01 20 00 Price and Payment Procedures, shall be the basis for progress payments for the first 60 days of Work. The preliminary schedule shall be updated monthly until the complete project schedule is approved.

1.4 COMPLETE SCHEDULE

A. Within 45 days after Notice of Award, submit complete cost loaded schedule using the Critical Path Method (CPM). The complete schedule shall show sequence and interdependence of all activities required for complete performance of all work, beginning with date of Notice to Proceed and concluding with date of final completion of Contract. Schedule shall be in Gannt Chart format.

B. Acceptance of the complete schedule is required for payment application approval after the first 60 days of Work.

C. Submit updated schedules every 30 days, as part of progress payment process. Failure to do so many result in the Owner withholding all or part of the monthly progress payment until the schedule is updated in a manner acceptable to Engineer.

1.5 COMPLETE SCHEDULE FORMAT

A. Provide a clear, legible, and accurate time-scaled logic diagram in Gantt chart format, indicating interdependence of activities and critical paths for the project.

B. In addition to native electronic file format, provide electronic PDF version in 22” x 34” drawing size.

C. Illustrate order and interdependence of activities and sequence of Work; how start of given activity depends on completion of preceding activities, and how completion of activity may restrain start of subsequent activities.

D. Illustrate complete sequence of construction by activity, identifying Work of separate stages. Indicate dates for submittals, including dates for Owner-furnished items, and return of submittals; dates for procurement and delivery of critical products; and dates for installation and provision for testing. Include legend for symbols and abbreviations used.

E. Complete schedule shall include all Work activities with the potential to delay project construction, including construction activity, procurement and submittal review activity, Owner activities, startup activities, and closeout activities.

F. Schedules shall include provisions for Weather Days as defined in the Contract Documents.

G. No activity, exclusive of submittal reviews and equipment lead times, shall have a duration longer than 15 days.

H. At a minimum identify the execution of the following, omitting items not applicable to Work:
1. Obtaining permits
2. Mobilization
3. Site work
4. Submittal reviews
5. Equipment lead times
6. Excavation and shoring
7. Dewatering
8. Concrete work, including installation of forms and reinforcement, placement of concrete, curing, finishing, and patching

9. Tests for leakage of concrete structures intended to hold water
10. Structural steel work
11. Masonry work
12. Framing work
13. Finish carpentry work
14. Architectural work.
15. Process equipment including pumps, conveyors, etc.
16. Building specialties
17. Process mechanical work including pipes, vales, gates, etc.
18. Building mechanical work including HVAC and plumbing
19. Electrical work
20. Instrumentation and Control work
21. Grading and paving
22. Fencing and landscaping
23. Testing and startup
24. Project close-out

I. Include the following information for each Work activity identified in the schedule:
1. Preceding and following event numbers.
2. Activity description.
3. Estimated duration of activity, in maximum 15-day intervals. Status of critical activities.
4. Earliest start date.
5. Earliest finish date.
6. Actual start date.
7. Actual finish date.
8. Latest start date.
9. Latest finish date.
10. Total and free float.
11. Monetary value of activity, keyed to Schedule of Values.
12. Percentage of activity completed.
13. Responsibility.

J. Required Sorts: List activities in sorts or groups:
1. By preceding Work item or event number from lowest to highest.
2. By longest float, then in order of early start.
3. By responsibility in order of earliest possible start date.
4. In order of latest allowable start dates.
5. In order of latest allowable finish dates.
6. Contractor's periodic payment request sorted by Schedule of Values list.
7. List of basic input data-generating report.
8. List of activities on critical path.

K. Prepare sub-schedules for each stage of Work and Sequencing of Construction Plan identified in Section 01 14 00 – Work Restrictions.

L. Cost Loading
1. Coordinate contents with Schedule of Values in Section 01 20 00 – Price and Payment Procedures.
2. The sum of all activity costs shall equal the Contract Price.

M. Produce a Summary Schedule alongside each updated Complete Schedule with consolidates groups of activities associated with major items of Work, intended to give an overall indication of the project schedule.

1.6 REVIEW AND EVALUATION

A. Participate in joint review and evaluation of schedules with Engineer at each submittal.

B. Evaluate Project status to determine Work behind schedule and Work ahead of schedule.

C. After reviews, revise schedules incorporating results of review, and resubmit within 10 days.

D. When schedule reflects Owner's and Contractor's agreement of project approach and sequence, schedule will be accepted by Owner. Use accepted schedule for planning, organizing, directing Work, and reporting progress.

E. Engineer's acceptance of schedule will not make any change in Contract requirements. Schedule remains the Contractor's responsibility and Contractor retains responsibility for performing all activities, activity durations, and sequences required to perform the Work in accordance with the Contract Documents.

1.7 UPDATING SCHEDULES

A. Schedule Updates:
   1. Overall percent complete, projected and actual.
   2. Completion progress by listed activity and sub-activity, to within five working days prior to submittal.
   3. Changes in Work scope and activities modified since submittal.
   4. Delays in submittals or resubmittals, deliveries, or Work.
   5. Adjusted or modified sequences of Work.
   6. Other identifiable changes.
   7. Revised projections of progress and completion.

B. Narrative Progress Report:
   1. Submit with each monthly submission of Progress Schedule.
   2. Summary of Work completed during the past period between reports.
   3. Work planned during the next period.
   4. Explanation of differences between summary of Work completed and Work planned in previously submitted report.
   5. Current and anticipated delaying factors and estimated impact on other activities and completion milestones.
   6. Corrective action taken or proposed.

C. Maintain schedules to record actual start and finish dates of completed activities.

D. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update schedules to depict current status of Work.

E. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

F. Upon approval of a Change Order, include the change in the next schedule submittal.

G. Indicate changes required to maintain Date of Substantial Completion.

H. Submit sorts as required to support recommended changes.

I. Prepare narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken or proposed and its effect including effects of changes on schedules of separate Contractors, if applicable.

1.8 ADJUSTMENT OF CONTRACT TIMES

A. Contract time will be adjusted only for causes specified in Contract Documents. Reference the General Conditions and Section 01 26 00 – Contract Modification Procedures.

B. Project delays are defined in the following categories:
   1. Non-excusable Delay: Actions or inactions of the Contractor, or events for which the Contractor has assumed contractual responsibility (including actions or inactions of subcontractors or suppliers) which would independently delay the completion of the Work beyond the current Contract completion date shall be designated as non-excusable delay. The Contractor shall not receive any time extension for such delays.
   2. Excusable Delay: Events which are unforeseeable, outside the control of, and without the fault or negligence of either the Owner or the Contractor (or any party for whom either is responsible), which would independently delay the completion of the Work beyond the current Contract completion date shall be designated as excusable delay. The Contractor is entitled to a time extension only and shall not receive any other damages.
   3. Compensable Delay: Actions or inactions of the Owner, or events for which the Owner has assumed contractual responsibility, which would independently delay the completion of the Work beyond the current Contract completion date shall be designated as compensable delay. The Contractor is entitled to a time extension and delay damages.
   4. Concurrent Delay: Concurrent delay is any combination of the above three types of delay occurring on the same calendar date(s), except in cases where the combination consists of two or more instances of the same type of delay occurring on the same calendar date(s). When one cause of delay is Owner-caused or caused by an event which is beyond the control and without the fault or negligence of either the Owner or the Contractor and the other Contractor-caused, the Contractor is entitled only to a time extension and no delay damages.

C. If the Contractor believes that the Owner has impacted its work, such that the project completion date will be delayed, the Contractor must submit proof demonstrating the delay to the critical path. This proof, in the form of a Time Impact Analysis, may entitle the Contractor to an adjustment of Contract Time.

D. Time Impact Analysis:
   1. The Time Impact Analysis submitted by the Contractor shall utilize the accepted schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other Owner-caused delay). The Contractor shall represent the delay event in the schedule by 1) inserting new activities associated with the delay event into the schedule, 2) revising activity logic, or 3) revising activity durations.
   2. If the project schedule's critical path and completion date are impacted as a result of adding this delay event to the schedule, a time extension equal to the magnitude of the impact may be warranted.
   3. The Time Impact Analysis submittal shall consist of 1) a fragment of the portion of the schedule affected by the delay event, 2) a narrative explanation of the delay issue and how it impacted the schedule.

E. When a delay to the project as a whole can be avoided by revising preferential sequencing or logic, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.

F. Indicate clearly that the Contractor has used, in full, all project float available for the work involved in the request, including any float that may exist between the Contractor's planned completion

date and the Contract completion date. Utilize the latest version of the Schedule Update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the Contract Time.

G. Float shall be for the mutual benefit of the Owner and the Contractor. Adjustment of the Contract Times will be granted only when the Contract Float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the contract completion date. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.
   1. Float time is a Project resource available to both parties to meet contract Milestones and Contract Times.
   2. Use of float suppression techniques, such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity times are prohibited. Use of float time disclosed or implied by use of alternate float-suppression techniques shall be shared to proportionate benefit of Owner and Contractor.
   3. Pursuant to above float-sharing requirement, no time extensions will be granted nor delay damages paid until a delay occurs, which:
      a. Impacts Project's critical path,
      b. Consumes all available float or contingency time, and
      c. Extends Work beyond contract completion date.

H. Actual delays in activities which do not affect the critical path work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the contract time.

I. The new Progress Schedule data, if accepted by the Owner, shall be included in the next monthly Schedule Update.

J. When the Owner has not yet made a final determination as to the adjustment of the Contract Time, and the parties are unable to agree as to the amount of the adjustment to be reflected in the Progress Schedule, reflect an interim adjustment as acceptable to Engineer. It is understood and agreed that any such interim acceptance by the Engineer shall not be binding and shall be made only for the purpose of continuing to schedule the Work, until such time as a final determination as to any adjustment of the Contract Time acceptable to the Engineer has been made. Revise the Progress Schedule prepared thereafter in accordance with the final decision.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 33 – PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Preconstruction photos
   2. Periodic construction progress photos
   3. Post construction photos
   4. Video recordings

B. Related Sections:
   1. 01 75 00 – Startup Testing and Training for video recording requirements for training.

1.2 SUBMITTALS

A. Digital Photographs
   1. Submit construction progress image files monthly along with Application for Payment. Files shall be uploaded to web-based project management software.
   2. Contractor shall prepare, update, and submit a log of photos with each submittal of photos. Log shall historically track the submittal of photos in reverse order, i.e. most recent photos being first in the log. The log shall document the following information:
      a. Identify each photo for topic of discussion. Identify name of Project, Contract number, phase, orientation of view, date and time of view, name and organization of photographer.
   3. Deliver complete set of digital image electronic files on CD, DVD, or USB flash drive to Owner with Project record documents. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as sensor, uncropped.

B. Video Recordings
   1. Submit video recordings to web-based project management software, and on USB flash drive.
   2. Project Video Log: Maintain an ongoing log that incorporates date of coverage in year-month-day-time format followed by a short description of video coverage.

1.3 PHOTOGRAPH REQUIREMENTS

A. Provide photographs in digital format of Site and construction throughout progress of Work produced by an experienced photographer acceptable to Engineer.
   1. Digital Images: JPG format, produced by digital camera with minimum sensor size of 12 megapixels, image resolution of not less than 3200 x 2400 pixels, and image stabilization technology. Compression shall be set to preserve quality over file size. Resizing to a smaller size when high resolution JPGs are available shall not be permitted.
   2. Submit digital media as originally recorded without alternation, manipulation, or modification using image-editing software.
   3. File Naming: Include date and time in filename for each image, as well as item being photographed and orientation of photo. Keep file naming convention consistent for all digital photographs.

B. Preconstruction Photographs
   1. Before commencement of the Work, take photographs of Project Site and surrounding properties, including existing items to remain during construction, from different vantage points.

2. Take a minimum of 20 site photographs from different directions and 20 interior photographs of each building or structure to capture existing conditions. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

C. Concealed Work Photographs
1. Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed work including, but not limited to, the following:
a. Underground utilities
b. Underslab services
c. Piping
d. Electrical conduit
e. Waterproofing barriers

D. Periodic Progress Photographs
1. Photographically demonstrate progress of construction, taking photographs as frequent as required to document all major aspects of construction, but not less than once per week.
2. At a minimum, take 10 Site photographs from different directions and 20 interior photographs of all work areas indicating relative progress of the Work.

E. Post Construction Photographs
1. Upon completion of the Work, take a minimum of 20 photographs of Project Site and surrounding properties from different vantage points.
2. Take a minimum of 20 photographs of each new building or structure.

1.4 AUDIO-VIDEO RECORDINGS

A. Prior to beginning Work on Construction Site or of a particular area of the Work, and again within 10 days following date of Substantial Completion, video-graph Construction Site and property adjacent to Construction Site.

B. In the case of preconstruction recording, no Work shall begin in the area prior to Engineer's review and approval of content and quality of video for that area.

C. Particular emphasis shall be directed to physical condition of existing vegetation, structures, and pavements within Construction Site and areas adjacent to and within the right-of-way or easement, and on Contractor storage and staging areas.

D. Engineer shall have right to select subject matter and vantage point from which videos are to be taken.

E. Video Format and Quality:
1. Produce bright, sharp, and clear images with accurate colors, free of distortion and other forms of picture imperfections. Make sure sound is clear and free of distortion.
2. Electronically, and accurately display the month, day, year, and time of day of the recording.
3. Audio documentation shall be done clearly, precisely, and at a moderate pace.
4. Indicate date, project name, and a brief description of the location of taping, including:
a. Facility name.
b. Street names or easements.
c. Addresses of private property.
d. Direction of coverage, including engineering stationing, if applicable.
5. Electronic File Name:

a. Date of coverage in year-month-day-time format followed by a short description of video coverage.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Definitions.
   2. Submittal procedures.
   3. Proposed product list.
   4. Product data.
   5. Shop Drawings.
   6. Samples.
   7. Other submittals.
   8. Design data.
   9. Test reports.
   10. Certificates.
   11. Manufacturer's instructions.
   12. Manufacturer's field reports.
   13. Erection Drawings.
   14. Contractor review.
   15. Engineer review.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

A. Transmit each submittal with Engineer-accepted form. Package submittal information by individual specification section. Do not combine different specification sections together in submittal package, unless otherwise directed in specification.

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

C. Identify: Project (Engineer’s project number and title), Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.

D. 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 according to requirements of the Work and Contract Documents.

E. Schedule submittals to expedite Project, and post electronic submittals as PDF electronic files to web based project management software. Coordinate submission of related items.

F. For each submittal for review, allow 30 days excluding delivery time to and from Contractor.

G. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.

H. Allow space on submittals for Contractor and Engineer review stamps.

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

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

K. Submittals not requested will not be recognized nor processed.

L. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

1.4 PROPOSED PRODUCT LIST

A. Within 15 days after date of Owner-Contractor Agreement, 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, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.5 PRODUCT DATA

A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.

B. Post electronic submittals as PDF electronic files to web-based project management software.

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. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 77 00 - Closeout Procedures.

1.6 SHOP DRAWINGS

A. Shop Drawings: Action Submittal: Submit to Engineer for assessing 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. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
   1. Include signed and sealed calculations to support design.
   2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
   3. Make revisions and provide additional information when required by authorities having jurisdiction.

D. Post electronic submittals as PDF electronic files to web based project management software.

E. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 77 00 - Closeout Procedures.

1.7 SAMPLES

A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

B. Samples for Selection as Specified in Product Sections:
   1. Submit to Engineer for aesthetic, color, and finish selection.
   2. Submit Samples of finishes, textures, and patterns for Engineer selection.

C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.

D. Include identification on each Sample, with full Project information.

E. Submit number of Samples specified in individual Specification Sections; Engineer or Owner will retain one Sample.

F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.

G. Samples will not be used for testing purposes unless specifically stated in Specification Section.

H. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 77 00 - Closeout Procedures.

1.8 OTHER SUBMITTALS

A. Closeout Submittals: Comply with Section 01 77 00 - Closeout Procedures.

B. Informational Submittal: Submit data for Engineer's knowledge as Contract administrator or for Owner.

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

1.9 TEST REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.

B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

1.10 CERTIFICATES

A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Engineer, 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 Engineer.

1.11 MANUFACTURER'S INSTRUCTIONS

A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.

B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.

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

1.12 MANUFACTURER'S FIELD REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge as Contract administrator or for Owner.

B. Submit report in duplicate and in electronic format (pdf) within 5 days of observation to Engineer for information.

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

1.13 ERECTION DRAWINGS

A. Informational Submittal: Submit Drawings for Engineer's knowledge as Contract administrator or for Owner.

B. Submit Drawings for information 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 Engineer or Owner.

1.14 CONTRACTOR REVIEW

A. Review for compliance with Contract Documents and approve submittals before transmitting to Engineer.

B. Contractor: Responsible for:
1. Determination and verification of materials including manufacturer's catalog numbers.
2. Determination and verification of field measurements and field construction criteria.
3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
4. Determination of accuracy and completeness of dimensions and quantities.
5. Confirmation and coordination of dimensions and field conditions at Site.
6. Construction means, techniques, sequences, and procedures.
7. Safety precautions.
8. Coordination and performance of Work of all trades.

C. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.

D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Engineer.

1.15 ENGINEER REVIEW

A. Do not make "mass submittals" to Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 20 or more submittals or items in one week. If "mass submittals" are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review "mass submittals" based on priority determined by Engineer after consultation with Owner, Contractor, and Construction Manager.

B. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.

C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.

D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order or Work Change Directive.

E. Action Submittal Dispositions: Engineer will review, mark-up, stamp as appropriate, and distribute marked-up electronic copies to appropriate parties as noted:
   1. Furnish as Submitted:
      a. Contractor may incorporate product(s) or implement Work covered by submittal.
   2. Furnish as Corrected or Noted:
      a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer’s notations.
   3. Revise and Resubmit:
      a. Make corrections or obtain missing portions and resubmit.
   4. Partial Resubmittal:
      a. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer’s notations.
   5. Rejected:
      a. Contractor may not incorporate product(s) or implement Work covered by submittal.

F. Owner may withhold monies due to Contractor to cover additional costs beyond the second submittal review.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Quality control.
   2. Tolerances.
   3. References.
   4. Delegated Design Services.
   5. Conflicting Requirements.
   6. Labeling.
   7. Mockup requirements.
   8. Testing and inspection services.
   9. Manufacturers' field services.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 QUALITY CONTROL

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

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

C. Perform Work using persons qualified to produce required and specified quality.

D. Products, materials, and equipment may be subject to inspection by Engineer and Owner at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.

E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

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' recommended tolerances and tolerance requirements in reference standards. When such 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, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.

B. Dating of reference standards may conflict with applicable building codes that reference standards with established dates. Therefore, individual SpecText Sections do not date reference standards, but rely on the first Paragraph below for applicable date of issue. Conversely, some products may be tested to specifically dated standards.

C. Conform to reference standard by date of issue current as of date for receiving Bids except where specific date is established by code.

D. Obtain copies of standards and maintain on Site when required by product Specification Sections.

E. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

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

1.5 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional licensed in the state of Work, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.6 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Engineer regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Engineer for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply

with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.7 LABELING

A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
   1. Model number.
   2. Serial number.
   3. Performance characteristics.

C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

1.8 MOCK-UP REQUIREMENTS

A. Use this Article for full-size assemblies for review of construction or for assemblies requiring esthetic review or coordination of several Sections of the Work. An example is a glazed wall, adjacent solid wall, and perimeter construction, which may require testing or assessment for quality of Work.

B. A mockup can also be used to educate and inform installers as to detailed relationship and connections between adjoining and adjacent products as mockup is being assembled or constructed.

C. Individual Specification Sections should specify mockup size and requirements for performance testing such as air or water infiltration or the operation of the item.

D. Tests will be performed under provisions identified in this Section and identified in individual product Specification Sections.

E. Assemble and erect specified or indicated items with specified or indicated attachment and anchorage devices, flashings, seals, and finishes.

F. Accepted mockups shall be comparison standard for remaining Work.

G. Where mockup has been accepted by Engineer and is specified in product Specification Sections to be removed, remove mockup and clear area when directed to do so by Engineer.

1.9 QUALIFICATIONS

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
   1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.10 OWNER’S REPRESENTATIVE

A. Owner’s project representative employed or retained by the Owner is authorized to inspect the Work in determining when the Work is faulty, defective, damaged, or does not conform to Contract Documents. Deficiencies or defects in the Work which have been observed will be called to the Contractor’s attention.

B. Owner’s representative will not:
   1. Alter or waive provisions of the Contract.
   2. Inspect Contractor’s means or methods of construction.
   3. Accept portions of the Work.
   4. Supervise, control, or direct Contractor’s safety programs.

1.11 CONTRACTOR TESTING AND INSPECTION SERVICES

A. Employ and pay for services of an independent testing agency or laboratory acceptable to Owner to perform specified testing and inspection as required in the Specification Sections for various work and materials.
   1. Before starting Work, submit testing laboratory name, address, and telephone number, and names of full-time Professional Engineer or specialist and responsible officer.

2. Submit copy of report of laboratory facilities' inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.

B. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-Site testing as required by Engineer or Owner.

C. Reports shall be submitted by independent firm to Engineer, Contractor, and authorities having jurisdiction, indicating observations and results of tests and compliance or noncompliance with Contract Documents.
1. Submit final report indicating correction of Work previously reported as noncompliant.

D. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
1. Provide Engineer and independent firm with ample notice before expected time for operations requiring services, no less than 48 hours.
2. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.

E. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.

F. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

G. Agency Responsibilities:
1. Test Samples of mixes submitted by Contractor.
2. Provide qualified personnel at Site. Cooperate with Engineer and Contractor in performance of services.
3. Perform indicated sampling and testing of products according to specified standards.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of Work or products.
6. Perform additional tests required by Engineer.
7. Attend preconstruction meetings and progress meetings.

H. Agency Reports: After each test, promptly submit a copy of report to Engineer, Contractor, and authorities having jurisdiction. When requested by Engineer, provide interpretation of test results. Include the following:
1. Date issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and Specification Section.
6. Location in Project.
7. Type of inspection or test.
8. Date of test.
9. Results of tests.
10. Conformance with Contract Documents.

I. Limits on Testing Authority:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume duties of Contractor.

4. Agency or laboratory has no authority to stop the Work.
    a. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
5. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
6. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.12 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner may employ and pay for a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction, as defined in Chapter 17 of the International Building Code (IBC). These special tests and inspections are in addition to all other testing and inspection requirements.

B. Contractor’s Responsibilities: The Contractor shall assist the Owner’s special tests and inspections by making available materials for testing, providing advanced notice of needed inspections, and providing sufficient time in project schedule for execution of Owner’s special tests and inspections. The costs of these support activities are included in the Contract Price.
1. Cooperate with Owner’s independent testing firm or laboratory personnel and provide access to construction operations.
2. Secure and deliver to Owner’s independent testing firm or laboratory adequate quantities of representative samples to be used and which require testing.
3. Provide to Owner’s independent testing firm or laboratory preliminary mix design proposed to be used for concrete and other material mixes which require control by testing laboratory.
4. Provide incidental labor and facilities:
    a. To provide access to construction
    b. To obtain and handle samples at Project Site or at source of product to be tested.
    c. To facilitate tests and inspections.
    d. For storage and curing of test samples.
5. Notify Owner’s independent testing firm or laboratory 48 hours in advance of when testing is needed for laboratory to schedule and perform services.

C. Refer to Section 01 45 24 – Special Tests and Inspections for additional special test and inspection requirements.

1.13 OWNER TESTING AND INSPECTION SERVICES

A. Owner will employ and Contractor shall pay, from cash allowances specified in Section 01 20 00 – Price and Payment Procedures, for services of an independent firm to perform testing and inspection as directed by the Owner or Engineer to confirm Contractor’s compliance with Contract Documents. Owner tests and inspections paid for by allowance are solely at the discretion of the Owner and Engineer, to confirm results of Contractor’s independent testing and inspections. They are not for the Contractor’s use to fulfill the testing and inspection requirements of the Contract Documents.

B. Contractor’s Responsibilities: The Contractor shall assist the Owner’s special tests and inspections in the same manner as defined in “Special Tests and Inspections” Article of this Specification. The costs of these requirements are included in the Contract Price.

1.14 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, startup of equipment, testing, adjusting, and balancing of equipment, and commissioning as applicable, and to initiate instructions when necessary.

B. Submit qualifications of staff 30 days in advance of required observations. Observer is subject to approval of Engineer or Owner.

C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

D. Refer to Section 01 33 00 - Submittal Procedures, "Manufacturer's Field Reports" Article.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Temporary Utilities:
      a. Temporary electricity.
      b. Temporary lighting for construction purposes.
      c. Temporary heating.
      d. Temporary cooling.
      e. Temporary ventilation.
      f. Communication services.
      g. Temporary water service.
      h. Temporary sanitary facilities.
      i. Temporary process pumping and piping
   2. Construction Facilities:
      a. Vehicular access.
      b. Parking.
      c. Progress cleaning and waste removal.
      d. Project identification.
      e. Traffic regulation.
      f. Fire-prevention facilities.
   3. Temporary Controls:
      a. Barriers.
      b. Enclosures and fencing.
      c. Security.
      d. Water control.
      e. Dust control.
      f. Erosion and sediment control.
      g. Noise control.
      h. Pest and rodent control.
      i. Pollution control.
   4. Removal of utilities, facilities, and controls.

1.2 REFERENCES

A. ASTM International:
   1. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
   3. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.3 SUBMITTALS

A. Temporary Pumping Systems
   1. Submit pump data, performance curves, and other operating information.
   2. Submit sketches showing layout of temporary pumping system, including pump quantity and location.
   3. Submit all information at least 30 days prior to when temporary pumping system is scheduled to be installed.

B. Temporary Piping Systems

1. Submit layout drawings showing proposed routing of piping, including proposed pipe support and pipe restraint locations.
2. Submit product data for piping, fittings, restraints, supports, and all appurtenances of the piping system.
3. Submit piping headloss calculations based on proposed layout.
4. Submit all information at least 30 days prior to when temporary piping system is scheduled to be installed.

1.4 TEMPORARY FACILITIES

A. Temporary Provisions Provided by Contractor
1. Temporary barriers, barricades, covered walkways, fencing, exterior closures, and interior closures.
2. Cleaning during construction.
3. Access roads and approaches.
4. Temporary sanitary facilities.
5. Temporary electrical service and distribution system for power and lighting.
6. Temporary tree and plant protection.
7. Temporary fire protection, dust control, erosion and sediment control, water control, noise control, and other necessary temporary controls
8. Temporary provisions for protection of installed Work

1.5 TEMPORARY ELECTRICITY

A. When using Owner's existing power service, provide separate metering, and reimburse Owner for cost of energy used.

1.6 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain lighting for construction operations at lighting levels not less than required by Occupational Safety and Health Administration (OSHA).

B. Permanent building lighting may be used during construction. When used, maintain lighting and provide routine repairs including replacement of lamps.

C.

1.7 TEMPORARY VENTILATION

A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

B. For construction activity is hazardous locations, provide ventilation levels to achieve unclassified ratings in accordance with NFPA 820.

1.8 TEMPORARY WATER SERVICE

A. Provide and pay for suitable quality water service as needed to maintain specified conditions for construction operations. Where existing water service is used, provide separate metering and reimburse Owner for cost of water used.

B.

1.9 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of Project mobilization. Remove facilities at completion of project and leave Site in neat and sanitary condition.

1.10 VEHICULAR ACCESS

A. Provide unimpeded access for emergency vehicles.

B. Provide and maintain access to fire hydrants and control valves free of obstructions.

C. Provide means of removing mud from vehicle wheels before entering streets.

D. Upon completion of construction, restore ground surface disturbed by access road construction to original condition.

1.11 PARKING

A. Arrange for temporary surface parking areas to accommodate construction personnel.

B. Locate as indicated on Drawings or as approved by Engineer or Owner.

C. If Site space is not adequate, provide additional off-Site parking.

D. No employee or equipment parking will be permitted on Owner’s existing parking areas, except as specifically designated for Contractor’s use.

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

F. Maintenance:
   1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, ice, and the like.
   2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original condition.

1.12 PROGRESS CLEANING AND WASTE REMOVAL

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

B. Collect and remove waste materials, debris, and rubbish from Site to maintain a clean and orderly Site and dispose of off-Site, at least at weekly intervals.

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

1.13 PROJECT IDENTIFICATION

A. Project Informational Signs:
   1. Painted informational lettering for legibility at 100-foot distance.
   2. No other signs are allowed without Owner's permission except those required by law.

1.14 FIRE-PREVENTION FACILITIES

A. Establish fire watch for cutting, welding, and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.

B. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.
   1. Provide one fire extinguisher at each stairway on each floor of buildings under construction and demolition.
   2. Provide minimum of one fire extinguisher in every construction trailer and storage shed.

1.15 CONSTRUCTOIN AIDS

A. Provide railings, kick plates, enclosure, safety devices, and controls as required for adequate protection of life and property as required by applicable laws and regulations.

B. Design temporary supports with adequate safety factor for designed load bearing capability. When requested, provide design calculations by a Professional Engineer prior to application of loads. Submitted design calculations are for information and record purposes only.

1.16 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way and for public access to existing building. All devices shall conform to minimum requirements of OSHA and State agencies.

C. Tree and Plant Protection: Preserve and protect existing trees and plants designated to remain.
   1. Protect areas within drip lines from traffic, parking, storage, dumping, chemically injurious materials and liquids, ponding, and continuous running water.
   2. Replace trees and plants damaged by construction operations.

D. Protect non-owned vehicular traffic, stored materials, Site, and structures from damage.

1.17 SECURITY

A. Security Program:
   1. Protect Work on existing premises and Owner's operations from theft, vandalism, and unauthorized entry.
   2. Initiate program in coordination with Owner's existing security system at Project mobilization.
   3. Maintain program throughout construction period until Owner occupancy or as directed by Engineer.

B. Entry Control:
   1. Restrict entrance of persons and vehicles to Project Site.
   2. Allow entrance only to authorized persons with proper identification.
   3. Maintain log of workers and visitors and make available to Owner on request.
   4. Coordinate access of Owner's personnel to Site in coordination with Owner's security forces.

C. Personnel Identification:

1. Provide identification badge for each person authorized to enter premises.
2. Badge to include: Personal photograph, name, expiration date, and employer.
3. Maintain list of accredited persons and submit copy to Owner on request.
4. Require return of badges at expiration of employment on the Work.

D. Restrictions:
1. Do not allow cameras on Site or photographs taken except by written approval of Owner.

1.18 DUST CONTROL

A. Execute Work by methods that minimize raising dust from construction operations.

B. Provide positive means to prevent airborne dust from dispersing into atmosphere, into Owner-occupied areas, and onto roadways, including dust pollution as a result of dumping and hauling rock or dirt.

1.19 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise produced by construction operations.

1.20 PEST AND RODENT CONTROL

A. Provide methods, means, and facilities to prevent pests and insects from damaging the Work.

B. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.21 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.

B. Do no cause or permit action to occur which would result in an overflow to an existing waterway.

C. Burning of waste materials, rubbish, or other debris will not be permitted on or adjacent to Site.

D. Comply with pollution and environmental control requirements of authorities having jurisdiction, including EPA guidance document 430/9-73-007 “Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activity”.

1.22 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials before Substantial Completion inspection.

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

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

1.23 PROTECTION OF WORK AND PROPERTY

A. Maintain in continuous service all existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and

all other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.

B. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.

C. Maintain original Site drainage wherever possible

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 60 00 - 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.

1.2 PRODUCTS

A. At minimum, comply with specified requirements and reference standards.

B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.

C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.

D. Do not use materials and equipment removed from existing premises except as specifically permitted by Contract Documents.

E. Furnish interchangeable components from same manufacturer for components being replaced.

F. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, hand wheels, chain operators, special tools, and other spare parts as required for maintenance.

G. Lubricant: Provide initial lubricant recommended by equipment Manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

H. Equipment Finish:
   1. Provide Manufacturer’s standard finish and color, except where specific color is indicated.
   2. If Manufacturer has no standard color, provide equipment with gray finish as approved by Engineer.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products according to 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; use methods to prevent soiling, disfigurement, or damage.

D. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

E. Unload products in accordance with Manufacturer's instructions for unloading or as specified, and record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.

F. Remove damaged products from Site, and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products according to manufacturer's instructions.

B. Store products with seals and labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.

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

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. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.

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

J. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60°F. Protect electrical, instrumentation, and control products, and insulation against moisture, water, and dust damage. Connect and operate continuously all space heaters furnished in electrical equipment.

K. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.

L. Hazardous Materials: Prevent contamination of personnel, storage building, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and complying with 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, according to Section 01 25 00 - Substitution Procedures.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 70 00 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Examination.
   2. Preparation.
   3. Coordination of Owner's portion of the Work.
   4. Survey control.
   5. Execution.
   6. Indoor air quality procedures.
   7. Cutting and patching.
   8. Protecting installed construction.
   9. Work within public right-of-way.

1.2 EXAMINATION

A. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual Specification Sections.

D. Verify that utility services are available with correct characteristics and in correct locations.

1.3 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

1.4 COORDINATION OF OWNER'S PORTION OF THE WORK

A. Site Access: Provide access to Project site for Owner's construction personnel.
   1. Provide temporary facilities required for Owner-furnished, Contractor-installed or Owner-furnished, Owner-installed products.
   2. Refer to Section 01 10 00 - Summary for other requirements for Owner-furnished, Contractor-installed or Owner-furnished, Owner-installed products.

B. Coordination: Coordinate construction and operations of the Work with Work performed by Owner's construction personnel.
   1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
   2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's Work. Attend

preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

1.5 EXECUTION

A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.

B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.

D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
   1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
   2. Physically separate products in place and provide electrical insulation or protective coatings to prevent galvanic action or corrosion between dissimilar metals.
   3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual effect choices to Engineer for final decision.

E. Allow for expansion of materials and building movement.

F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.
   1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
   2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.

G. Mounting Heights: Where not indicated, mount individual units of Work at industry-recognized standard mounting heights for particular application indicated.
   1. Refer questionable mounting height choices to Engineer for final decision.
   2. Elements Identified as Handicap Accessible: Comply with applicable codes and regulations.

H. Adjust operating products and equipment to ensure smooth and unhindered operation.

I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

1.6 ALTERATION PROCEDURES

A. Existing facilities may be occupied for normal operations during progress of construction. Cooperate with Owner in scheduling operations to minimize conflict and to permit continuous usage.
   1. Perform Work not to interfere with operations of occupied areas.
   2. Keep utility and service outages to a minimum and perform only after written approval of Owner.
   3. Clean Owner-occupied areas daily. Clean spillage, overspray, and heavy collection of dust in Owner-occupied areas immediately.

B. Materials: As specified in product Sections; match existing products with new products for patching and extending Work.

C. Employ skilled and experienced installer to perform alteration and renovation Work.

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

E. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

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

G. Prepare surface and remove surface finishes to permit installation of new Work and finishes.

H. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity.

I. Remove, cut, and patch Work to minimize damage and to permit restoring products and finishes to specified condition.

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

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

L. 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 Engineer for review.

M. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition to Engineer for review and request instructions from Engineer.

N. Trim existing doors to clear new floor finish. Refinish trim to specified condition.

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

P. Finish surfaces as specified in individual product Sections.

1.7 CUTTING AND PATCHING

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

B. Submit written request in advance of cutting or altering elements affecting the following:
   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 to complete Work and to accomplish the following:
   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 nonconforming Work.
4. Remove samples of installed Work for testing.
5. Provide openings in elements of Work for penetrations of mechanical and 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.

F. Restore Work with new products according to requirements of Contract Documents.

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

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

I. At penetrations of fire-rated walls, partitions, ceiling, or floor construction, completely seal voids with fire-rated material to full thickness of penetrated element to maintain fire rating of complete assembly.

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

K. Identify the hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

1.8 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual Specification Sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 75 00 – STARTUP TESTING AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Manufacturer’s services.
   2. Startup plan.
   3. Pre-startup testing.
   4. Functional testing.
   5. Site Acceptance Test.
   6. Demonstration and Training

1.2 MANUFACTURER’S SERVICES

A. Execute testing and startup under supervision of manufacturer's representative according to manufacturer's instructions. Schedule services to avoid conflict with other testing and startup activity.

B. Comply with requirements of individual equipment specification sections, including requirements for an on-site manufacturer’s representative to inspect, check, and approve equipment or system installation prior to startup and supervise placing equipment or system in operation.

C. Manufacturer’s representative shall maintain a log of activities, prepare startup and testing forms, and submit records generated during start-up and testing phase of Project.

D. Manufacturer’s Certificate of Proper Installation: Provide a written report prepared and signed by Manufacturer’s representative certifying that equipment:
   1. Has been properly installed, adjusted, aligned, and lubricated.
   2. Is free of any stresses imposed by connecting piping or anchor bolts.
   3. Is suitable for satisfactory full-time operation under full load conditions.
   4. Operates within the allowable limits for vibration.
   5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.
   6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown have been tested and are properly functioning.

1.3 STARTUP PLAN

A. Provide a startup plan for each piece of equipment and each system not less than 2 weeks prior to planned initial start-up of equipment or system. At a minimum, provide the following information:
   1. Step-by-step instructions for startup of each piece of equipment or system.
   2. Description of the process, including equipment numbers/nomenclature of each item and all included devices.
   3. Detail procedure for startup including valves to be opened/closed, sequence of startup, etc.
   4. Startup requirements including water, power, chemicals, etc.
   5. Provide testing plan with test logs for each item and system when specified. Include testing of alarms, control circuits, capacities, ratings, speeds, flows, pressures, vibrations, sound level, and other specified performance parameters.
   6. Provide a summary of shutdown requirements for existing systems, if any, which are necessary to complete startup of new equipment and systems.

B. Coordinate schedule for startup of various equipment and systems. Allow realistic durations in the Progress Schedule for testing and startup activities, including the following:
   1. Manufacturer's services
   2. Pre-startup testing
   3. Functional testing
   4. Site Acceptance Test

C. Revise and update startup plan based upon review comments or to accommodate changes in startup sequence.

1.4 PRE-STARTUP TESTING

A. Prior to start-up of any piece of equipment, perform all checks and adjustments required to make the equipment ready for safe and proper operation.

B. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing all pre-startup testing.

C. Perform pre-startup testing and checks as indicated in the individual equipment specification sections and as required by manufacturer's literature.

D. Mechanical Systems
   1. Remove rust preventatives and oils applied to protect equipment during construction.
   2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.
   3. Flush fuel system and provide fuel for testing and startup.
   4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
   5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
   6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
   7. Perform cold alignment and hot alignment to manufacturer's tolerances.
   8. Adjust V-belt tension and variable pitch sheaves.
   9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to insure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.
   10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
   11. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to functional testing.

E. Electrical Systems
   1. Perform testing as indicated in Division 26 including insulation testing, continuity testing, ground testing, circuit breaker testing, and motor testing.
   2. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.

F. Instrumentation and Control Systems
   1. Perform testing as indicated in Division 40 including instrumentation calibration and adjustment, point-to-point wiring checks, signal range testing, and input/output testing.
   2. Verify that tests agree with those required by equipment or system manufacturer.

G. Document results of pre-startup testing on test forms and reports, and submit upon completion of testing. Acceptance of pre-startup testing results is required prior to performing functional testing.

1.5 FUNCTIONAL TESTING

A. Functionally test mechanical, electrical, and instrumentation and control equipment for proper operation after pre-startup testing and adjusting is completed.

B. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing all functional testing.

C. Functional testing of equipment shall be performed for all possible operational scenarios from no load to full load conditions. The various tests performed during functional testing shall be designed to demonstrate that systems fulfill all the requirements of the Contract Documents.

D. Functional testing shall be performed utilizing water, air, electricity, chemicals, or other mediums to simulate permanent operating conditions.
   1. Some processes may require the use of temporary clean water for functional demonstration testing.
   2. Contractor shall coordinate with the Owner for availability of water source. Contractor shall be responsible for all temporary piping, pumping, and power to convey clean water to the facility for testing.
   3. Coordinate with Owner removal of test water from process after satisfactory completion of functional testing. Do not discharge test water in a manner to cause upset or disruption to plant operations.

E. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration.

F. Demonstrate that equipment meets performance requirements specified.

G. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation, and other equipment functions. Where required, generate signals with test equipment to simulate operating conditions in each control mode.

H. Document results of functional testing on test forms and reports, and submit upon completion of testing. Acceptance of functional testing results is required prior to performing the Site Acceptance Test.

1.6 SITE ACCEPTANCE TEST

A. After all systems have been functionally tested and are operating in accordance with the Contract Documents, the Contractor shall perform a Site Acceptance Test of the comprehensive completed installation.

B. During the testing period, the Owner shall have full use of the system. The Owner will provide operations, personnel, power, fuel, and other consumables for the duration of the site acceptance test.

C. The complete installation must meet all performance requirements for the duration of the Site Acceptance Test.

D. Contractor personnel shall be readily available to address issues onsite during the test. Immediately correct defects in materials, workmanship, or equipment which become evident during the test.

E. The Site Acceptance Test period shall be 30 days, during which time the completed installation must meet specified operation without significant interruption. A significant interruption may include any of the following events:
   1. Failure to meet specified functional or performance requirements for more than 2 consecutive hours.
   2. Failure of any critical component that is not corrected within 8 hours after failure.
   3. Other failures or interruptions as defined by the Engineer.

F. A significant interruption will require restarting of the Site Acceptance Test after the problem is corrected and when directed by the Owner/Engineer. Restarting and satisfactory completion of the Site Acceptance Test shall be conducted at no additional cost to the Owner.

1.7 DEMONSTRATION AND TRAINING

A. Demonstrate operation and maintenance of products to Owner's personnel prior to date of Substantial Completion.

B. Provide a training schedule for all training sessions required for the project. Allow for multiple sessions of each training to accommodate multiple operator shifts. Submit training schedules for approval by Owner.

C. Demonstrate Project equipment and instruct in classroom environment located at the Site and instructed by qualified manufacturer's representative who is knowledgeable about the equipment.

D. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

E. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time at designated location.

F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER: _____ EQUIP. SERIAL NO: _____

EQUIP. TAG NO: _____ EQUIP. SYSTEM: _____

PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above referenced equipment/system has been:

(Check Applicable)

	Installed in accordance with Manufacturer's recommendations.
	Inspected, checked, and adjusted.
	Serviced wit proper initial lubricants.
	Electrical and mechanical connections meet quality and safety standards.
	All applicable safety equipment has been properly installed.
	Functional tests.
	System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments:

_____
_____
_____
_____
_____
_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate its equipment, and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20___.

Manufacturer: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

UNIT PROCESS STARTUP FORM

OWNER: _____ PROJECT: _____

Unit Process Description: (Include description and equipment number of all equipment and devices):

_____

_____

_____

_____

Startup Procedure: (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

_____

_____

_____

_____

Startup Requirements (Water, power, chemicals, etc.):

_____

_____

_____

Evaluation Comments:

_____

_____

_____

_____

FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

OWNER: _____ PROJECT: _____

Unit Process Description: (List unit processes involved in facility startup):

_____

_____

_____

_____

Unit Processes Startup Sequence: (Describe sequence for startup, including computerized operations if any):

_____

_____

_____

_____

Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

Contractor: _____ Date: _____, 20 ___

Engineer: _____ Date: _____, 20 ___

SECTION 01 77 00 – CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Closeout procedures.
   2. Project record documents.
   3. Operation and maintenance data.
   4. Manual for materials and finishes.
   5. Manual for equipment and systems.
   6. Spare parts and maintenance products.
   7. Product warranties and product bonds.
   8. Maintenance service.
   9. Final cleaning.

1.2 CLOSEOUT PROCEDURES

A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:
   1. Submit maintenance manuals, Project record documents, digital images of construction photographs, video recordings, and other similar final record data in compliance with this Section.
   2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this Section and 01 75 00 – Startup Testing and Training.
   3. Complete demonstration and training to Owner's operating and maintenance personnel as specified in compliance with this Section and 01 75 00 – Startup Testing and Training.
   4. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
   5. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner.
   6. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
   7. Perform final cleaning according to this Section.

B. Substantial Completion Inspection:
   1. When Contractor considers Work to be substantially complete, submit to Engineer and Owner:
      a. Written certificate that Work, or designated portion, is substantially complete.
      b. List of items to be completed or corrected (initial punch list).
   2. After receipt of request for Substantial Completion, Engineer or Owner will make inspection to determine whether Work or designated portion is substantially complete.
   3. Should Engineer or Owner determine that Work is not substantially complete:
      a. Engineer or Owner will promptly notify Contractor in writing, stating reasons for its opinion.
      b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion.
      c. Engineer or Owner will reinspect Work.
      d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer or Owner inspection.
   4. When Engineer or Owner finds that Work is substantially complete, Engineer or Owner will:

a. Prepare Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected as verified and amended by Engineer and Owner (final punch list).
b. Submit Certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.

5. After Work is substantially complete, Contractor shall:
   a. Allow Owner occupancy of Project under provisions stated in Certificate of Substantial Completion.
   b. Complete Work listed for completion or correction within time period stipulated.

C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.
1. When Contractor considers Work to be complete, submit written certification that:
   a. Contract Documents have been reviewed.
   b. Work has been examined for compliance with Contract Documents.
   c. Work has been completed according to Contract Documents.
   d. Work is completed and ready for final inspection.
2. Submittals: Submit the following:
   a. Final punch list indicating all items have been completed or corrected.
   b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
   c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
   d. Accounting statement for final changes to Contract Sum.
   e. Contractor's affidavit of payment of debts and claims.
   f. Contractor affidavit of release of liens.
   g. Consent of surety to final payment.
3. Perform final cleaning for Contractor-soiled areas according to this Section.

D. Final Completion Inspection:
1. After receipt of request for final inspection, Engineer or Owner will make inspection to determine whether Work or designated portion is complete.
2. Should Engineer or Owner consider Work to be incomplete or defective:
   a. Engineer or Owner will promptly notify Contractor in writing, listing incomplete or defective Work.
   b. Contractor shall remedy stated deficiencies and send second written request to Engineer or Owner that Work is complete.
   c. Engineer or Owner will reinspect Work.
   d. Redo and Inspection of Deficient Work: Repeated until Work passes Engineer or Owner inspection.

1.3 PROJECT RECORD DOCUMENTS

A. Maintain on Site one set of the following record documents; record actual revisions to the Work:
1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, product data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates used.
   3. Changes made by Addenda, bulletin, Change Order, and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
   1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
   2. Field changes of dimension and detail.
   3. Details not on original Drawings.

G. Submit PDF electronic files of marked-up documents to Engineer within 10 days after the date of Substantial Completion and prior to final Application for Payment.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit in PDF composite electronic indexed file.

B. Submit data bound in 8-1/2 x 11-inch text pages, three D side ring binders with durable plastic covers.

C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project, and subject matter of binder when multiple binders are required.

D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

F. Contents: Prepare table of contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.
      f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
      g. Safety precautions to be taken when operating and maintaining or working near equipment.
   3. Part 3: Project documents and certificates, including the following:
      a. Shop Drawings and product data.
      b. Air and water balance reports.
      c. Certificates.
      d. Executed and notarized duplicates of warranties and bonds.

1.5 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes before Substantial Completion. Completed volumes, with Engineer comments, will be returned after Substantial Completion. Revise content of document sets as required prior to final submission.

D. Submit two sets of revised final volumes within 10 days after final inspection.

E. Submit in PDF composite electronic indexed file of final volumes within 10 days after final inspection.

F. Equipment and Systems: Include description of unit or system and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

G. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

H. Include color-coded wiring diagrams as installed.

I. Operating Procedures: Include startup, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and special operating instructions.

J. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

K. Include servicing and lubrication schedule and list of lubricants required.

L. Include manufacturer's printed operation and maintenance instructions.

M. Include sequence of operation by controls manufacturer.

N. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

O. Include control diagrams by controls manufacturer as installed.

P. Include Contractor's coordination drawings indicating installed color-coded piping diagrams.

Q. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

R. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

S. Include test and balancing reports as specified in Section 01 40 00 - Quality Requirements.

T. Additional Requirements: As specified in individual product Specification Sections.

U. Include listing in table of contents for design data with tabbed dividers and space for insertion of data.

1.6 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.

B. Deliver to Project Site and place in location as directed by Owner; obtain receipt prior to final payment.

1.7 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible Subcontractors, suppliers, and manufacturers within ten days after completion of applicable item of Work.

B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Include table of contents and assemble in three D side ring binder with durable plastic cover.

F. Submit prior to final Application for Payment.

G. Time of Submittals:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
   2. Make other submittals within ten days after date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

H. Refer to Section 01 78 36 - Warranties and Bonds for additional requirements.

1.8 MAINTENANCE SERVICE

A. Furnish service and maintenance of components indicated in specification sections during warranty period.

B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.

D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

1.9 FINAL CLEANING

A. Execute final cleaning prior to final Project assessment.
   1. Employ experienced personnel or professional cleaning firm.

B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces**;** and vacuum carpeted and soft surfaces.

C. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.

D. Clean or replace filters of operating equipment.

E. Clean debris from roofs, gutters, downspouts, and drainage systems.

F. Clean Site; pressure wash exterior concrete surfaces, pressure wash grating platforms, pressure wash stairs, sweep paved areas, rake clean landscaped surfaces.

G. Remove waste and surplus materials, rubbish, and construction facilities from Site.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 36 – WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers' standard warranties on products and special warranties.

1.2 RELATED WORK

A. Refer to Conditions of Contract for the general requirements relating to warranties and bonds.

B. General closeout requirements are included in Section 01 77 00 Closeout Procedures.

C. Specific requirements for warranties for the Work and products and installations that are specified to be warranted, are included in the individual Sections of Division 2 through 46.

1.3 SUBMITTALS

A. Submit written warranties to the Owner prior to the date fixed by the Engineer for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Owner.

B. Refer to individual Sections of Divisions 2 through 46 for specific content requirements, and particular requirements for submittal of special warranties.

C. Contractor shall submit digital copies and a 3-ring binder of warranties for each piece of equipment installed coupled with an overall project summary spreadsheet listing of all equipment items and date warranty starts and expires, etc.

1.4 WARRANTY REQUIREMENT

A. Warranty Period
   1. Warranties shall commence on the date of Substantial Completion.
   2. Warranties shall be in force from the date of Substantial Completion through the date of Final Acceptance.
   3. Warranties shall be in force for **[one year]** following the date of Final Acceptance.
      a. Warranty periods defined in Specification Divisions 02 through 46, longer than the warranty period defined in this specification, shall prevail over the requirements in this specification.
      b. Warranty periods defined in Specification Divisions 02 through 46, shorter than the warranty period defined in this specification, shall be required to meet the warranty period requirements in this specification.

B. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

C. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

D. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

E. Owner 's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

F. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

G. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

H. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.5 DEFINITIONS

A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the Manufacturer to the Owner.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

DIVISION 2

EXISTING CONDITIONS

SECTION 02 41 00 – DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Portions of buildings and other areas, equipment and materials selective demolition, and partial demolition work are as shown on Drawings and specified herein.
   2. Equipment and materials to be removed for construction and reinstalled for reuse or continued operation are as shown on the drawings and specified herein.

B. Related Sections:
   1. Section 01 32 16 – Construction Progress Schedule.
   2. Section 01 40 00 – Quality Requirements.

1.2 SUBMITTALS

A. Shop Drawings:
   1. Plans showing all equipment and materials to be removed and reinstalled for reuse on continued operation including interim storage plans for each item.

B. Quality requirements Submittals:
   1. Schedule of demolition, as part of and consistent with the progress schedule specified in Section 01 32 16, CONSTRUCTION PROGRESS SCHEDULE.
   2. Methods of demolition and equipment proposed to demolish each structure.
   3. Copies of any authorizations and permits required to perform Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

A. Utilities:
   1. Notify Owner and appropriate utilities 72 hours prior to turning off affected services before starting demolition or alterations.
   2. Remove utility lines exposed by demolition excavation.
   3. Remove electric, sanitary, and storm drainage adjacent to buildings to be demolished.
   4. Excavate utility lines serving buildings to be demolished and provide a permanent leak-proof closure for water and gas lines.
   5. Plug sewer lines at locations shown or at limits of excavation if NOT shown with min. 2,000 psi compressive strength concrete plug to prevent groundwater infiltrating sewer systems. Length of plug shall be 5 feet minimum.

B. Removal and Storage of Equipment for Reuse:
   1. DO NOT remove equipment and materials without approval of Engineer.
   2. Properly store and maintain equipment and materials in same condition as when removed.
   3. Engineer or Owner shall determine condition of equipment and materials prior to removal.

3.2 DEMOLITION

A. Drawings define minimum portion of equipment to be removed and structures to be modified. Unless otherwise shown, rough cuts or breaks may be made exceeding limits of demolition shown.

B. Provide all demolition, removal, temporary storage, and reinstallation of existing equipment as required for implementation of the work.

C. Core drill floor slabs, catch basins, and other concrete improvements to remain in place below ground, or break holes at structure's lowest point to allow water to freely migrate through.

D. Remove piping from areas to be backfilled. Pipe, valves, and fittings adjacent to those to be removed may also be removed as salvage.

E. Remove all materials associated with existing equipment that is to be removed or relocated.

F. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 3/4 inch below final finished surface.

G. Cut off drilled piers a minimum of 6 inches below bottom of new foundations.

H. Demolish existing concrete structure to 18” below grade.

3.3 DISPOSAL

A. Dispose of debris and other non-salvaged materials offsite in licensed landfills.

3.4 SALVAGE

A. Equipment and materials NOT reused or reinstalled, including all metals and piping within the limits of demolition, unless otherwise specified, shall be removed by the Contractor.

END OF SECTION

DIVISION 3

CONCRETE

SECTION 03 01 00 – MAINTENANCE OF CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Repair and resurfacing of new and existing concrete surfaces in preparation for finish materials and final use.

B. Related Sections:
   1. Section 01 33 00 – Submittal Procedures
   2. Section 01 40 00 – Quality Requirements.
   3. Section 03 30 00 – Cast-In-Place Concrete
   4. Section 03 20 00 – Concrete Reinforcing

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this Section:
   1. AASHTO:
      a. T277, Standard Method of Test for Rapid Determination of the Chloride Permeability of Concrete.
   2. ASTM International:
      a. A82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
      b. A185 – Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
      c. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      d. C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
      e. C78 – Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
      f. C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
      g. C157 – Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
      h. C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      i. C348 – Standard Test Method for Flexural Strength of Hydraulic Cement Mortars.
      j. C469 – Standard Test Method for Static Modulus of Elasticity and Poisson’s Ratio of Concrete in Compression.
      k. C496 – Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
      l. C531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes.
      m. C596 – Standard Test Method for Drying Shrinkage of Mortar Containing Portland Cement.
      n. C666 – Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
      o. C779 – Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
      p. C882 – Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
      q. C928 – Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repair.

r. C1012 – Standard Test Method for Length Change of Hydraulic Cement Mortars Exposed to a Sulfate Solution.
s. C1202 – Standard Test Method for Electrical Induction of Concrete's Ability to Resist Chloride Ion Penetration.
t. C1583 – Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method).
u. D638 – Standard Test Method for Tensile Properties of Plastics.
v. D695 – Standard Test Method for Compressive Properties of Rigid Plastics.
w. D4258 – Standard Practice for Surface Cleaning Concrete for Coating.
x. D4259 – Standard Practice for Abrading Concrete.
y. E699 – Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM Committee.

3. NSF International:
   a. NSF 61, Standard for Drinking Water System Components – Health Effects.

1.3 DEFINITIONS

A. Low Pressure Spray Mortar: Mortar designated by "S" before the product number, applied by low pressure spraying, or in small areas by hand troweling.

B. Defective Area: As defined in Section 03 30 00, CAST-IN-PLACE CONCRETE.

C. High-Pressure Water Blasting (sometimes referred to as water demolition): Water projected under pressure and at high velocity which may or may NOT use an abrasive medium. Used for preparation of concrete surfaces including cleaning, removal of existing coatings and roughening.

D. New Concrete: As defined in Section 03 30 00, CAST-IN-PLACE CONCRETE.

E. Rebound: Shotcrete material that bounces off the surface against which shotcrete is being applied.

F. Shotcrete: Mortar pumped through a hose and projected at a high velocity against a surface as a construction technique.

1.4 SUBMITTALS

A. Section 01 33 00, SUBMITTAL PROCEDURES, specifies requirements for submittals.

B. Action Submittal:
   1. Product data sheets for each material supplied.

C. Information Submittals:
   1. Mortar System:
      a. Manufacturer's installation instructions.
      b. Manufacturer's recommended fabric size for mesh reinforcement.
   2. Written description of equipment proposed for hydro-demolition surface preparation.
   3. Certificates:
      a. Certificate of Compliance that proposed product systems meet or exceed the requirements of ASTM C928 and specified performance criteria when tested in accordance with Article FIELD QUALITY REQUIREMENTS.
      b. Mortar system Manufacturer's Certificate of Proper Installation.
      c. Confirmation that mortar materials meet requirements of NSF 61, where applicable.
   4. Statements of Qualification:

a. Independent testing laboratory.
b. Mortar system Manufacturer's representative.
c. Repair mortar system applicator.

5. Mortar system Manufacturer's proposed modified test procedures for ASTM C109 and ASTM C882 test methods.
6. Independent testing laboratory test report.

1.5 QUALITY ASSURANCE

A. Qualifications:
1. Independent Testing Laboratory: Based on evaluation of laboratory submitted criteria in accordance with ASTM E699.
2. Mortar System Applicator: For low pressure spray mortar system in lieu of endorsement, complete mortar system manufacturer's demonstration in accordance with Article MANUFACTURER'S SERVICES. For Shotcrete Mortar, a trained and experienced applicator certified by the repair mortar manufacturer.

B. Pre-repair Conference:
1. Required Attendees: Contractor, repair Subcontractor, repair material representative.
2. Schedule and conduct prior to incorporation of repair products.
3. Agenda:
a. Review field conditions.
b. Confirm material selection.
c. Repair material representative shall review proposed preparation, application, finishing and curing of the materials.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver repair mortar in moisture-resistant packaging.

B. Handle in accordance with manufacture's written instructions.

PART 2 - PRODUCTS

2.1 LOW PRESSURE SPRAY MORTAR SYSTEM (FOR VERTICAL AND OVERHEAD REPAIRS)

A. Mortar:
1. One component, rheoplastic, cement based, fiber reinforced, shrinkage compensated, gray in color, with a minimum 30-minute working time.
2. Cured materials mixed to a flow of 70%, at five drops shall conform to the following criteria:
a. Minimum Slant Shear Bond Strength: 3,000 psi in 28 days in accordance with "modified" ASTM C882 test method.
b. Minimum Compressive Strength: 11,000 psi at 28 days in accordance with ASTM C109.
c. Minimum Direct Shear Bond Strength: 650 psi in 28 days in accordance with Michigan DOT.
d. Minimum Tensile Bond Strength (MBT In-House Test): 300 psi. in 28 days.
e. Minimum Flexural Properties: 1,250 psi in 28 days in accordance with ASTM C348.
f. Modulus of Elasticity: 4.1 to 4.5 by 106 psi in accordance with ASTM C469.
g. Maximum Permeability: 1,000 coulombs in accordance with AASHTO T 277.
h. System shall NOT produce a vapor barrier.

B. Sprayable, extremely low permeability, sulfate resistant, easy to use, and requiring only the addition of water.

C. Free of chlorides and other chemicals causing corrosion.

D. Manufacturer and Product:
1. BASF Building Systems, MasterEmaco S 488CI.
2. Sika Corp., Lyndhurst, NJ; SikaRepair 224.

2.2 SHOTCRETE MORTAR (FOR VERTICAL AND OVERHEAD REPAIRS)

A. Mortar:
1. Blend of Portland cements, microsilica, aggregates and fibers designed for the repair of vertical and overhead surfaces.
2. Workable down to 1/4" thickness.
3. Shall NOT contain chlorides, nitrates, or high aluminum cements.

B. Properties:
1. Working time: 5 – 10 minutes, Finishing time: 10 – 20 minutes, Color: dark gray.
2. Compressive strength per ASTM C109:
   a. 6,000 psi min at 7 days.
   b. 7,000 psi min at 28 days.
3. Flexural Strength per ASTM C78: 1,100 psi min at 28 days.
4. Splitting Tensile Strength per ASTM C496: 400 psi min at 28 days.
5. Certified to meet NSF 61 for potable water projects.

C. Manufacturers and Products:
1. BASF Building Systems, MasterEmaco S 211 SP.
2. Sika Corp., SIKACHEM 103F.

2.3 POLYMER-MODIFIED REPAIR MORTAR (HORIZONTAL SURFACE REPAIR)

A. Mortar: One component, polymer-modified, cementitious based, chloride resistant, flowable, gray in color, working time of 20 minutes minimum, surface renovation mortar conforming to the following properties:
1. Bond strength in accordance with ASTM C1042 Test Method at 7 days: Minimum 1,750 psi.
2. Modules of Elasticity: ASTM C469, minimum 2.0 by 10^6 psi.
3. Compressive Strength:
   a. ASTM C109 at 1 day: minimum 2,500 psi.
   b. ASTM C109 at 28 days: minimum 7,500 psi.
4. Flexural Properties, ASTM C348 at 28 days: minimum 1,200 psi.
5. Permeability, AASHTO T 277: 800 coulombs maximum.
6. Splitting Tensile Strength: ASTM C496 at 7 days, minimum 450 psi.
7. Drying Shrinkage, ASTM C596 at 28 days: -0.090%.
8. Freeze Thaw Resistance, ASTM C666, at 300 cycles: 95% RDF.
9. Abrasion Resistance: ASTM C799, 60 minutes, 0.0165".

B. Manufacturers and Products:
1. BASF Building Systems, MasterEmaco T 310 CI (NOT for potable water structures).
2. Sika Corp, SikaTop 111 Plus (for potable water structures).

2.4 HIGH EARLY STRENGTH REPAIR MORTAR (HORIZONTAL SURFACE REPAIR)

A. Mortar: one or two component, fast-setting, high early strength repair mortar.

B. Properties:
1. Compressive Strength per ASTM C109:

a. 1,500 psi min at 2 hours.
b. 4,500 psi min at 1 day.
c. 8,000 psi min at 7 days.
d. 9,000 psi min at 28 days.

2. Flexural Strength per ASTM C348:
   a. 850 psi min at 1 day.
   b. 1,000 psi min at 7 days.
   c. 1,100 psi min at 28 days.
3. Slant Shear Bond Strength per ASTM C882:
   a. 2,500 psi min at 1 day.
   b. 2,900 psi min at 7 days.
   c. 3,100 psi min at 28 days.
4. Splitting Tensile Strength per ASTM C496:
   a. 850 psi min at 1 day.
   b. 1,200 psi min at 7 days.
   c. 1,300 psi min at 28 days.
5. Chloride Ion Permeability per AASHTO T277:
   a. 960 coulombs max at 28 days.

C. Manufacturers and Products:
1. BASF Building Systems, MasterEmaco T 415 (NOT for potable water structures).
2. Euclid Chemical Co, Versaspeed (NOT for potable water structures).

2.5 WATER

A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances, meeting federal drinking water standards.

2.6 REINFORCEMENT

A. Per Section 03 20 00, CONCRETE REINFORCING.

2.7 ACCESSORIES

A. Finishing Aid Manufacturer and Product: BASF Building Systems, MasterKure ER 50.

B. Flexible Cementitious Rebar Coating Manufacturer and Product:
1. BASF Building Systems, MasterEmaco P 124.
2. Sika Corp., Armatec 110 EpoCem.
3.

PART 3 - EXECUTION

3.1 GENERAL

A. Where required because of deficiencies, concrete surface repair system shall be appropriate for the surface type and allowable schedule.

3.2 PREPARATION

A. Remove unsound and deteriorated concrete from Work by high pressure water blasting machines capable of scoring concrete surfaces to minimum amplitude roughness of 3/16” or as shown. Remove to provide for maximum thickness specified for mortar.

B. High pressure water blasting machines with 8,000 psi minimum.

C. Collect and dispose of water from removal operations in manner and location acceptable to Owner.

D. DO NOT use power-driven jackhammers and chipping hammers, unless water blasting is prohibited due to potential damage to installed equipment.

E. Remove concrete minimum of 1" clearance around rebar for application and bonding of new mortar to entire periphery of exposed rebar if the following surface conditions exist:
   1. 50% or more of periphery around rebar is exposed during removal of concrete.
   2. 25% or more of periphery around rebar is exposed during removal of concrete and corrosion has eventuated to the extent that loss of section has occurred.
   3. Bond between existing concrete and reinforcement has deteriorated.

F. Clean exposed reinforcing bars of rust and concrete, and coat with flexible cementitious rebar coating.

G. Maintain surface areas free of slurry where concrete has been removed. Remove slurry from prepared areas before new mortar is applied.

H. Square edges of repair area by sawing or chipping to avoid feathered edges.

I. Clean surface areas to be filled with new mortar of laitance and contamination by high pressure water blasting NOT more than 24 hours before applying bonding agent, Saturated Surface Dry (SSD) existing concrete at time of application of mortar.

3.3 LOW PRESSURE SPRAY MORTAR APPLICATION

A. Mix mortar in mortar-concrete mixer attached to pump-spray equipment for spray application. Mix with a slow speed drill and jiffler-type paddle or small mortar type mixer for hand trowel application.

B. Apply mortar by low pressure spraying with a machine such as Moynotype, MEYCO DEQUNA Model 20.

C. Finish mortar with a hand float application to smooth even surface matching adjacent concrete. Provide finishing aid at full strength.

D. Bonding Agent:
   1. Hand apply bonding agent within 20 minutes of troweling on mortar. Prevent bonding agent from drying by reapplying bonding agent to maintain surface tackiness of coat.
   2. Work mortar firmly and quickly into area and compact with firm trowel stroke. Finish smooth with finishing aid at full strength.

3.4 SHOTCRETE MORTAR APPLICATION

A. Apply mortar in accordance with ACI 506.2 and per manufacturer's instructions.

B. DO NOT reuse rebound materials.

C. Mortar shall be applied in a steady, uninterrupted flow. Hold nozzle at right angles to the surface.

D. Apply at minimum thickness of 2" of cover over existing reinforcement or to level of surrounding concrete, whichever is thicker.

E. Apply finish to mortar to match existing concrete finish.

3.5 POLYMER-MODIFIED REPAIR MORTAR APPLICATION FOR REPAIR OF HORIZONTAL SURFACES

A. Mix mortar in mortar-concrete mixer.

B. Hand Troweling: Apply (scrub in) a bond coat slurry of the repair mortar to the SSD prepared substrate before application of the mortar. DO NOT apply more of the bond coat than can be covered with mortar before the bond coat dries. DO NOT re-temper this bond coat.

C. Place mortar into prepared area from one side to the other.

D. Work material firmly into the side and bottom of patch to assure a good bond. Level repair mortar and screed to elevation of existing concrete.

E. Finish to same texture as existing concrete around patch.

F. Use self-leveling mixture where appropriate to obtain uniform or plane surface.

3.6 HIGH EARLY STRENGTH MORTAR APPLICATION

A. Remove standing water from application area.

B. Apply bond scrub mortar coat per manufacturer's instructions.

C. Work material into bottom and sides of the patch to ensure good continuous bond.

D. Level mortar to match elevation of existing concrete.

E. Finish to same texture as existing concrete.

3.7 CURING

A. Water fog nozzle all of the mortar systems prior to curing in accordance with mortar system Manufacturer's instructions.

B. Commence water curing after mortar system application and when curing shall NOT cause erosion of mortar.

C. Continuously cure mortar system for a period of 7 days.

D. DO NOT membrane cure, unless method is part of mortar system Manufacturer's instructions and approval has been obtained.

E. Cure intermediate layers of mortar in accordance with manufacturer's instructions.

3.8 FIELD QUALITY REQUIREMENTS

A. Independent testing laboratory shall perform the following:
   1. Secure production samples of mixed materials during construction and test for compliance with the Specifications.
   2. Obtain actual core samples from the completed repair Work and test, where required.
   3. Perform "modified" ASTM C109 and ASTM C882 test methods in accordance with manufacturer's approved modifications of testing procedures.

B. Construction Testing:

1. Production Samples:
    a. Obtain mixed mortar material from shotcrete or spray equipment and produce samples, and cure samples prior to testing.
    b. Provide minimum of three samples each test for each 1,000 square feet or portion thereof of mortar repair to be installed.
2. Core Samples of In-Place Repair:
    a. Obtain two core samples and test samples for each 2,000 square feet or portion thereof for actual repair Work.
    b. Cores shall be either 2-1/2" or 3" in diameter and shall be cored through cured mortar repair and into base concrete to total depth equal to at least 2.5 times repair mortar thickness.
    c. Sawcut the cores after removal to trim base concrete thickness to same thickness as mortar so that bond line is at center of repaired sample.
    d. Samples shall be epoxy bonded to steel plates at each end using a bonding agent to prevent failure in bond to steel plates.
    e. Sustain bond line without failure or movement with a minimum of 300 psi in direct tension. The tension test shall use eyebolts or threaded connectors tapped and threaded into base plate so that tension load is concentric with center of core sample.

C. Repair and fill holes where core samples have been removed using same mortar used in repair.

D. If possible, use Direct Tension Bond Test per ASTM C1583 in place of core sampling.

3.9 MANUFACTURER'S SERVICES

A. Provide mortar system manufacturer's representative at site for installation assistance, inspection and certification of proper installation, and training of mortar system applicators.

B. Mortar System Manufacturer's Demonstration:
1. Schedule a time for Manufacturer's demonstration of repair system proposed for the Project. Prepare mortar, to specified consistency, for testing and placement. Initiate curing on portions of each type of surface to be repaired to include overhead and vertical applications.
2. Prepare surface area in advance of demonstration and obtain manufacturer's acceptance of preparation for each type of application.
3. Demonstrate:
    a. Mixing and application equipment capabilities and procedures, including the flow of material from nozzle or sprayer.
    b. Nozzle operator and person in charge of low-pressure sprayer, capabilities, and ability to follow prescribed application procedures and properly operate equipment and apply surface repair materials.
4. Make compression test samples during demonstration and deliver to an independent testing laboratory for testing at 1, 7, and 28 days. Take a core of the demonstration placement, or demonstrate Direct Bond Tensile test, and test for tensile bond at 1 day.

3.10 PROTECTION

A. Protect adjacent surfaces, and equipment, from being damaged by overshooting of low-pressure spray mortar.

3.11 CLEANING

A. Remove overshot mortar and deposited rebound materials as Work proceeds. Remove from Work, waste materials, unsound material from concrete surfaces, material chipped from walls, water used in preparation of application and finishing.

END OF SECTION

SECTION 03 10 00 – CONCRETE FORMING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Sections:
   1. Section 01 33 00 – Submittal Procedures
   2. Section 03 62 00 – Non-Shrink Grouting

1.2 REFERENCES

A. The following is a list of standards which may be referenced:
   1. ACI:
      a. 117, Standard Specifications for Tolerances for Concrete Construction and Materials.
      b. 350, Code Requirements for Environmental Engineering Concrete Structures
      c. 347, Formwork for Concrete.
   2. NSF International: 61, Drinking Water System Components – Health Effects.

1.3 DESIGN REQUIREMENTS

A. Design formwork in accordance with ACI 301, ACI 347, and ACI 350 to provide concrete finishes specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.

B. When high range water reducer (superplasticizer) is used in concrete mix, forms shall be designed for full hydrostatic pressure per ACI 347.

C. Make joints in forms watertight.

D. Limit panel deflection to 1/360th of each component span to achieve tolerances specified.

E. Ensure compatibility between form liner and concrete mixture with manufacturer and concrete producer.

1.4 SUBMITTALS

A. Section 01 33 00, SUBMITTAL PROCEDURES, specifies requirements for submittals.

B. Shop Drawings:
   1. Form Ties-Tapered Through-Bolts: Proposed method of sealing form tie hole; coordinate with details shown.
   2. Manufacturer’s Data for the Following Products:
      a. Form-release agent.
      b. Form liners.

C. Samples: One each as follows:
   1. Form ties.

D. Information Submittals:
   1. Statement of qualification for formwork designer.
   2. Statement of qualification for form liner designer and installer.

E. Mockup Panel – for each form liner type.

1.5 QUALIFICATIONS

A. Formwork Designer: Formwork, falsework, and shoring design shall be by an Engineer licensed in the State of the project site.

B. Form liner designer shall have previous experience with the design and installation of similar form liners.

C. Form liner installer shall be approved by the manufacturer.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Wall Forms and Underside of Slabs:
   1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel in “new and undamaged” condition, of sufficient strength and surface smoothness to produce specified finish.
   2. Circular Structures:
      a. Conform forms to circular shape of structure.
      b. Straight panels may be substituted for circular forms provided panels DO NOT exceed 2’ in horizontal width and angular deflection is no greater than 3-1/2° per joint.

B. Painted Surface Forms: High density overlay plywood for flat concrete surfaces to be painted.

C. Form Liners: Elastomeric FRP, ABS or PVC.

D. All Other Forms: Materials as specified for wall forms.

E. Form-Release Agent:
   1. Material: Release agent shall NOT bond with, stain, or adversely affect concrete surfaces, and shall NOT impair subsequent treatments of concrete surfaces when applied to forms or form liners. A “ready to use” water-based material formulated to reduce or eliminate surface imperfections, containing no mineral oil or organic solvents. Environmentally safe, meeting local, state, and federal regulations and can be used in potable water facilities. Certified as complying with NSF 61.
   2. Manufacturers and Products:
      a. Atlas Construction Supply; Bio-Guard
      b. Cresset Chemical Company; Crete-Lease 20-VOC.
      c. Hill and Griffith; Grifcote LV-50 Plus

F. Rustication Grooves and Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

G. Form Ties:
   1. Material: Steel
   2. Spreader Inserts:
      a. Conical or spherical type.
      b. Design to maintain positive contact with forming material.
      c. Furnish units that shall leave no metal closer than 1” to concrete surface when forms, inserts, and tie ends are removed.
   3. Wire ties NOT permitted.
   4. Flat bar ties for panel forms furnish plastic or rubber inserts with minimum 1” depth and sufficient dimensions to permit patching of tie hole.

5. Water Stop Ties: For water-holding structures, basements, pipe galleries, and accessible spaces below finish grade, furnish one of the following:
    a. Integral steel water stop 0.103” thick and 0.625” in diameter tightly and continuously welded to tie.
    b. Neoprene water stop 3/16” thick and 15/16” diameter whose center hole is 1/2-diameter of tie, or molded plastic water stop of comparable size.
    c. Orient water stop perpendicular to tie and symmetrical about center of tie.
    d. Design ties to prevent rotation or disturbance of center portion of tie during removal of ends and to prevent water leaking along tie.
6. Through-Bolts: Tapered minimum 1” diameter at smallest end.
7. Elastic Vinyl Plug:
    a. Design and size of plug to allow insertion with tool to enable plug to elongate and return to original length, and diameter upon removal forming watertight seal.
    b. Manufacturer and Product: Dayton/Richmond Co., Miamisburg, OH; A58 Sure Plug.
    c. Sika Corporation; X-Plug
    d. Recess plug 1” minimum and grout over hole. See Section 03 62 00, NON-SHRINK GROUTING.

PART 3 - EXECUTION

3.1 FORM SURFACE PREPARATION

A. Thoroughly clean form surfaces that shall be in contact with concrete or that have been in contact with previously cast concrete, dirt, and other surface contaminants prior to coating surface.

B. Exposed Wood Forms in Contact with Concrete: Apply form-release agent as recommended by the manufacturer.

C. Steel Forms: Apply form-release agent to steel forms as soon as they are cleaned to prevent discoloration of concrete from rust.

D. Form Liner Forms:
1. Prepare forms as recommended by the manufacturer.
2. Provide liners in full sheets and locate seams as shown on approved shop drawings.
3. Clean form liner after each use and use only form-release agents approved by the manufacturer.

3.2 ERECTION

A. General: Unless specified otherwise, follow applicable recommendations of ACI347.

B. Beveled Edges (Chamfer):
1. Form 3/4” bevels at concrete edges, unless otherwise shown.
2. Where beveled edges on existing adjacent structures are other than 3/4”, obtain Engineer’s approval of size prior to placement of beveled edge.

C. Wall Forms:
1. DO NOT reuse forms with damaged surfaces.
2. Locate form ties and joints in an uninterrupted uniform pattern.
3. Inspect form surfaces prior to installation to assure conformance with specified tolerances.

D. Forms Supporting Form Liners:
1. Construct to withstand the high hydraulic pressures associated with rapid filling and heavy high-frequency vibration.

E. Form Liner Installation:
   1. Protect form liners from extended exposure to sunlight and high surface temperatures during installation.
   2. Install form liners per manufacturer's written instructions.
   3. Place form liners in accordance with specified patterns and joints.
   4. Maintain required concrete cover between form liner and reinforcement.

F. Forms for Curbs and Sidewalks:
   1. Provide standard steel or wood forms.
   2. Set forms to true lines and grades, and securely stake in position.

G. Form Tolerances: Provide forms in accordance with ACI 117, 347 and 318 and the following tolerances for finishes specified:
   1. Wall Tolerances:
      a. Straight Vertical or Horizontal Wall Surface: Flat planes within tolerance specified.
      b. Wall Type W-A:
         1) Plumb within 1/4" in 10' or within 1" from top to bottom for walls over 40 feet high.
         2) Depressions in Wall Surface: Maximum 5/16" when 10' straightedge is placed on high points in all directions.
      c. Wall Type W-B:
         1) Plumb within 1/8" in 10' or within 1/2" from top to bottom for walls over 40' high.
         2) Depressions in Wall Surface: Maximum 1/8" when 10' straightedge is placed on high points in all directions.
   2. Thickness: Maximum -1/4" or +1/2" from dimension shown.
   3. Form Offset: Between adjacent pieces of form work, facing material shall NOT exceed 1/8" where exposed to public view and 1/4" maximum for all other conditions.

3.3 ADDITIONAL REQUIREMENTS

A. Construct forms tight enough to prevent loss of concrete mortar.

B. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses and the like for easy removal.
   2. DO NOT use rust-stained steel form-facing material.
   3. Use only form or form-tying methods which DO NOT cause spalling of the concrete upon form stripping or tie removal.

C. Elevated Structural Slabs and Beams: DO NOT strip forms until concrete has reached 80 percent of the specified 28-day strength as determined by test cylinder breaks.

D. Forms with Form Liners: Remove per manufacturer's recommendations. Use consistent removal timing to avoid variations in concrete color. Avoid damaging formed profiles.

E. Set edge forms, bulkheads and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

F. Provide temporary 12-inch-wide x 18-inch-high openings for cleanouts and inspection ports every 7 feet at the bottom of each lift form and where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations, where possible.

G. Chamfer exterior corners and edges of permanently exposed concrete.

H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds and bulkheads required in the Work.
   1. Determine sizes and locations from trades providing such items.
   2. Openings shall be of sufficient size to permit final alignment of pipes or other items without deflection or offsets of any kind. Allow space for packing where items pass through the wall to ensure watertightness. Provide openings with continuous keyways and waterstops. Provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with reinforcement as indicated in the typical structural details. Reinforcing shall be at least 2 inches clear from the opening surfaces and encased items.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions before placing reinforcement.

L. Embedded Items.
   1. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions and directions furnished with items to be embedded.
      a. Install anchor bolts/rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
      b. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles and other conditions.
      c. Check special castings, channels or other metal parts that are to be embedded in the concrete prior to and again after placing the concrete.
      d. Check nailing blocks, plugs and strips necessary for the attachment of trim, finish and similar work prior to placing the concrete.

M. Pipes and wall spools cast in concrete.
   1. Install wall spools, wall flanges, and wall anchors before placing concrete. DO NOT weld, tie or otherwise connect the wall spools or anchors to the reinforcing steel.
   2. Support pipe and fabricated fittings to be encased in concrete-on-concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement shall occur during construction.
   3. Pipes or spools located below operating water level shall have waterstop ring collars and shall be cast in place. DO NOT block out such piping and grout after the concrete section is cast. Pipes fitted with thrust rings shall be cast in place.

N. Removing and reusing forms.
   1. General: DO NOT remove forms from concrete which has been placed with outside temperature below 50°F without first determining and verifying with Engineer if the concrete has properly set without regard for time. DO NOT apply loading on green concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.
      a. Leave formwork for beam soffits, joists, structural slabs, beams, girders, and other structural elements that support weight of concrete in place until concrete has achieved 100 percent its 28-day design compressive strength.

b. Formwork for sides of beams, walls, columns, and similar parts of the Work that does NOT support weight of concrete may be removed after cumulatively curing at NOT less than 50°F (10 deg C) for 48 hours after placing concrete, if concrete is hard enough to NOT be damaged by form-removal operations and curing and protection operations are maintained.
c. Leave bracing for walls until the top or roof slab concrete reaches 100% of its 28-day design compressive strength.
d. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

2. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated or otherwise damaged form-facing material shall NOT be acceptable for exposed surfaces. Apply new form-release agent.
3. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. DO NOT use patched forms for exposed concrete surfaces.

O. Aluminum surfaces in contact with concrete.
1. Aluminum surfaces in contact with concrete or grout or dissimilar metals shall be protected with a Mylar isolator, bituminous paint or other material approved by Engineer.

P. Shores and reshores.
1. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation and removal of shoring and reshoring.
a. DO NOT remove shoring or reshoring until measurement of slab tolerances is complete.
2. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member shall be excessively loaded or shall induce tensile stress in concrete members without sufficient steel reinforcement.
3. For multi-storied structures, the shoring and reshoring diagrams and procedures shall be signed and sealed by a Registered Professional Engineer in the state where the construction is being undertaken. These diagrams and procedures shall take into account the effect of the loads on the uncured concrete and the construction load on each floor.
4. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

END OF SECTION

SECTION 03 20 00 – CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Reinforcing steel and related items required for cast-in-place concrete.

B. Related sections:
   1. Section 03 10 00 – Concrete Forming.
   2. Section 03 30 00 – Cast-In-Place Concrete.

1.2 REFERENCES

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

B. ASTM International:
   1. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   2. A1064 – Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

C. Concrete Reinforcing Steel Institute (CRSI):
   1. Manual of Standard Practice.

1.3 SUPERVISION

A. Workmanship: Always provide qualified supervision reinforcing work is in progress. Workmen shall be experienced iron workers.

B. Codes: Reinforcement placement and detailing shall comply with practice specified in the ACI SP-66 – Detailing Manual - latest edition of the American Concrete Institute or its latest revision, unless otherwise specified herein.

1.4 SUBMITTALS

A. Shop drawings: Shop drawings shall be prepared for all reinforcement required by the project. Shop drawings shall be logically and legibly prepared to permit reasonable ease of sorting, selecting, placing reinforcement as well as checking drawings. Preparer and fabricator shall be identified on the drawings.
   1. Reinforcement shall NOT be fabricated until the shop drawings have been processed, approved, and returned.
   2. Check all shop drawings to verify reinforcement dimensions required by drawings are satisfied.
   3. Provide bar sizes, bar lengths, bar material, bar grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and lap lengths, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

B. Reinforcement shop drawings:
   1. Review of reinforcement shop drawings by the Engineer shall be limited to general compliance with the Contract Documents.

2. Submit reinforcement shop drawings in a complete package for each specific structure. Partial submittals shall be rejected.

C. Changes to reinforcing steel contract drawing requirements:
1. Indicate in separate letter submitted with shop drawings any changes of requirements indicated on the Drawings for reinforcing steel.
2. Such changes shall NOT be acceptable unless the Engineer has accepted such changes in writing.

PART 2 - PRODUCTS

2.1 CONCRETE REINFORCEMENT

A. General: All reinforcement shall be free from rust, loose mill scale, and other contaminants.

B. All bars shall be billet steel bars for concrete reinforcement ASTM A615 Grade 60.

C. Wire bar supports located between reinforcing bars and face of concrete:
1. Stainless steel. Type 304 stainless steel bar supports.
2. Support reinforcing for concrete placed on ground using bar support chairs with Type 304 stainless steel plates for resting on ground welded to the chairs.

D. Concrete bar supports located between reinforcing bars and face of concrete:
1. Manufactured expressly for supporting reinforcing bars.
2. Manufactured with two annealed steel wires to securely tie concrete bar support to reinforcing steel.
3. Manufactured with minimum f'_c = 5,000 psi concrete.

2.2 WWR (WELDED WIRE REINFORCEMENT):

A. In accordance with ASTM A185 (withdrawn in 2013, replaced by A1064), 75ksi minimum tensile strength.

B. WWR may NOT be used in place of reinforcing bars unless accepted in writing by the Engineer.

C. Provide WWR in flat sheet form.

D. If WWR is used, provide WWR having cross-sectional area per linear foot of NOT less than cross-sectional area per linear foot of reinforcing bars indicated on the Drawings.

2.3 ACCESSORIES

A. General: Accessories shall be subject to Engineer's approval.
1. Tie wire - 18-gauge annealed steel wire.
2. Number of chairs shall be adequate to prevent sag during steel and concrete placement.
3. Wall layer spacers shall be 1/4-inch round "Z" bar.
4. Horizontal layer spacers shall be wire bar supports or reinforcing bars bent to support top layer.
5. Dowel bar splicer:
   a. Dowel bar splicer shall be Richmond or approved equal, manufactured from standard specified rebar material, with NC threads and shop fabricated to specified dowel configurations.
6. Mechanical Connectors:
   a. Approved Manufacturers: Dayton Superior, Erico, or approved equal.

b. The mechanical connection shall meet the code requirements of developing in tension and compression as required by the referenced codes. Install per the manufacturer’s approved procedures.

PART 3 - EXECUTION

3.1 GENERAL

A. Reinforcing bars and welded wire fabric reinforcement: Verify that reinforcement is new stock free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings which adversely affect bonding capacity when placed in the work.

B. Other trades: Coordinate all work of other trades to avoid conflict with reinforcement.

C. Shop drawings: Check all shop drawings to verify dimensions required.

3.2 FABRICATING

A. General: Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice." Reinforcement shall be shop fabricated except where straight bars No. 5 or smaller are required.

B. Bending: All bending shall be by using bending jigs and mandrels. All bars shall be bent cold.

C. Cutting: Bars shall be cut by cold shearing. Torch cutting in the field may be permitted in special situations.

3.3 PREPARATION

A. Surface Preparation:
1. Reinforcing bars: thin coating of red rust resulting from short exposure shall NOT be considered objectionable. Thoroughly clean any bars having rust scale, loose mill scale, or thick rust coat.
2. Cleaning of reinforcement materials: Remove concrete or other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent concrete placement.

3.4 PLACING

A. General:
1. Accurately place all bars to meet tolerances as outlined in ACI 318 and tie in place before placing concrete, include dowels. Tie with 18-gauge steel wire.
2. Corner bars required for horizontal reinforcing. Unless otherwise noted on plans corner bars shall be same size and spacing as horizontal bar.
3. No field bending of bars shall be allowed.

B. Clearance:
1. Preserve clearance between bars of 1 inch minimum, NOT less than one bar diameter or 1-1/3 times large aggregate, whichever is larger.
2. Provide following concrete coverage over reinforcing steel unless otherwise indicated on plans:
   a. Three inches above subgrade - in excavation.
   b. Two inches above subgrade - slab on fill.
   c. Two inches from form - walls exposed to water or earth and for slab over water.
   d. One and one-half inches from form - normal cover interior walls, beams, columns, etc.

e. Three-fourths inch on top steel - interior slabs.
f. One and one-half inches on top and bottom - exterior slab.

3. Lap all reinforcing bars as required by ACI 318-latest edition Class B as indicated on the drawings except where otherwise required by ACI.
4. Stagger splices except where otherwise shown.
5. Welded splices are NOT permitted.
6. Lap welded wire reinforcement a minimum of two spaces.

C. Dowels: All dowels shall be placed and securely anchored before placing concrete.

D. Supports:
1. Provide enough to prevent sagging, to prevent shifting, and to support loads during construction; but in no case less than quantities and at locations as indicated in ACI 315 (SP-66).
2. DO NOT use brick, broken concrete masonry units, spalls, rocks, wood, or similar materials for supporting reinforcing steel.
3. DO NOT use reinforcing bars that have less cover than required by the Contract Documents.
4. DO NOT adjust location of reinforcement required by the Contract Documents to provide cover to these bars.
5. Wire chairs shall NOT be accepted to hold reinforcing clearance on walls.

E. Tying of bar reinforcement:
1. Fasten bars securely in place with wire ties.
2. Tie bars sufficiently often to prevent shifting.
3. Provide at least 3 ties in each bar length.
4. DO NOT apply to dowel lap splices or to bars shorter than 4 feet, unless necessary for rigidity.
5. Tie slab bars at every intersection around periphery of slab.
6. Tie wall bars and slab bar intersections other than around periphery at NOT less than every fourth intersection, but at NOT greater than following maximum spacings:

Bar Size	**Slab Bar Spacing Inches**	**Wall Bar Spacing Inches**
Bars Number 5 and Smaller	60	48
Bars Number 6 through Number 9	96	60
Bars Number 10 and Number 11	120	96

7. After tying wire ties, bend ends of wire ties in towards the center of the concrete section.
a. The cover for wire ties shall be the same as the cover requirements for reinforcing bars.

F. Openings and Obstructions:
1. Place additional reinforcing around openings as shown on the drawings and standard details.
2. Bend reinforcing around obstructions. Place extra reinforcing where cutting is authorized. Engineer's approval required before cutting steel.
3. Consult Engineer on special situations.

G. Welded Wire Reinforcement:
1. Install necessary wiring, spacing chairs, or supports to keep welded wire fabric in place while concrete is being placed.

2. Bend fabric as indicated on the Drawings or required to fit work.
3. Unroll or otherwise straighten fabric to make flat sheet before placing in the Work.
4. Lap splice welded wire fabric as indicated on the Drawings.
5. If lap splice length is NOT indicated on the Drawings, splice fabric in accordance with ACI 318 and ACI 350.

H. Certification: Certify material and type of deformation.

I. Condition: All reinforcement shall be free from loose rust, dirt coating, oil, paint, or any foreign substance.

END OF SECTION

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes Cast-in-Place Concrete for:
   1. Hydraulic (liquid containing) structures.
   2. Beams and columns.
   3. Building walls.
   4. Retaining walls.
   5. Foundation walls.
   6. Footings.
   7. Suspended slabs.
   8. Slabs on grade.
   9. Equipment pads.

B. Related Sections:
   1. Section 01 33 00 – Submittal Procedures
   2. Section 01 40 00 – Quality Requirements
   3. Section 01 50 00 – Temporary Facilities and Controls
   4. Section 01 60 00 – Product Requirements
   5. Section 01 77 00 – Closeout Procedures
   6. Section 03 01 00 – Maintenance of Concrete
   7. Section 03 39 00 – Concrete Curing

1.2 REFERENCE STANDARDS

A. American Concrete Institute (ACI):
   1. ACI 117 – Specification for Tolerances for Concrete Construction and Materials
   2. ACI 301 – Specifications for Structural Concrete
   3. ACI 305R – Guide to Hot Weather Concreting
   4. ACI 306.1 – Standard Specification for Cold Weather Concreting
   5. ACI 308.1 – Specification for Curing Concrete
   6. ACI 318 – Building Code Requirements for Structural Concrete
   7. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures
   8. ACI 350.1 – Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures
      a. Manual of Concrete Practice

B. ASTM International:
   1. C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
   2. C33 – Standard Specification for Concrete Aggregates
   3. C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
   4. C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
   5. C94 – Standard Specification for Ready-Mixed Concrete
   6. C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete
   7. C150 – Standard Specification for Portland Cement
   8. C172 – Standard Practice for Sampling Freshly Mixed Concrete
   9. C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
   10. C227 – Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
   11. C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

12. C260 – Standard Specification for Air-Entraining Admixtures for Concrete
13. 309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
14. C330 – Standard Specification for Lightweight Aggregates for Structural Concrete
15. C494 – Standard Specification for Chemical Admixtures for Concrete
16. C595 – Standard Specification for Blended Hydraulic Cements
17. C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
18. 881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
19. C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars
20. C1012 – Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution
21. C1017 – Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
22. C1064 – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
23. C1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
24. C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
25. C1116 – Standard Specification for Fiber-Reinforced Concrete
26. C1218 – Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
27. C1240 – Standard Specification for Silica Fume Used in Cementitious Mixtures
28. C1260 – Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
29. C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
30. D994 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
31. D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
32. D1752 – Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
33. E96 – Standard Test Methods for Water Vapor Transmission of Materials
34. E329 – Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
35. E1155 – Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers
36. E1643 – Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
    a. ASTM E1745 – Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 DEFINITIONS

A. Cementitious Materials:
   1. Portland cement alone or in combination with one or more of the following:
      a. Blended hydraulic cement
      b. Fly ash and other pozzolans
      c. Ground granulated blast-furnace slag
      d. Silica fume
   2. Subject to compliance with requirements.

B. Cold Weather:
   1. Ambient temperature below 40 degrees F or approaching 40 degrees F and falling.

C. Defective Area:

1. Surface defects that include:
    a. Honeycomb
    b. Rock pockets
    c. Indentations
    d. Surface voids greater than 3/16-inch deep
2. Surface voids greater than 3/4-inch diameter
3. Cracks in liquid containment structures and below-grade habitable spaces that are 0.010-inch wide and wider
4. Cracks in other structures that are 0.015-inch wide and wider
5. Spalls, chips, embedded debris, lift lines, sand lines, deviations that exceed specified tolerances and include, but are NOT limited to, fins, form pop-outs, and other projections, stains, and other color variations that can NOT be removed by cleaning.

D. Exposed Concrete:
1. Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when the structure is drained.

E. Hot Weather:
1. As defined in ACI 305R.

F. Hydraulic Structure:
1. Liquid containment structure.

G. New Concrete:
1. Less than 60 days old.

1.4 SUBMITTALS

A. Section 01 33 00, SUBMITTAL PROCEDURES, specifies requirements for submittals.

B. Product Data: Submit data for each type of product indicated.

C. Design Data:
1. Submit concrete mix design for each mix included in the Supplement at the end of this Section.
    a. Proportions of all materials in the mix, signed by the mix designer.
    b. Average strength per ACI 301.
    c. Manufacturer’s Certificate of Compliance per Section 01 60 00, PRODUCT REQUIREMENTS.
    d. Cementitious materials.
    e. Admixtures.
    f. Test Reports – chemical analysis, chloride-ion content, shrinkage test results.
    g. Coarse and fine aggregate gradations.
    h. Water to be withheld for later addition at Project site.
2. Detailed plan for placing and curing concrete in cold weather.
3. Detailed plan for placing and curing concrete in hot weather.
    a. Thermal control plan for concrete sections greater than 2’-6”.
    b. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
    c. Manufacturer Instructions: Submit installation procedures and interfacing required with adjacent Work.
    d. Field Quality requirements Submittals: Indicate results of Contractor-furnished tests and inspections, including tightness test results and floor surface flatness and levelness measurements.

D. Ready-Mix Concrete Delivery Tickets
    a. Record the amount of water added at the Project site on the delivery ticket.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 77 00, CLOSEOUT PROCEDURES specifies requirements for closeout submittals.

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

1.6 QUALITY ASSURANCE

A. Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

B. Perform Work according to ACI 301 and ACI 117.

C. Comply with ACI 305R when placing concrete during hot weather.

D. Comply with ACI 306.1 when placing concrete during cold weather.

E. Obtain each type or class of cementitious material from a single source, obtain aggregate from a single source and obtain admixtures from a single supplier for the Project. If any of these sources need to, by necessity, change, notify the Engineer.

F. Installer Qualifications: Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician. If an ACI-certified Technician is NOT available, submit flatwork installer qualifications to the Engineer.

G. Manufacturer Qualifications: A firm with a minimum of 5 years' experience in manufacturing ready-mix concrete products and that complies with ASTM C94 requirements for production facilities and equipment.
    1. Manufacturer certified according to NRMCA's "Certification of Ready-Mixed Concrete Production Facilities" or equivalent program.
    2. Mix Designer: Certified as NRMCA Concrete Technologist Level 2 or Licensed Engineer. If neither, the Mix Designer's qualifications shall be submitted to the Engineer.

H. Testing Agency Qualifications: An independent agency, acceptable to the Authority Having Jurisdiction, qualified according to ASTM C1077 and ASTM E329 for the testing indicated.
    1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
        a. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician – Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician – Grade II.

I. Concrete Pre-Installation Conference:
    1. Schedule and conduct at Project site prior to submitting mix designs.
    2. Required meeting attendees:
        a. Contractor's superintendent.
        b. Structural Engineer in responsible charge or designee.
        c. Independent testing agency.
        d. Ready-mix producer.
        e. Concrete Subcontractor.
        f. Admixture representative.

3. Agenda shall include:
    a. Concrete testing and special inspection.
    b. Mix designs and admixtures.
    c. Formwork and formwork removal.
    d. Reinforcement.
    e. Placement methods.
    f. Concrete finishing.
    g. Curing procedures.
    h. Hot and cold weather placement protections.
    i. Joints.
    j. Placement of anchors and miscellaneous embeds.
    k. Tolerances including floor and slab flatness and levelness.
    l. Concrete repair procedures.

1.7 MOCKUPS

A. Section 01 40 00, QUALITY REQUIREMENTS, specifies requirements for mockups.

B. Construct mockups for architectural concrete surfaces receiving special treatment or finish as result of formwork.

C. Size: Sufficient to indicate required special treatment or finish.

D. If requested by Architect/Engineer, cast concrete against sample panel.

E. Obtain acceptance of Architect/Engineer for resultant surface finish prior to erecting formwork.

F. Locate where indicated on Drawings.

G. Incorporate accepted mockup as part of Work.

1.8 AMBIENT CONDITIONS

A. Section 01 50 00, TEMPORARY FACILITIES AND CONTROLS, specifies requirements for ambient condition control facilities for product storage and installation.

B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum seven days.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete:
    1. Cement:
        a. Comply with ASTM C150, for cement type, see Supplement at end of Section.
        b. Type: Portland.
    2. Blended Cement:
        a. Comply with ASTM C595.
        b. For sulfate resistance option, see Supplement at End of Section.
        c. Color: Gray.
    3. Normal Weight Aggregates:
        a. Comply with ASTM C33.
        b. Coarse Aggregate Maximum Size: 1” nominal.

c. Coarse Aggregate – NOT more than 15 percent by weight of thin or elongated pieces having a length of five times the average thickness.
d. Fine Aggregate – consisting of clean natural sand or of sand prepared from crushed stone or crushed gravel.

4. Water:
   a. Comply with ACI 318.
   b. Potable, without deleterious amounts of chloride ions.

B. Admixtures:
1. Manufacturers:
   a. BASF Admixtures, Inc, Shakopee, MN.
   b. Euclid Chemical Co., Cleveland, OH.
   c. W.R. Grace & Co., Cambridge, MA.
   d. Substitutions: As specified in Section 01 60 00, PRODUCT REQUIREMENTS.
2. Air Entrainment: Comply with ASTM C260.
3. Chemical:
   a. Comply with ASTM C494.
   b. Type A - Water-Reducing.Type B - Retarding.
   d. Type C - Accelerating.
   e. Type D - Water-Reducing and Retarding.
   f. Type E - Water-Reducing and Accelerating.
   g. Type F - Water-Reducing, High Range.
   h. Type G - Water-Reducing, High Range, and Retarding.
4. Fly Ash: Comply with ASTM C618, Class F.
5. Silica Fume: Comply with ASTM C1240.
6. Slag:
   a. Description: Ground-granulated blast-furnace slag.
   b. Comply with ASTM C989.
   c. Grade 100 or 120.
7. Plasticizing:
   a. Comply with ASTM C1017.
   b. Type I or Type II.
8. Shrinkage Reducing Admixture:
   a. BASF; Tetraguard AS20.
   b. Euclid; Eucon SRA Series.
   c. W.R. Grace; Eclipse Series.

2.2 CONCRETE MIX

A. See Supplement at the end of this Section for design requirements for each concrete mix.

B. Select proportions for concrete according to ACI 318.

C. Use water-reducing admixture in concrete that is part of a Hydraulic Structure or with a water-cementitious ratio below 0.50.

D. Where fly ash is used, it shall be limited to 25 percent of total cementitious materials, unless approved in writing by the Engineer.

E. Limit water-soluble chloride-ion content in hardened concrete to 0.15 percent by weight of cement for non-hydraulic structures and 0.10 percent for hydraulic structures.

F. Fine aggregate shall be in the range of 36 percent to 40 percent of total aggregate weight.

G. Concrete Shrinkage Limits: See Subsection 3.5.J.

H. Target Slump
   1. Without high-range water reducers – 4 inches
      a. With high-range water reducers – 2 inches prior to the addition of the admixture, 8 inches maximum at point of delivery, unless otherwise permitted.
      b. Target slump for drilled pier – 6 to 8 inches.

I. Admixtures:
   1. Include admixture types and quantities indicated in concrete mix designs only if approved by Architect/Engineer.
   2. Cold Weather:
      a. Use accelerating admixtures in cold weather.
      b. Use of admixtures shall NOT relax cold weather placement requirements.
   3. Hot Weather: Use set-retarding admixtures.
   4. DO NOT use calcium chloride or admixtures containing calcium chloride.
      a. Add air entrainment admixture to concrete mix for Work exposed to freezing and thawing.
      b. Average Compressive Strength Reduction: NOT permitted.

J. Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C94 and deliver batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 90 minutes to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
      a. Contractor may coordinate with the concrete producer and admixture manufacturer to demonstrate the efficacy of using a retarding admixture to extend placement times during hot weather.

K. Site-Mixed Concrete: Mix concrete according to ACI 318.

2.3 ACCESSORIES

A. Bonding Agent:
   1. Manufacturers:
      a. BASF Building Systems Inc.
      b. Euclid Chemical Co.
      c. Prime Resins
      d. Sika Chemical Corp.
   2. Substitutions: As specified in Section 01 60 00, PRODUCT REQUIREMENTS.
   3. Furnish materials according to ASTM C881, Type V standards.Description: Two-component moisture insensitive, 100 percent solids epoxy resin.

B. Vapor Retarder:
   1. Manufacturers:
      a. Fortifiber Corp.
      b. Revan Industries, Inc.
      c. Stego Industries, LLC
   2. Substitutions: As specified in Section 01 60 00, PRODUCT REQUIREMENTS.
   3. Furnish materials according to E1745, Class B standards.Description: Clear polyethylene film.
   5. Thickness: 10 mils min.
   6. Type: As recommended for below-grade application.
      a. Joint Tape: As recommended by manufacturer.

C. Bond Breaker:
   1. Manufacturers:
      a. Dayton Superior: EDOCO Clean Lift Bond Breaker

2. Substitutions: As specified in Section 01 60 00, PRODUCT REQUIREMENTS.
3. Description: Nonstaining, providing positive bond prevention.

D. Concrete Reinforcing Fibers:
1. Manufacturers:
   a. Euclid Chemical Co.
   b. Propex Concrete Systems Corp.
   c. Substitutions: As specified in Section 01 60 00, PRODUCT REQUIREMENTS.
2. Description: High-strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete.
3. Comply with ASTM C1116.
4. Tensile Strength: 130 ksi.
5. Toughness: 15 ksi.
6. Fiber Length: 3/4 inch.
7. Fiber Count: 34 million/lb.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 77 00, CLOSEOUT PROCEDURES, specifies requirements for installation examination.

B. Verify requirements for concrete cover over reinforcement.

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

3.2 PREPARATION

A. Section 01 77 00, CLOSEOUT PROCEDURES specifies requirements for installation preparation.

B. Previously Placed Concrete:
1. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
   a. Remove laitance, coatings, and unsound materials.
   b. Doweled Joints: Install dowel bars and support assemblies at joints as indicated on drawings.
   c. Remove debris and ice from formwork, reinforcement, and concrete substrates.

C. Remove water from areas receiving concrete before concrete is placed.

3.3 INSTALLATION

A. Placing Concrete:
1. Place concrete according to ACI 301.
2. Notify testing laboratory Engineer minimum 24 hours prior to commencement of operations.
3. Ensure that reinforcement, inserts, embedded parts, formed expansion and contraction joints, and waterstop are NOT disturbed during concrete placement.
4. Install vapor retarder under interior slabs on grade according to ASTM E1643. Lap joints minimum 6 inches and seal watertight by taping edges and ends per manufacturer's instructions.
   a. Repairs:
      1) Repair vapor retarder damaged during placement of concrete reinforcement.

2) Using vapor retarder material, lap over damaged areas minimum 6 inches and seal watertight.

5. Joint Filler:
   a. Separate slabs on grade from vertical surfaces with 1/2-inch-thick joint filler.
   b. Place joint filler in floor slab pattern placement sequence; set top to required elevations; secure to resist movement by wet concrete.
   c. Extend joint filler from bottom of slab to within 1/2 inch of finished slab surface.
6. Deposit concrete at final position, preventing segregation of mix. Limit vertical free fall to 5 feet.
7. Place concrete in continuous operation for each panel or section as determined by predetermined expansion, control and construction joints.
   a. Place in horizontal layers NOT to exceed 2.0 feet in depth, except for slabs which shall be placed full depth.
   b. DO NOT exceed formwork design pressures.
8. DO NOT use aluminum conveying devices.
9. Retempering of concrete is NOT permitted where cement has partially hydrated.
10. Pumping of Concrete:
    a. Provide standby pump, conveyor system or other system onsite during pumping to ensure completion of concrete placement without cold joints in case of equipment failure.
11. Consolidate concrete using mechanical vibrating equipment per ACI 301
    a. DO NOT use vibrators to transport concrete within formwork. Insert and withdraw vibrators vertically at uniform spacing to quickly penetrate placed layer and at least 6 inches into preceding layer. DO NOT insert vibrators into lower layers that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement, waterstop and other items without causing segregation.
    b. Slabs with horizontal waterstop: limit concrete placement to elevation of waterstop in first pass, ensure space beneath waterstop completely fills with concrete, vibrate under waterstop, then place remaining concrete to full height of slab.
    c. Maintain at least one standby vibrator prior to placing concrete.
12. Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.
13. Maximum Size of Concrete Placements:
    a. Locate expansion, control and contraction joints where shown on drawings
    b. Locate construction joints where shown on drawings or where approved in joint location submittal.
    c. Provide vertical construction joints in walls and slabs at maximum spacing of 40 feet, unless shown or approved otherwise.
    d. Place joints to avoid penetrations.
14. DO NOT interrupt successive placement and DO NOT permit cold joints to occur.
15. Minimum Time Between Adjacent Placements:
    a. Construction or Control Joints: 7 days unless otherwise specified.
    b. Construction joint between top of footing or slab and column or wall: NOT less than 24 hours.
    c. Expansion or Contraction Joints: NOT less than 24 hours.
16. Hot Weather Placement:
    a. Comply with ACI 305.1
    b. Maintain concrete temperature below 95 deg F at time of placement. If chilled water or ice are used to maintain concrete temperature, that water equivalent shall be included in the total water used to calculate the water-cement ratio.
    c. Fog-spray forms, reinforcement, and subgrade just before placing concrete, without creating standing water or dry areas.
17. Cold Weather Placement:
    a. Comply with ACI 306.1

b. DO NOT place concrete on frozen subgrade or subgrade containing frozen materials. Top 12 inched of subgrade shall be thawed prior to concrete placement.
c. DO NOT place concrete in contact with reinforcement or embedments with surfaces that are less than 35 deg F.
d. Provide supplemental heat when other means of thermal protection are insufficient. Vent carbon-based fuel heaters away from concrete surface to avoid concrete carbonation.
e. Provide temperature sensors placed on the concrete surfaces throughout the work. Record surface temperature at least once every 12 hours.
f. Protect concrete from freezing until the end of the curing period.

18. Saw-Cut Joints (where permitted):
    a. Saw-cut joints within 12 hours after placing.
    b. Use 3/16-inch-thick blade.
    c. Cut into 1/4 depth of slab thickness.
19. Screeding:
    a. Screed floors and slabs to elevations and slopes shown on drawings.
    b. Surface Flatness: FF 20 (conventional slab).

B. Curing and Protection:
1. Per Section 03 39 00, CONCRETE CURING.

3.4 BACKFILL AGAINST STRUCTURES

A. DO NOT backfill against walls until the concrete has reached the design 28-day strength as demonstrated by concrete cylinder breaks.

B. For structures with top slabs or diaphragms, the top slab shall reach design strength, or the diaphragm shall be secured per the contract documents prior to backfill.

C. Unless otherwise permitted, backfill evenly around structure to prevent differential horizontal pressures.

3.5 FIELD QUALITY REQUIREMENTS

A. Section 01 40 00, QUALITY REQUIREMENTS, specifies requirements for inspecting and testing.

B. Inspection and Testing: Performed by testing laboratory according to ACI 318.

C. Provide unrestricted access to Work and cooperate with appointed testing and inspection firm.

D. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.

E. Concrete Inspections:
1. Continuous Placement Inspection: Inspect for proper installation procedures.
    a. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
    b. Samples for testing air content in pumped concrete shall be taken at point of placement and point of delivery to establish a correlation to estimate air content at point of placement. All other samples shall be taken at point of delivery.
    c. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours.

F. Strength Test Samples:
1. Sampling Procedures: Comply with ASTM C172.
2. Cylinder Molding and Curing Procedures:Comply with ASTM C31.

b. Cylinder Specimens: Standard cured.

3. Sample concrete and make one set of four 4-inch diameter test cylinders for every 50-cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and walls.
4. If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five random batches, or from every batch if less than five batches are used.
   a. Make one additional cylinder during cold weather concreting and field cure.

G. Field Testing:
1. Slump Test Method: Comply with ASTM C143.
2. Air Content Test Method: Comply with ASTM C173 or C231.
3. Temperature Test Method: Comply with ASTM C1064.
4. Frequency of Testing:
   a. Measure slump and temperature for each sample.
   b. Measure air content in air-entrained concrete for each sample.

H. Cylinder Compressive Strength Testing:
1. Test Method: Comply with ASTM C39.
2. Test Acceptance: According to ACI 318.
3. Test one cylinder at seven days.
4. Test two cylinders at 28 days.Retain one cylinder for 56 days for testing when requested by Engineer.
   a. Dispose of remaining cylinders if testing is NOT required.

I. Core Compressive Strength Testing:
1. Sampling and Testing Procedures: Comply with ASTM C42.
2. Test Acceptance: According to ACI 318.
   a. Drill three cores for each failed strength test from failed concrete.

J. Shrinkage Testing:
1. Comply with ASTM C157 with the following modifications:
   a. Prisms shall be moist cured for 7 days prior to the 28-day drying period.
   b. Measurement at the end of the 7-day moist cure shall be considered the initial length.
   c. The reported results shall be the average of three prisms.
2. If the drying shrinkage measurement of a specimen varies from the average by more than.004 percent, disregard the results from that specimen.
3. Test shrinkage characteristics every 5,000 cubic yards and every 3 months during construction of hydraulic structures.
4. Results at the end of the 28-day drying period shall NOT exceed 0.04 percent if 3-inch prisms are used or 0.038 percent if 4-inch prisms are used.
   a. If the 7-day or 14-day field shrinkage tests exceed the limits established by testing of the mix design, furnish an additional 14 days of water cure beyond the original curing period for hydraulic structures. Modify the mix design to reduce shrinkage.

K. Liquid Tightness Tests:
1. In accordance with ACI 350.1.
2. Purpose: To determine the integrity and water tightness of finished concrete surfaces of liquid containment structures. Contractor shall perform and pay for all costs associated with liquid tightness tests. Report all test results to the Engineer.
3. For All Water-Holding Structures:
   a. Perform tightness tests after the concrete structure is complete and capable of resisting the hydrostatic pressure of the water test. The concrete shall have achieved its full design strength.
   b. Perform tightness tests before backfill, brick facing, or other work that shall cover the concrete wall surfaces has begun.

c. Install all temporary bulkheads, cofferdams and pipe blind flanges and close all valves. Inspect each to assure that it provides a complete seal.
d. Fill with water to test level shown, or maximum liquid level if no test level is given. Maintain this level for 72 hours prior to the start of the test to allow for water absorption, structural deflection and temperature to stabilize.
e. Measure evaporation and precipitation by floating a partially filled, transparent, calibrated, open top container.
f. Measure the water surface at two points 180 degrees apart, when possible where attachments such as ladders exist, at 24-hour intervals. Use a sharp pointed hook gage and fixed metal measure capable of reading to 1/100 of an inch. Continue the test for a period sufficient to produce at least 1/2" drop in the water surface based on the assumption that leakage would occur at the maximum allowable rate specified or for 72 hours, whichever is the lesser time.

4. Acceptance Criteria:
   a. Volume loss shall NOT exceed 0.075% of contained liquid volume in a 24-hour period, correcting for evaporation, participation, and settlement.
   b. No damp spots or seepage visible on exterior surfaces. A damp spot is defined as sufficient moisture to be transferred to a dry hand upon touching.
5. Repairs when test fails:
   a. Dewater the structure; fill leaking cracks with crack repair epoxy. Patch areas of damp spots previously recorded and repeat tightness test in its entirety until the structure successfully passes the test.

L. Water-Soluble Chloride-Ion Concentration Test Method:
1. Comply with ASTM C1218.
2. Test at 28 days.
   a. Maximum Chloride-Ion Concentration: As permitted by applicable code.

M. Patching:
1. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
2. Honeycombing or Embedded Debris in Concrete:
   a. NOT acceptable.
   b. Notify Engineer upon discovery.
   c. Patch imperfections per Section 03 01 00, MAINTENANCE OF CONCRETE.

N. Defective Concrete:
1. Description: See Definitions.
2. Repair or replacement of defective concrete shall be determined by Engineer.
3. DO NOT patch, fill, touch up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.6 SUPPLEMENTS

A. Requirements of concrete mix designs following "End of Section" are a part of this specification and supplement requirements of Part 1 through Part 3 of this Section.

END OF SECTION

5000 PSI CONCRETE MIX

A. Use for Hydraulic Structures exposed to freezing and thawing cycles, severe sulfate exposure and requiring low permeability. Typically used in wastewater treatment.

B. Mix Design Properties:
   1. Maximum water / cementitious ratio of 0.40.
   2. Minimum compressive strength at 28 days of 5,000 psi.
   3. Conform to shrinkage limits.
   4. Air content of 4.5% to 7.0%, assuming 3/4” or 1” maximum aggregate size.
   5. Provide cementitious materials per one of the following:
      a. ASTM C150 Type V – type F fly ash may be included as an option
   6. Minimum cementitious materials content in the mix shall be:
      a. 560 pounds per cubic yard for 3/4-inch maximum aggregate size.
      b. 535 pounds per cubic yard for 1-inch maximum aggregate size.
      c. Limit maximum cementitious content to 100 pounds per cubic yard greater than specified minimums.
   7. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent.
      a. Test if total chloride-ion content of individual ingredients, calculated on the basis of concrete proportions, exceeds 0.10 percent.
      b. Refer to PART 1 through PART 3 of this Section for additional requirements.

4500 PSI CONCRETE MIX

A. Use for Hydraulic Structures exposed to freezing and thawing cycles, moderate sulfate exposure and requiring low permeability. Typically used in water treatment.

B. Mix Design Properties:
   1. Maximum water / cementitious ratio of 0.42.
   2. Minimum compressive strength at 28 days of 4,500 psi.
   3. Conform to shrinkage limits.
   4. Air content of 4.5% to 7.0%, assuming 3/4” or 1” maximum aggregate size.
   5. Provide cementitious materials per one of the following:
      a. ASTM C150 Type II – type F fly ash may be included as an option.
      b. ASTM C595 Type IP – complies with moderate sulfate resistance option.
   6. Minimum cementitious materials content in the mix shall be:
      a. 560 pounds per cubic yard for 3/4-inch maximum aggregate size
      b. 535 pounds per cubic yard for 1-inch maximum aggregate size
      c. Limit maximum cementitious content to 100 pounds per cubic yard greater than specified minimums.
   7. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent.
      a. Test if total chloride-ion content of individual ingredients, calculated on the basis of concrete proportions, exceeds 0.10 percent.
      b. Refer to PART 1 through PART 3 of this Section for additional requirements.

4500 PSI CONCRETE MIX

A. Use for Hydraulic Structures NOT exposed to freezing and thawing cycles, moderate sulfate exposure and requiring low permeability. Typically used in water treatment in non-freeze / thaw areas.

B. Mix Design Properties:
   1. Maximum water / cementitious ratio of 0.42.
   2. Minimum compressive strength at 28 days of 4,500 psi.
   3. Conform to shrinkage limits.
   4. Air content of 3.5% to 6.0% for 3/4" maximum aggregate size and 3.0% to 5.5% for 1" maximum aggregate size.
   5. Provide cementitious materials per one of the following:
      a. ASTM C150 Type II – type F fly ash may be included as an option.
      b. ASTM C595 Type IP – complies with moderate sulfate resistance option.
   6. Minimum cementitious materials content in the mix shall be:
      a. 560 pounds per cubic yard for 3/4-inch maximum aggregate size
      b. 535 pounds per cubic yard for 1-inch maximum aggregate size
      c. Limit maximum cementitious content to 100 pounds per cubic yard greater than specified minimums.
   7. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent.
      a. Test if total chloride-ion content of individual ingredients, calculated on the basis of concrete proportions, exceeds 0.10 percent.
      b. Refer to PART 1 through PART 3 of this Section for additional requirements.

4500 PSI CONCRETE MIX

A. Use for non-hydraulic structural concrete exposed to freezing and thawing cycles, moderate sulfate exposure and requiring low permeability. Typically used for buildings.

B. Mix Design Properties:
   1. Maximum water / cementitious ratio of 0.45.
   2. Minimum compressive strength at 28 days of 4,500 psi.
   3. Air content of 5.5% to 7.0% for 3/4” and 1” maximum aggregate size.
   4. Provide cementitious materials per one of the following:
      a. ASTM C150 Type II – type F fly ash may be included as an option.
      b. ASTM C595 Type IP – complies with moderate sulfate resistance option.
   5. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent.
      a. Test if total chloride-ion content of individual ingredients, calculated on the basis of concrete proportions, exceeds 0.30 percent.
      b. Refer to PART 1 through PART 3 of this Section for additional requirements.

4000 PSI CONCRETE MIX

A. Use for secondary elements NOT exposed to freezing and thawing cycles, with moderate sulfate exposure. Typically used below grade for electrical duct banks, pipe encasements NOT cast monolithically with structural slabs, thrust blocks, and drilled piers.

B. Mix Design Properties:
   1. Maximum water / cementitious ratio of 0.50.
   2. Minimum compressive strength at 28 days of 4,000 psi.
   3. Air content of 1.5% to 4.5% for 3/4" and 1" maximum aggregate size.
   4. Provide cementitious s materials per one of the following:
      a. ASTM C150 Type II – type F fly ash may be included as an option.
      b. ASTM C595 Type IP – complies with moderate sulfate resistance option.
   5. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent.
      a. Test if total chloride-ion content of individual ingredients, calculated on the basis of concrete proportions, exceeds 0.30 percent.
      b. Refer to PART 1 through PART 3 of this Section for additional requirements.

SECTION 03 39 00 – CONCRETE CURING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Curing Methods.
   2. Curing Products.

B. Related Sections:
   1. Section 01 33 00 – Submittal Procedures

1.2 REFERENCE STANDARDS

A. ASTM International:
   1. C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

B. American Concrete Institute:
   1. 308.1, Specification for Curing Concrete.

C. NSF International:
   1. 61 – Drinking Water Components – Health Effects.

1.3 SUBMITTALS

A. Section 01 33 00, SUBMITTAL PROCEDURES, specifies requirements for submittals.

B. Manufacturer's Product Data:
   1. Curing Compound.
   2. Evaporation Retardant.
   3. Penetrating Water Repellant Sealer.

C. Curing Methods:
   1. For each type of element in the facility such as slabs, walls, beams or columns.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Curing Compound:
   1. Water-based, high-solids, white pigmented, nonyellowing curing compound meeting the requirements of ASTM C309, Type 2, Class A.
   2. Manufacturers:
      a. Euclid Chemical; Kurez VOX White Pigmented.
      b. WR Meadows; 1640 – White.
      c. Vexcon; Certi-Vex Envio Cure White.

B. Evaporation Retardant:
   1. Manufacturers:
      a. BASF; MasterKure ER 50.
      b. Euclid Chemical; Eucobar.

C. Penetrating Water Repellant Sealer

1. Water-based, single component, silane/siloxane, penetrating, clear water repellant sealer.
2. Manufacturers:
    a. BASF; MasterProtect H 400.
    b. Euclid Chemical; Baracade WB 244.

PART 3 - EXECUTION

3.1 CONCRETE CURING

A. General:
1. Cure all concrete per project specifications and ACI 308.1.
2. Use only water curing procedures where surfaces are to receive paint or other coatings.
3. Use only water curing procedures on potable water structures.
4. If the result of the 7-day concrete strength test is less than 50 percent of the specified 28-day strength, extend the moist curing period for an additional 7 days.
5. Protect concrete from freezing during curing period.

B. Use one of the following curing methods as approved by the Engineer:
1. Vertical Surfaces:
    a. Method 1 – leave concrete forms in place and keep surfaces of forms and concrete wet for 7 days.
    b. Method 2 – apply curing compound, where allowed, immediately after removal of forms.
2. Horizontal Surfaces:
    a. Method 1 – water pond surface for 7 days.
    b. Method 2 – continuously sprinkle surface for 7 days.
    c. Method 3 – cover surface with material that will retain moisture such as burlap or cotton mats, sand or sawdust and keep continuously wet for 7 days.
    d. Method 4 – apply curing compound, where allowed, immediately after final finishing.

C. All slabs for structures defined as Environmental Structures per ACI 350 – Code Requirements for Environmental Engineering Concrete Structures shall be cured per the Horizontal Surfaces Methods 1, 2 or 3.

3.2 EVAPORATION RETARDANT APPLICATION

A. Use when environmental conditions will cause rapid drying of the concrete surface. DO NOT use on potable water structures unless NSF 61 approved.

B. Apply and reapply as required per manufacturer’s written instructions.

3.3 PENETRATING WATER REPELLENT SEALER APPLICATION

A. Apply where indicated on drawings.

B. Water cure concrete to receive sealer. DO NOT use membrane curing compounds. Keep surface clean and unpainted.

C. Apply per manufacturer’s recommendations for coverage and curing time.

END OF SECTION

SECTION 03 60 00 - GROUT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Non-shrink grout.
   2. Topping grout.
   3. Concrete Fill.
   4. Cement grout for pipe invert fill.
   5. Construction joint mortar.

B. Related Sections:
   1. Section 03 10 00 – Concrete Forming.
   2. Section 03 30 00 – Cast-In-Place Concrete.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. ASTM International (ASTM):
      a. C 230, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
      b. C 1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

B. Cement Grout (Non-shrink).
   1. Corps of Engineers (COE):
      a. CRD-C 611, Flow of Grout for Prep laced Aggregate Concrete.
      b. CRD-C 621, Specification for Non-shrink Grout

1.3 SUBMITTALS

A. Product data for each type of product indicated.

B. Certified test results verifying compliance with compressive strength, shrinkage and expansion requirements and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of non-shrink and epoxy grout.

C. Fine aggregate gradation.

D. One copy of each 30 consecutive strength test results and mix design used from a record of past performance, or one copy of laboratory trial mix and design and results, and one copy of the mix design proposed for each cementitious mixture and use under this contract.

E. Qualification for testing agency.

F. Material test reports: For the following from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates, Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
   2. Non-shrink grout.
   3. Epoxy grout.

G. Material certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Non-shrink grout.
3. Epoxy grout.

H. Field quality-control tests and observation reports.

I. Ready mix concrete (Cement Grout)
1. Provide delivery tickets for ready-mix concrete (cement grout) or weigh master's certificate per ASTM C 94, include weights of cement and each size aggregate and amount of water added at the plant and a record of placements. Record the amount of water added at the job site on the delivery ticket. Water added at the plant shall account for the moisture in aggregate. If water is added at the job site, then the total water content shall not exceed the water content of the approved design mix.
2. Keep records showing time and place of each placement of concrete, joint mortar bed material or cement grout, together with transit delivery slips certifying the contents of the placement. Furnish records to Engineer.

J. Joint Mortar Bed: Provide material analysis and certification for each placement.

K. Shop Drawings:
1. Product data of grouts.
2. Curing method for grout.
3. Mix design of cement-sand grout mixture for pipe invert/structure fill.
4. Mix design of Joint Mortar Bed.

L. Information Submittals:
1. Manufacturer's written instructions for mixing of grout.
2. Manufacturer's Certificate of Compliance: Grout free from chlorides and other corrosion-causing chemicals.
3. Manufacturer's Certificate of Proper Installation.
4. Statements of Qualification: Non-shrink grout manufacturer's representative.
5. Test Reports: Test report for 24-hour evaluation of non-shrink grout.

1.4 QUALIFICATIONS

A. Manufacturer's qualifications for cement grout and joint mortar bed: A firm experienced in manufacturing ready-mixed concrete products and a firm that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician – Grade I, Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician – Grade II.

C. Source limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source and obtain admixtures through one source from a single manufacturer.

1.5 QUALIFICATIONS

A. Non-shrink Grout Manufacturer's Representative: Authorized and trained representative of grout manufacturer, with minimum of 1 year experience that has resulted in successful installation of grouts similar to those for this Project.

B. For grout suppliers not listed herein, provide completed 24-hour Evaluation of Non-shrink Grout Test Form, attached at the end of this section. Independent testing laboratory to certify that testing was conducted within last 18 months.

1.6 GUARANTEE

A. Manufacturer's guarantee shall not contain disclaimer on the product data sheet, grout bag, or container limiting responsibility to only the purchase price of products and materials furnished.

B. Manufacturer guarantees participation with Contractor in replacing or repairing grout found defective due to faulty materials, as determined by industry standard test methods.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand and source throughout project:
   1. Portland Cement (Nonhydraulic Above Grade Structures): ASTM C 150, Type I or II or combination of Type I with fly ash.
   2. Portland Cement (Hydraulic and Below Grade Structures): ASTM C 150 Type II or combination of Type I with fly ash.
      FLY ASH: ASTM C 618, CLASS F, FLY ASH SHALL NOT EXCEED 15 PERCENT.

B. Fine aggregates: ASTM C 33, Class 4S or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Aggregates shall be free of materials with deleterious reactivity to alkali in cement. Aggregates for cement grout and/or mortar bed shall be provided from the same source as aggregate for the cast-in-place concrete.

C. Water: ASTM C 94 and potable.

2.2 ADMIXTURES

A. Comply with Section 03 30 00 Cast-In-Place Concrete.

2.3 NONSHRINK GROUT SCHEDULE

A. Furnish non-shrink grout for applications in grout category in the following schedule:

Application	Temperature Range 40 to 100 °F	Max. Placing Time 20 min	Max. Placing Time Greater than 20 min
Filling tie hole	I	I	I
Machine bases 25 hp or less	II	II	II
Through-bolt openings	II	II	II
Patching Concrete Walls	II	II	II
Machine bases 26 hp and up	III	III	III
Base plates and/or soleplates with vibration, thermal movement, etc.	III	III	III
Other applications not listed	II	II	II

2.4 NONSHRINK GROUT

A. Category I:
1. Nonmetallic and non gas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Test in accordance with ASTM C1107:
   a. Flowable consistency 140%, five drops in 30 seconds, in accordance with ASTM C 230.
   b. Flowable for 15 minutes.
4. Grout shall not bleed at maximum allowed water.
5. Minimum strength of flowable grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
6. Manufacturers and Products:
   a. Chemrex, Inc., Shakopee, MN; Set Grout.
   b. Euclid Chemical Co., Cleveland, OH; NS Grout.
   c. Dayton Superior Corp., Miamisburg, OH; 1107 Advantage Grout.
   d. US MIX Products, Denver, CO; US Spec Multi-Purpose Grout.
   e. L & M Construction Chemicals, Inc., Omaha, NE; Duragrout.
   f. Master Builders.

B. Category II:
1. Nonmetallic, non gas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency - at specified times or temperatures.
4. Test in accordance with COE CRD-C 621 and ASTM C 1107, Grade B:
   a. Fluid consistency 20 to 30 seconds in accordance with COE CRD-C 611.
   b. Temperatures of 40, 80, and 100 °F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 3,500 psi at 1 day, 4,500 psi at 3 days, and 7,500 psi at 28 days.
7. Maintain fluid consistency when mixed in 1 to 9 yard loads in ready- mix truck.
8. Manufacturers and Products:
   a. Chemrex, Inc., Shakopee, MN; Master Flow 928.
   b. Five Star Products Inc., Fairfield, CT; Five Star 100.
   c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
   d. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.
   e. L & M Construction Chemicals, Inc., Omaha, NE; Crystex.
   f. Master Builders.

C. Category III
1. Metallic and nongas-liberating flowable fluid.

2. Prepackaged aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with CRD-C 621 and ASTM C 1107, Grade B:
   a. Fluid consistency 20 to 30 seconds in accordance with CRD-C 611.
   b. Temperatures of 40 and 100 °F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of grout, 4,000 psi at 1 day, 5,000 psi at 3 days, and 9,000 psi at 28 days.
7. Maintain fluid consistency when mixed in 1 to 9 yard loads in ready-mix truck.
8. Manufacturers and Products: Chemrex, Inc., Shakopee, MN; EMBECO 885.

2.5 TOPPING GROUT AND CONCRETE/GROUT FILL

A. Where fill is thicker than 3-inches, structural concrete 03 30 00, CAST-IN-PLACE CONCRETE, may be used when accepted by the Engineer.

B. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tank, channel and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water and admixtures proportioned and be mixed as indicated. Bonding Agent shall be used to enhance adhesion to basin concrete. Materials and procedures indicated for normal concrete in Section 03 30 00, CAST-IN-PLACE CONCRETE, shall apply unless indicated otherwise.

C. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Topping grout in clarifiers shall contain between 750 and 8900 pounds of cement per cubic yard with a maximum water cement ratio of 0.42.

D. Aggregate shall be graded as follows:

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

E. Final mix design shall be as determined by trial mix design as indicated in Section 03 30 00, except that drying shrinkage tests are not required.

F. Topping grout and concrete grout/fill shall contain air-entraining agent per Section 03 30 00.

G. Strength: Minimum compressive strength of topping grout and concrete/grout fill at 28 days shall be 4000 psi.

H. Topping grout used in clarifiers shall contain fiber reinforcing. Fiber shall be 100 percent virgin polypropylene fibrillated fibers specifically manufactured in a blended gradation for use as concrete secondary reinforcement. Fibers shall be added at a rate of 1.5 pounds per cubic yard of concrete. Fibers shall conform to ASTM C 1116 – Fiber Reinforced Concrete and Shotcrete. Type III.

2.6 CEMENT-GROUT (CEMENT-SAND GROUT) MIXTURE FOR PIPE INVERT/STRUCTURE FILL

A. Prepare design mixture proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. Submit proposed mixture design to Engineer for review. Comply with Section 03 30 00 Cast-In-Place Concrete and as follows.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based upon laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete and cement grout as follows:
   1. Fly Ash, 15 percent, Class F.

C. Admixtures: All materials other than Portland cement, water and aggregates that are added to the concrete or cement grout, shall be subject to the approval of the Engineer. If so approved, use admixtures according to manufacturer's written instructions.
   1. Use water reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete for heavy-use slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

D. Minimum compressive strength: 2000 psi at 28 days.

E. Minimum cementitious material of 846 pounds (9 bags) per cubic yard of cement grout.

F. Air content: ASTM C 94, 5 percent, plus or minus 1.0 percent at point of delivery.

G. Aggregate shall be sand, three parts sand to one part cementitious material by volume. The sand gradation shall be such that 100% shall pass the No. 16 sieve and not more than 30% shall be retained on a No. 30 sieve.

H. Water – cementitious material ratio. The Contractor shall submit a proposed mix design to the Engineer for review. The amount of water shall be the minimum amount of water necessary to make a workable mixture.

I. Slump: Maximum of 4 inches.

2.7 JOINT MORTAR BED

A. Joint Mortar Bed: Mortar placed on horizontal construction joints shall be a mixture of cement, sand and water in the same proportions used in the approved 4000 psi cast-in-place concrete mix design and/but with the coarse aggregate omitted.

PART 3 - EXECUTION

3.1 NONSHRINK GROUT

A. General: Mix, place, and cure non-shrink grout in accordance with grout Manufacturer's representative's training instructions.

B. Form Tie or Through-Bolt Holes: Provide non-shrink grout, Category I and II, fill space with dry pack dense grout hammered in with steel tool and hammer. Through-bolt holes; coordinate dry

pack dense grout application with vinyl plug in Section 03 11 00, CONCRETE FORMWORK, and bonding agent in Section 03 30 00, CAST-IN-PLACE CONCRETE.

C. Grouting Machinery Foundations:
   1. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material.
   2. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts.
   3. Form with watertight forms at least 2" higher than bottom of plate.
   4. Fill space between bottom of machinery base and original concrete in accordance with Manufacturer's representative's training instructions.

3.2 CEMENT GROUT

A. Place cement grout topping over concrete slabs where indicated on the drawings. Place in accordance with the procedures of this section and the manufacturer's or suppliers of equipment recommendations. The finish surface of the grout topping shall be similar to a steel trowel finish and which will facilitate the proper operation of the mechanical equipment. The finish of the structural slab below the cement grout topping shall be a heavy broom finish.

B. Where cement grout is to be placed without mechanical equipment, the fresh surface of the cement grout shall be a smooth trowel finish. Placement procedure of cement grout at areas with mechanical equipment includes:
   1. Notify Project Representative or Engineer a minimum of 48 hours in advance of placement.
   2. Make a trial cement grout batch of not less than 1/2 cubic yard to allow time for adjustment in mix design if required.
   3. Clean the exposed structural slab by sandblasting and washing clean.
   4. Thoroughly broom a neat cement paste containing an epoxy binder into the concrete slab surface immediately ahead of placing the cement grout topping.
   5. Where applicable, install level and trial operate mechanical screed equipment over the floor slab to provide a minimum thickness of 2 inches +/- 1/4 inch. In areas where the distance between the mechanical screed and the structural slab is less than the above clearances, grind surface as directed by Engineer to provide such clearance. The mechanical screed shall operate at a speed acceptable to the cement grout topping placement procedures. Screeding procedures shall account for the effects of differential temperatures on the mechanical screed equipment.
   6. Place cement grout topping in a continuous operation. If grouting operations are interrupted, clean the edge of the previously placed topping by water jetting and add a coat of cement paste to provide a bond to the fresh topping.
   7. Temporarily equip the mechanical screed mechanism on at least two arms with a 2-inch by 10 inch continuous wood plate with light gauge metal angles and surface plates or channels. The bottom of the screed plates or steel plates shall be adjustable and set to elevations which allow the proper operation of equipment and as recommended by the equipment manufacturer or supplier.
   8. Screed the topping immediately after consolidation with vibrators or tampers and provide a steel trowel finish.
   9. Cure cement grout topping with water and cover with PVC sheeting to prevent damage from foot traffic for seven days. When/If the cement grout topping is found not to be acceptable, remove and replace. Cement grout topping not acceptable shall include, but is not limited to, poor bonding with the concrete slab, low strength, excessive cracking and unevenness in finish or elevation.

3.3 JOINT MORTAR BED

A. Joint Mortar Bed: Immediately prior to placement of fresh concrete at horizontal joints, or as indicated, place joint mortar bed to cover horizontal joint and protect water stop as applicable. Spread uniformly and work into all irregularities of the surface. The water cement ratio of the joint mortar bed shall not exceed that of the concrete being placed and the consistency of the mortar shall be suitable for placing and working. The fresh concrete shall then be immediately placed in a time and manner so that the joint mortar bed and the fresh concrete mix to form a homogenous concrete meeting all requirements.

3.4 NON-SHRINK GROUT

A. Non-Shrink grout:
   1. Used for repair of holes and defects and at locations indicated where epoxy grout is not indicated. Execution shall follow manufacturer's recommendations.
   2. Base plates and equipment where indicated. Execution shall follow manufacturer's recommendations.

3.5 EPOXY GROUT

A. Epoxy Grout: Used to embed all anchor bolts and reinforcing steel set in grout, specific machinery base plates as indicated and at other locations where indicated. Execution shall follow manufacturer's recommendations.

3.6 FIELD QUALITY CONTROL

A. Evaluation and Acceptance of Non-shrink Grout:
   1. Consistency: As specified in Article NON-SHRINK GROUT. Grout with consistencies outside range requirements shall be rejected.
   2. Segregation: As specified in Article NON-SHRINK GROUT. Grout when aggregate separates shall be rejected.

3.7 MANUFACTURER'S SERVICES

A. General: Coordinate demonstrations, training sessions, and applicable site visits with grout manufacturer's representative.

3.8 SUPPLEMENTS

A. The supplement listed below, following "END OF SECTION," is part of this Specification.
   1. 24-hour Evaluation of Non-shrink Grout Test Form and Grout Testing Procedures.

END OF SECTION

DIVISION 5

METALS

SECTION 05 05 23 – WELDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. The Work required for welding.

B. Related Specifications:
   1. Section 01 33 00 – Submittal Procedures
   2. Section 01 40 00 – Quality Requirements.

1.2 REFERENCE STANDARDS

A. The following is a list of standards that may be referenced in this section:
   1. ASME:
      a. BPVC.V, Nondestructive Examination.
      b. BPVC.IX, Welding and Brazing Qualifications.
   2. ASNT:
      a. SNT TC 1A, Personnel Qualification and Certification in Nondestructive Testing.
   3. ASTM International:
      a. A370 – Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
   4. AWS:
      a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
      b. A3.0, Standard Welding Terms and Definitions.
      c. D1.1, Structural Welding Code - Steel.
      d. D1.8, Structural Welding Code - Seismic Supplement.
      e. D1.2, Structural Welding Code - Aluminum.
      f. D1.3, Structural Welding Code - Sheet Steel.
      g. D1.4, Structural Welding Code - Reinforcing Steel.
      h. D1.6, Structural Welding Code - Stainless Steel.
      i. QC1, Standard for AWS Certification of Welding Inspectors.

1.3 DEFINITIONS

A. CJP: Complete Joint Penetration.

B. CWI: Certified Welding Inspector.
   1. Contractor's Welding Inspector:
      a. Contractor's CWI acts for, and on behalf of, the Contractor for all inspection and quality matters within the scope of the Contract Documents.
      b. Contractor is required to provide a welding inspector to oversee welding operations and be responsible for visual inspection and necessary correction of all deficiencies in materials and workmanship required to meet referenced welding codes.
      c. This type of Quality requirements Inspection is NOT classified as Special Inspection.
   2. Verification Inspector:
      a. CWI who acts on behalf of the Owner.
      b. This type of independent inspection and testing is the prerogative of the Owner, who may perform this function, or waive independent verification inspection if it is NOT required by the building official and building code.

C. MT: Magnetic Particle Testing.

D. NDE: Nondestructive Examination.

E. NDT: Nondestructive Testing.

F. PJP: Partial Joint Penetration.

G. PQR: Procedure Qualification Record.

H. PT: Liquid Penetrant Testing.

I. Special Inspection:
   1. Nondestructive examination exclusive of VT.
   2. Special inspection includes NDE such as MT, PT, UT, RT, and Verification Inspection. Special Inspection personnel report to and are retained by the Owner or the Engineer on behalf of the Owner**.**
   3. See additional requirements in Section 01 40 00, QUALITY REQUIREMETNS.

J. RT: Radiographic Testing.

K. UT: Ultrasonic Testing.

L. VT: Visual Inspection/Testing.

M. WPQ: Welder/Welding Operator Performance Qualification Record.

N. WPS: Welding Procedure Specification.

1.4 SUBMITTALS

A. Section 01 33 00, SUBMITTAL PROCEDURES, specifies requirements for submittals.

B. Action Submittals:
   1. Shop Drawings:
      a. Shop and field WPSs and PQRs.
      b. NDT procedure specifications prepared in accordance with ASME BPVC.V.
      c. Welding Data (Shop and Field): Submit welding data together with Shop Drawings as a complete package.
         1) Show on Shop Drawings, or on a weld map, complete information regarding base metal specification designation, location, type, size, and extent of welds with reference called out for WPS and NDE numbers in tails of combined welding and NDE symbols as indicated in AWS A2.4.
         2) Clearly distinguish between shop and field welds.
         3) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
         4) Welding and NDE Symbols: In accordance with AWS A2.4.
         5) Welding Terms and Definitions: In accordance with AWS A3.0.

C. Informational Submittals:
   1. WPQs.
   2. CWI credentials.
   3. Testing agency personnel credentials.
   4. CWI visual inspection (VT) reports.
   5. Welding Documentation: Submit on forms in referenced welding codes.

1.5 QUALIFICATIONS

A. WPSs: In accordance with AWS D1.1 for shop or field welding or ASME BPVC.IX (Forms QW 482 and QW 483) for shop welding only.

B. WPQs: In accordance with AWS D1.1 or ASME BPVC.IX (Form QW 484).

C. CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require prior approval by Engineer.

D. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT TC 1A.

1.6 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, Submittals required in this Section shall be submitted and approved prior to commencement of welding operations.

PART 2 - PRODUCTS

2.1 SOURCE QUALITY REQUIREMENTS

A. CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1 or referenced welding code and as follows:
   1. Verifying conformance of specified job material and proper storage.
   2. Monitoring conformance with approved WPS.
   3. Monitoring conformance of WPQ.
   4. Inspecting weld joint fit-up and performing in-process inspection.
   5. Providing 100 percent visual inspection of welds.
   6. Coordinating with nondestructive testing personnel and reviewing NDE test results.
   7. Maintaining records and preparing reports documenting that results of CWI VT and subsequent NDE testing comply with the Work and referenced welding codes.

PART 3 - EXECUTION

3.1 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Quality requirements Inspection:
   1. All Welds: 100 percent VT by Contractor's CWI.
   2. Acceptance Criteria:
      a. Structural Pipe and Tubing: AWS D1.1, Paragraph 9.25.
      b. All Other Structural Steel: AWS D1.1, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
      c. Stud Connections: AWS D1.1, Paragraph 7.8.1.

B. Nondestructive Testing Requirements:
   1. NDT frequency shall be as specified below, as required by referenced welding codes, or as specified in the attached table. In case there is a conflict, the higher frequency level of NDT shall apply.
      a. Nontubular Connections:
         1) CJP Butt Joint Groove Welds: 10 percent random RT. Use UT for CJP butt joint groove welds that can NOT be readily radiographed.
         2) All Other CJP Groove Welds: 10 percent random UT**.**
         3) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT**.**

b. Tubular Connections:
   1) CJP butt joint groove welds made from one side without backing: 100 percent RT or UT in accordance with AWS D1.1, Paragraph 9.26.2 requirements**.**
   2) CJP Butt Joint Groove Welds made without backing or back-gouging: 10 percent random RT**.** Use UT for CJP butt joint groove welds that can NOT be readily radiographed.
   3) All Other CJP Groove Welds**:** 10 percent random UT**.**
   4) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT**.**

2. NDT Procedures and Acceptance Criteria:
   a. Nontubular Connections:
      1) RT: Perform in accordance with AWS D1.1, Clause 6, Part E. Acceptance criteria per AWS D1.1, Paragraph 6.12.1.
      2) UT: Perform in accordance with AWS D1.1, Clause 6, Part F. Acceptance criteria per AWS D1.1, Paragraph 6.13.1.
      3) PT and MT:
         a) Perform on fillet and PJP groove welds in accordance with AWS D1.1, Paragraph 6.14.4 and Paragraph 6.14.5.
         b) Acceptance criteria per AWS D1.1, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.
   b. Tubular Connections:
      1) RT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1, Clause 9, Paragraph 9.28 and Paragraph 9.29.
      2) UT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1, Clause 9, Paragraph 9.27.
      3) PT and MT:
         a) Perform on fillet and PJP groove welds in accordance with AWS D1.1, Paragraph 6.14.4 and Paragraph 6.14.5.
         b) Acceptance criteria per AWS D1.1, Paragraph 9.25.

3.2 FIELD QUALITY REQUIREMENTS

A. CWI shall be present whenever field welding is performed. CWI shall perform inspection, at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1 or referenced welding code and as follows:
   1. Verify conformance of specified job material and proper storage.
   2. Monitor conformance with approved WPS.
   3. Monitor conformance of WPQ.
   4. Inspect weld joint fit-up and perform in-process inspection.
   5. Provide 100 percent visual inspection of all welds in accordance with Subparagraph Quality requirements Inspection.
   6. Supervise nondestructive testing personnel and evaluating test results.
   7. Maintain records and prepare report confirming results of inspection and testing comply with the Work.

3.3 WELD DEFECT REPAIR

A. Repair and retest rejectable weld defects until sound weld metal has been deposited in accordance with appropriate welding codes.

END OF SECTION

SECTION 05 31 00 – STEEL DECK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Galvanized roof deck with prime-painted bottom surface.

B. Related Sections:
   1. Section 01 33 00 – Submittal Procedures
   2. Section 01 40 00 – Quality Requirements.

1.2 SUBMITTALS

A. Section 01 33 00, SUBMITTAL PROCEDURES, specifies requirements for submittals.

B. Product Data: For each type of deck, accessory, and product indicated.

C. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

D. Product Certificates: For each type of steel deck, signed by product manufacturer.

1.3 QUALITY ASSURANCE

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI “North American Specification for the Design of Cold-Formed Steel Structural Members.”

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. ASC Profiles, Inc.
   2. Canam Steel Corp.; The Canam Manac Group.
   3. Consolidated Systems, Inc.
   4. DACS, Inc.
   5. D-Mac Industries Inc.
   6. Epic Metals Corporation.
   7. Marlyn Steel Decks, Inc.
   8. New Millennium Building Systems, LLC.
   9. Nucor Corp.; Vulcraft Division.
   10. Roof Deck, Inc.
   11. United Steel Deck, Inc.
   12. Valley Joist; Division of EBSCO Industries, Inc.
   13. Verco Manufacturing Co.

14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
15. Approved equal.

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with “SDI Specifications and Commentary for Steel Roof Deck,” in SDI Publication No. 30, and with the following:
   1. Galvanized Steel Sheet: ASTM A653, Structural Steel, Grade 33, and G90 zinc coating.
   2. Prime paint underside of galvanized deck with manufacturer’s standard baked on, rust inhibited primer.
   3. Deck Profile: As shown on drawings.
   4. Profile Depth: As shown on drawings.
   5. Design Uncoated-Steel Thicknesses: As indicated.
   6. Span Condition: Furnish in longest practical lengths with no individual sheet shorter than that required to span 3 joists.
   7. Side Laps: Overlapped or interlocking seam at Contractor’s option.

2.3 ACCESSORIES

A. General: Provide manufacturer’s standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, NOT less than 0.0359” design, uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. Flat Sump Plate: Single-piece steel sheet, 0.0747” thick, of same material and finish as deck. For drains, cut holes in the field.

H. Galvanizing Repair Paint: ASTM A780, SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94% zinc/dust by weight.

I. Repair Paint: Manufacturer’s standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. DO NOT stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members using Buildex #12 screws or approved equal.
   1. As shown on drawings.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals NOT exceeding the lesser of 1/2 of the span or 18", and as follows:
   1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
   2. Minimum 2 fasteners per span.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2", with end joints as follows:
   1. End Joints:
      a. Lapped 2" minimum.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.

E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY REQUIREMENTS

A. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field connections will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Engineer.

D. Remove and replace work that does NOT comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

B. Repair Painting:
   1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation and apply repair paint.
   2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 52 13 – PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aluminum pipe railings.

B. Related Sections:
   1. Section 01 33 00 – Submittal Procedures
   2. Section 05 50 00 – Metal Fabrications
   3. Section 09 96 00 – High-Performance Coatings

1.2 PERFORMANCE REQUIREMENTS

A. General:
   1. In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
      a. For aluminum, the lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.

B. Structural Performance:
   1. Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
      a. Handrails:
         1) Uniform load of 50 lbf/ ft. applied in any direction.
         2) Concentrated load of 200 lbf applied in any direction.
         3) Uniform and concentrated loads need NOT be assumed to act concurrently.
      b. Top Rails of Guards:
         1) Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
         2) Concentrated load of 200 lbf applied in any direction.
         3) Uniform and concentrated loads need NOT be assumed to act concurrently.
      c. Infill of Guards:
         1) Concentrated load of 200 lbf (0.89 kN) applied horizontally on an area of 1 ft^2.
         2) Uniform load of 25 lbf / ft^2 applied horizontally.
         3) Infill load and other loads need NOT be assumed to act concurrently.

C. Thermal Movements:
   1. Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   2. Base the engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   3. Temperature Change (Range): 120 °F, ambient; 180 °F, material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.3 SUBMITTALS

A. Section 01 33 00, SUBMITTAL PROCEDURES, specifies requirements for submittals.

B. Product Data for the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Grout, anchoring cement, and paint products.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional Engineer responsible for their preparation.

D. Samples for Initial Selection: For products involving selection of color, texture, or design.

E. Samples for Verification for each type of exposed finish required:
1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need NOT be full height.
a. Show method of finishing and connecting members at intersections.

F. Mill Certificates: Signed by Manufacturers of stainless-steel products certifying that products furnished comply with requirements.

G. Welding certificates.

H. Qualification Data: For testing agency.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing through one source from a single Manufacturer.

B. Welding: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.6, "Structural Welding Code--Stainless Steel."

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements canNOT be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.6 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings.
1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. DO NOT support railings temporarily by any means that DO NOT satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Subject to compliance with requirements, provide products by one of the following:
      a. Thompson Fabricating LLC, Tarrant, AL.
      b. Approved equal.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.3 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with NOT less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Structural Pipe and Round Tubing: ASTM B429, Alloy 6063-T6.
   1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.

C. Drawn Seamless Tubing: ASTM B210, Alloy 6063-T832.

D. Plate and Sheet: ASTM B209, Alloy 6061-T6.

E. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.

F. Castings: ASTM B26, Alloy A356.0-T6.

2.4 RAIL AND POSTS

A. Nominal 1-1/2” diameter.

B. Rails: 1.900” outside diameter by 0.145” wall thickness. Schedule 40.

C. Posts: 1.900” outside diameter by 0.200” wall thickness. Schedule 80.

2.5 FITTINGS

A. Top Mount Base:
   1. Cast Aluminum
   2. For holes in base for concrete anchors.
   3. For narrow walls or curbs, furnish two holes in base for concrete anchors with required edge distance.
   4. Manufacture and Products:
      a. Thompson Fabricating LLC.; Part No. TBF-3.4
      b. Thompson Fabricating LLC.; Part No. TBF-3.2 for narrow walls and curbs.

B. Handrail and Post Fittings:
   1. Extruded, machined bar stock, permanent mold casting, or die castings of sufficient strength to meet load requirements.
   2. Fittings shall match color of pipe in handrails.
   3. Sand cast parts NOT permitted.

C. Side Mounted Handrail Bracket:
   1. Extruded aluminum, Alloy 6063-T6 with four holes for bolts or concrete anchors.
   2. Manufacturer and Product: Thompson Fabricating LLC; Part TSM-1.50

D. Handrail Connections to Metal Stairway Stringers:
   1. Extruded aluminum bracket, Alloy 6060-T6
   2. Brackets and bolts 1/2” diameter Type 304 or 316 stainless steel bolts.
   3. Offset adjustable stir fitting of cast Al-mag, Part No. ASF

E. Handrail Connections to Metal Beams:
   1. Extruded aluminum bracket, Alloy 6060-T6
   2. Bracket bolts 1/2” diameter Type 304 stainless steel bolts.
   3. Manufacturer and Products: Thompson Fabricating LLC; Part Nos. SMB-2 or SMB-3. Use part no. TSM-1.50 if bracket is attached to flat side of a channel.

F. Handrail Wall Brackets:
   1. Cast Al-mag aluminum bracket, Par No. AWF adjustable wall fitting, with provision for three 3/8” Type 304 stainless steel bolts or concrete anchors.
   2. Manufacturer and Product: Thompson Fabricating LLC; Part No. AWF.

G. Miscellaneous Rail to Post Fitting:
   1. Cast Aluminum Tee Fitting: Part Nos. TF-1 and TX-1
   2. Cast Aluminum Ell Fitting: Part Nos. TE-1, TE-2, and TE-3
   3. Aluminum Splice Lock: Part No. SL-1
   4. Aluminum Expansion Joint Splice: Part No. CF-2
   5. Manufacturer: Thompson Fabricating LLC

H. Handrail Gate:
   1. Furnish 6063-T6, 6105-T5, or 6061-T6 extruded aluminum
   2. Manufacturer: Thompson Fabricating LLC

I. Toeboards and Accessories: Molded or extruded 6063 or 60621 aluminum
   1. Manufacturer: Thompson Fabricating LLC

J. Casting for Handrails: Cast Al-mag with sufficient strength to meet load and test requirements. Anodizable grade finish with excellent resistance to corrosion when subject to exposure of sodium chloride solution intermittent spray and emersion.

K. Concrete Embedded Metal Anchorage: In accordance with Section 05 50 00, METAL FABRICATIONS.

2.6 FASTENERS

A. General:
   1. Provide the following:
      a. In accordance with Section 05 50 00, METAL FABRICATIONS
      b. Aluminum Railings: Type 304 or 316 stainless-steel fasteners.

B. Locknuts, Washers, and Screws:

1. Elastic Locknuts, Steel Flat Washers, RHMS Rounded Head Machine Screws; Type A 304 or A 316 stainless steel.
2. Flat Washers: Molded Nylon
3. Manufacturer: Mc-Master-Carr Supply Co.

C. Concrete Anchors: Stainless steel Type 304 or 316. Use ICBO approved service load allowable values for size, length, embedment, spacing, and edge distance to match required loads shown in calculations.

D. Epoxy Anchors Heavy Duty 1/2-inch diameter, for exterior use only.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but NOT less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32” unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that shall be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Non-welded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is Manufacturer’s standard splicing method.

H. Close exposed ends of railing members with prefabricated end fittings.

I. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4” or less.

J. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

K. For railing posts set in concrete, provide steel sleeves NOT less than 6” long with inside dimensions NOT less than 1/2” greater than outside dimensions of post, with steel plate forming bottom closure.

L. For removable railing posts, fabricate slip-fit sockets from stainless-steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to NOT more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated.
2. Fabricate from same metal as railings.

M. Toeboards:
1. Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms.
2. Fabricate to dimensions and details indicated.
3. Dimension between bottom of toeboard and walking surface NOT to exceed 1/4-inch.

2.8 FINISHES, GENERAL

A. Comply with NAAMM “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work:
1. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples.
2. Noticeable variations in the same piece are NOT acceptable.
3. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.9 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
1. Handrail Pipe and Posts: In accordance with AA 45, designation AA-M32-C22-A41.
2. Cast Fittings and Toeboards: In accordance with AA 45, designation AA-M10-C22-A41.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if NOT already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints and in accordance with Manufacturers written instructions.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
1. DO NOT weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16” in 3’.

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members DO NOT exceed 1/4” in 12’.

C. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces in accordance with manufacturers’ recommendations and Section 09 96 00, HIGH-PERFORMANCE COATINGS.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

F. Mount handrails only on completed walls. DO NOT support handrails temporarily by means NOT satisfying structural performance requirements.

3.3 RAILING CONNECTIONS

A. Set rails horizontal or parallel to slope of steps. Install posts and rails in the same plane. Remove projects or irregularities and provide smooth surface for sliding hand continuously along top rail. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.

B. Expansion Joints: Install expansion joints at locations indicated but NOT farther apart than required to accommodate thermal movement, maximum interval of 54 feet on center and at structural joints. Provide slip-joint internal sleeve extending 2” beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6” of post.

3.4 ANCHORING POSTS

A. Where indicated, use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves fill annular space between the post and sleeve with non-shrink, nonmetallic grout, or anchoring cement mixed and placed to comply with anchoring material manufacturer’s written instructions.

B. Form or core-drill holes NOT less than 5” deep and 3/4” larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material per Manufacturer’s written instructions.

C. Leave anchorage joint exposed; wipe off surplus anchoring material; and leave 1/8” buildup, sloped away from post.

D. Where indicated, anchor posts with fittings engineered for anchoring posts to concrete.

E. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

G. Anchor bolts shall be stainless steel.

3.5 ANCHORING RAILING ENDS

A. Anchor railing ends to concrete and masonry with round flanges connected to railing ends and anchored to wall construction with anchors and bolts.

3.6 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets. Provide brackets with 1-1/2” clearance from inside face of handrail and finished wall surface.
   1. Use type of bracket with predrilled hole for exposed bolt anchorage.

B. Locate brackets as indicated or, if NOT indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:
   1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
   2. For hollow masonry anchorage, use toggle bolts.

3.7 ADJUSTING AND CLEANING

A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

3.8 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing Manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that can NOT be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION

SECTION 05 53 00 – METAL GRATINGS AND PLANK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal gratings and aluminum plank.

B. Related Sections:
   1. Section 01 33 00 – Submittal Procedures
   2. Section 01 40 00 – Quality Requirements.
   3. Section 09 96 00 – High-Performance Coatings

1.2 GENERAL REQUIREMENTS

A. Contractor, and/or Subcontractor, is responsible for field verifying all grating and plank locations, dimensions, obstructions, openings, and any other pertinent coordination issues prior to bidding. For existing items marked to be reused, Contractor is responsible for field verifying existing condition and determining whether replacement is required prior to bidding.

1.3 SUBMITTALS

A. Section 01 33 00, SUBMITTAL PROCEDURES, specifies requirements for submittals.

B. Shop Drawings:
   1. Include plans, elevations, sections, details, supports and attachment to other work.
   2. Grating and Plank: Show dimensions, weight, and location of connections to adjacent grating, supports, and other Work.
   3. Grating and Plank Supports: Show dimensions, size, location, and anchorage to supporting structure.
   4. Catalog information and catalog cuts.
   5. Manufacturer's specifications, to include coatings.

C. Quality requirements Submittals:
   1. Special handling and storage requirements.
   2. Installation instructions.
   3. Factory test reports.
   4. Manufacturer's Certification of Compliance for specified products.
   5. Written Test Report that swaged crossbars, if used on grating, meet the requirements of the specified test and additional requirements of these Specifications.

1.4 REFERENCES

A. AASHTO:
   1. Standard Specifications for Highway Bridges, latest edition.

B. ASTM International:
   1. A36 – Standard Specification for Structural Steel.
   2. A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware (R 1987).
   4. A193 – Standard Specification for Alloy-Steel and Stainless-Steel Bolting Materials for High-Temperature Service.

5. A194 – Standard Specification for Carbon and Alloy-Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
6. A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
7. A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. A1011/A1011M-17, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High-Strength.
9. B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
10. F844 – Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

C. National Association of Architectural Metal Manufacturers (NAAMM):
1. ANSI MBG 531, Metal Bar Grating Manual.
2. ANSI MBG 532, Heavy-Duty Metal Bar Grating Manual.

1.5 PREPARATION FOR SHIPMENT

A. Factory assemble items to insure proper fit before shipping to job site.

B. Package and clearly tag parts and assemblies that are of necessity shipped unassembled and protect the materials from damage and facilitate identification and final assembly in the field.

PART 2 - PRODUCTS

2.1 FOOT TRAFFIC GRATING

A. Size: As indicated on the drawings.

B. Type: A-19-4, unless indicated otherwise.

C. Weight: No section shall weigh more than 150 pounds.

D. Material:
1. Aluminum Bar Type Grating:
a. Swage locked aluminum I-bar grating, as manufactured by:
1) Thompson Fabricating, LLC, Tarrant, AL
2) Ohio Gratings, Inc., Canton, OR
3) Approved equal.
2. Galvanized Steel Bar Type Grating:
a. Press-locked, deep rectangular crossbar design, as manufactured by:
1) IKG/Borden, Clark, NJ; Type B or Type F.

2.2 LIGHT VEHICULAR TRAFFIC GRATING

A. Size: As indicated on the drawings.

B. Type: W-15-4, unless indicated otherwise.

C. Weight: No section shall weigh more than 150 pounds.

D. Material:
1. Aluminum Bar Type Grating:

a. Press-locked deep rectangular crossbar design as manufactured by:
1) IKG/Borden, Clark, NJ, IKG/Borden; Type B or Type F.

2. Galvanized Steel Bar Type Grading:
a. After Fabrication: ASTM A123, zinc coating.
b. Heavy-weld type HWF or type HWB or press-locked, rectangular crossbar design as manufactured by:
1) IKG/Borden, Clark, NJ; IKG/Borden, Type FJ or BJ.

2.3 HEAVY VEHICULAR TRAFFIC GRATING

A. Size: As indicated on the drawings.

B. Type: High Load Capacity (HLC), unless indicated otherwise.

C. Material:
1. Galvanized Steel Bar Type:
a. After Fabrication: ASTM A123, zinc coating.
b. Heavy-weld type HWF or type HWB or press-locked, rectangular crossbar design as manufactured by:
1) IKG/Borden, Clark, NJ; IKG/Borden, Type FJ or BJ.

2.4 ALUMINUM PLANK

A. Acceptable Manufacturers, subject to the requirements, which may have acceptable products include, but are NOT limited to, the following:
1. Ohio Gratings Inc.
2. Grating Pacific, Inc.
3. Harsco Industrial IKG.
4. McNichols Co.
5. Or Approved Equal.

B. Materials: Planks and banding are Aluminum-Alloy 6063-T6, ASTM B221.
1. Description: Heavy-Duty, Extruded Aluminum Plank.
a. All ends to be banded.
2. Type(s): As indicated on the drawings, include:
a. Interlocking and Unpunched
b. Unpunched
c. Diagonally punched with approximately 8% openings.
3. Top Surface: Manufacturer’s standard slip-resistant finish.
4. Finish: Mill Finish.
5. Fabrication and Tolerances: In accordance with NAAM Metal Bar Grating Manual.
6. Depth: As indicated on the drawings.
7. Loading: As indicated on the drawings.
8. Weight: No section shall weigh more than 150 pounds.

2.5 ACCESSORIES

A. Anchor Bolts and Nuts:
1. Carbon Steel: ASTM A307 or A36.
2. Stainless Steel: ASTM A193 and ASTM A194, Type 316.
3. Galvanized Steel Bolts and Nuts: ASTM A153, zinc coating for ASTM A307 or A36.

B. Flat Washers (Unhardened): ASTM F844; use ASTM A153 for zinc coating.

C. Removable Fastener Clips and Bolts:

1. Removable from above grating walkway surface.
2. Material: To match Plank or Grating material
3. Type(s):
    a. Saddle clips
    b. Z clips
    c. Plank clips
    d. Plank lugs
    e. Countersunk land

2.6 FABRICATION

A. General:
1. Exposed Surfaces: Smooth finish and sharp, well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in a neat, substantial manner.
3. Conceal fastenings where practical.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Weld Connections: NOT permitted on grating except at banding bars.

B. Sizing:
1. Field measure areas to receive grating, verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.
2. Section Length: Sufficient to prevent falling down through clear opening when oriented in the span direction when one end is touching either the concrete or the vertical leg of grating support.
3. Minimum Bearing: ANSI/NAAMM MBG 531.
4. Metal Crossbar Spacing: 4” maximum, unless otherwise shown or specified.
5. Crossbars: Flush with top of main bar and extend downward a minimum of 50% of the main bar depth.
    a. Swaged Crossbars:
        1) Within 1/4” of top of grating with ½” minimum vertical dimension after swaging, and minimum before swaging dimension of 5/16” square.
        2) Crossbar Dimension After Swaging: Minimum 1/8” wider than the opening at minimum of two comers at each side of each square opening in main bar.
        3) Crossbars may be a special extruded shape so that after swaging the top shall be flat, 3/16” wide and shall be flush with the top surface of the bearing bars for a minimum of 5/8” at center between bearing bars.
        4) Flush crossbar meeting all the above except that after swaging shall overlap one comer by a minimum of 1/8”. A sample of one bearing bar and one crossbar shall be tested by holding the bearing bar and pulling on the crossbar. The crossbar to bearing bar shall sustain a minimum of 300 pounds without pullout of the bearing bar.
        5) Tightly fit main bars and crossbars allowing no differential movement.
6. DO NOT use weld type crossbars.
7. Banding: All ends to be banded with same material as grating or plank; ANSI/NAAMM MBG 531 and ANSI/NAAMM MBG 532.
8. Furnish stainless steel Type 316 threaded anchor studs, as fasteners for grating or plank attachment to metal supports either NOT embedded or partially embedded in concrete.

C. Supports:
1. Seat angles and beams where shown:
    a. Material: To match grating or plank.
    b. Extruded aluminum frame with slot for recessed grating clips.
2. Coordinate dimensions and fabrication with grating or plank to be supported.
3. Welded Frames with Anchors: Continuously welded.

D. Slip-Resistant Surface:
   1. Rectangular Aluminum Bar Grating as manufactured by:
      a. IKG/Borden, Clark, NJ; EZ Weldslip-Resistant Coating.
      b. Seidelhuber Metal Products, Inc., Hayward, CA; Safety Grit Non-Slip System.
      c. Ohio Gratings, Inc., Canton, OH with “Slip-Not” Safety Surface manufactured by W.S. Molnar Co., Detroit, MI.
   2. I-Bar grating aluminum shall incorporate a striated anti-skid walking surface produced during the extrusion process, as manufactured by:
      a. IKG/Borden, Clark, NJ.
      b. Seidelhuber Metal Products, Inc., Hayward, CA.
      c. Klemp Corp., Chicago, IL.

E. Aluminum:
   1. ASTM B221 extruded shapes.
   2. Fabricate as shown and in accordance with Manufacturer’s recommendations.
   3. Grind smooth sheared edges exposed in the finished work.
   4. Swage crossbars, if used, with equipment strong enough to deform crossbars.
   5. Eliminate any loose crossbar intersections on swaged grating.

PART 3 - EXECUTION

3.1 PREPARATION

A. Electrolytic Protection:
   1. Aluminum in contact with dissimilar metals, other than stainless steel, or in contact with masonry, grout, or concrete shall be coated with a bituminous coating as specified in Section 09 96 00, HIGH-PERFORMANCE COATINGS.
   2. Allow paint to dry before installation of the material.

3.2 INSTALLATION

A. Install supports such that grating or plank sections have a solid bearing on both ends, and that rocking or wobbling movement does NOT occur under designed traffic loading.

B. Install plumb or level as applicable.

C. Install welded frames with anchors to straight plane without offsets.

D. Anchor grating or plank securely to supports using minimum of four fastener clips and bolts per grating or plank section.

E. Use stainless steel anchors and accessories with aluminum gratings.

F. Completed installation shall be rigid and neat in appearance.

G. Wherever grating or plank is pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a rectangular band bar of the same height and material as bearing bars.

H. Cutouts for circular openings are to be 2” larger in diameter than the obstruction. Cutouts for all piping 4” or less shall be made in the field.

I. All rectangular cutouts are to be made to the next bearing bar beyond the penetration with a clearance NOT to exceed bearing bar spacing.

J. Commercially Manufactured Products:
   1. Install in accordance with Manufacturer's recommendations.
   2. Secure grating or plank to support members with fasteners.
   3. Fasteners: Field locate and install.
   4. Permit each grating section or plank style grating assembly to be easily removed and replaced.

K. Protect all painted surfaces during installation.

L. Should coating become marred, prepare and touch up surface in accordance with paint Manufacturer's instructions.

END OF SECTION

DIVISION 9

FINISHES

SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: High-performance coatings and special preparation for surfaces of piping and process equipment, and other surfaces in contact with process water and wastewater.

1.2 REFERENCE STANDARDS

A. Federal Specification Unit:
   1. FS A-A-3054 - Paint, Heat Resisting (204 Degrees C).
   2. FS AA-3120A - Paint: For Swimming Pools.
   3. FS TT-C-555B - Coating, Textured (for Interior and Exterior Masonry Surfaces).
   4. FS TT-P-28H - Paint, Aluminum, Heat Resisting.

B. Master Painters Institute:
   1. MPI - Approved Products List.
   2. MPI - Architectural Painting Manual.

C. SSPC: The Society for Protective Coatings:
   1. SSPC - Painting Manual, Volume 2: Systems and Specifications.
   2. SSPC-Paint 16 - Coal Tar Epoxy-Polyamide Black (or Dark Red).
   3. SSPC-SP 2 - Hand Tool Cleaning.
   4. SSPC-SP 3 - Power Tool Cleaning.
   5. SSPC-SP 5 - White Metal Blast Cleaning.
   6. SSPC-SP 6 - Commercial Blast Cleaning.
   7. SSPC-SP 7 - Brush-Off Blast Cleaning.
   8. SSPC-SP 10 - Near-White Metal Blast Cleaning.
   9. SSPC-SP 11 - Power Tool Cleaning to Bare Metal.
   10. SSPC-SP 13 – Concrete Surface Preparation.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:
   1. Schedule of proposed coating materials.
   2. Schedule of surfaces to be coated with each coating material.

C. Product Data:
   1. Submit manufacturer information indicating coating materials, performance ratings and description of physical properties of coatings including solids content and ingredient analysis, VOC content, temperature resistance, typical exposures and limitations, and manufacturer's standard color chips:
   2. Data Sheets:
      a. For each paint system, furnish a Paint System Data Sheet (PSDS), the Manufacturer’s Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system. The PSDS form is appended to the end of this section.
      b. Submit required information on a system-by-system basis.
      c. Furnish copies of paint system submittals to the coating applicator.
      d. Indiscriminate submittal of Manufacturer’s literature only is not acceptable.
      e. Regulatory requirements: Submit data concerning the following:

f. Volatile organic compound limitations.
g. Coatings containing lead compounds and PCBs.
h. Abrasives and abrasive blast cleaning techniques, and disposal.
i. NSF certification of coatings for use in potable water supply systems.

3. Include MPI - Approved Products Lists with proposed products highlighted.

D. Samples: Submit two square drawdowns or brush-outs of topcoat finish samples eight inches by eight inches in size, illustrating colors for selection. Identify each sample as to finish, formula, color name and number and sheen name and gloss units.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Manufacturer Instructions: Submit special procedures, perimeter conditions requiring special attention**.**

1. Include the following:
   a. Special requirements for transportation and storage.
   b. Mixing instructions.
   c. Shelf life.
   d. Pot life of material.
   e. Precautions for applications free of defects.
   f. Surface preparation.
   g. Method of application.
   h. Recommended number of coats.
   i. Recommended dry film thickness (DFT) of each coat.
   j. Recommended total dry film thickness (DFT).
   k. Drying time of each coat, including prime coat.
   l. Required prime coat.
   m. Compatible and non-compatible prime coats.
   n. Recommended thinners, when recommended.
   o. Limits of ambient conditions during and after application.
   p. Time allowed between coats (minimum and maximum).
   q. Required protection from sun, wind, and other conditions.
   r. Touch-up requirements and limitations.
   s. Minimum adhesion of each system submitted in accordance with ASTM D 4541.

G. Qualifications Statements:
1. Submit qualifications for manufacturer and applicator.
2. Submit manufacturer's approval of applicator.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 77 00 – Closeout Procedures: Requirements for submittals.

B. Operation and Maintenance Data: Submit maintenance and cleaning requirements for coatings, repair, and patching techniques**.**

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 77 00 – Closeout Procedures: Requirements for maintenance materials.

B. Extra Stock Materials:
1. Furnish 5 gal. of each color of each type of coating specified, for Owner's maintenance use.
2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.6 QUALITY ASSURANCE

A. MPI Standards:
   1. Comply with indicated MPI standards.
   2. Products: Listed in MPI - Approved Products List.

B. Quality Assurance Submittals:
   1. Quality Assurance plan.
   2. Qualifications of coating applicator including List of Similar Projects and List of References substantiating experience.
   3. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
   4. If the Manufacturer of finish coating differs from that of shop primer, provide both Manufacturers' written confirmation that materials are compatible.
   5. Manufacturer's written instructions and special details for applying each type of paint.
   6. Manufacturers' Certification of Proper Installation.

C. Certifications: All paints and coatings to be used on this project comply with current federal, state, and local VOC regulations

D. Compatibility of coatings: Use products by same manufacturer for prime coats, intermediate coats, and finish coats on same surface, unless specified otherwise.

E. Services of coating manufacturer's representative: Arrange for coating manufacturer's representative to attend pre-installation conferences. Make periodic visits to the project site to provide consultation and inspection services during surface preparation and application of coatings, and to make visits to coating plants to observe and approve surface preparation procedures and coating application of items to be "shop primed and coated".

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

B. Applicator Qualifications:
   1. Company specializing in performing Work of this Section with minimum five years' experience applying specified type or types of coatings under conditions similar to those of the Work and approved by manufacturer.
   2. Provide qualifications of applicator and references listing 5 similar projects completed in the past 2 years.
   3. Manufacturer approved applicator when manufacturer has approved applicator program.
   4. Approved and licensed by polymorphic polyester resin manufacturer to apply polymorphic polyester resin coating system.
   5. Approved and licensed by elastomeric polyurethane (100 percent solids) manufacturer to apply 100 percent solids elastomeric polyurethane system.
   6. Applicator of off-site application of coal tar epoxy shall have successfully applied coal tar epoxy on similar surfaces in material, size, and complexity as on the Project.

C. Regulatory requirements: Comply with governing agencies regulations by using coatings that do not exceed permissible volatile organic compound limits and do not contain lead:
   1. Do not use coal tar epoxy in contact with drinking water or exposed to ultraviolet radiation.
   2. Perform surface preparation and painting in accordance with recommendations of the following:
   3. Paint Manufacturer's instructions.
   4. SSPC-PA Guide No. 3, Guide to Safety in Paint Applications.

5. Federal, state, and local agencies having jurisdiction.

1.8 MOCKUPS

A. Prior to start of surface preparation, furnish a 4” by 4” steel panel for each grade of sandblast specified herein, prepared to specified requirements.

B. Provide panel representative of the steel used; prevent deterioration of surface quality.

C. Upon approval of Engineer, panel to be reference source for inspection.

D. Unless otherwise specified, before painting work is started, prepare minimum 8” by 10” samples with type of paint and application specified on similar substrate to which paint is to be applied.

E. Furnish additional samples as required until colors, finishes, and textures are approved.

F. Approved samples to be the quality standard for final finishes.

G. Field samples:
1. Prepare and coat a minimum 100 square foot area between corners or limits such as control or construction joints of each system.
2. Approved field sample may be part of Work.
3. Obtain approval before painting other surfaces.

1.9 Section 01 45 00 - Quality Control: Requirements for mockup.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver new unopened containers.

B. Do not deliver materials aged more than 12 months from manufacturing date.

C. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

D. Container Labeling: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

E. Inspection:
1. Accept materials on Site in manufacturer's sealed and labeled containers.
2. Inspect for damage and to verify acceptability.

F. Store materials in ventilated area and otherwise according to manufacturer instructions.

G. Remove unspecified and unapproved paints from Project site immediately.

H. Protection:
1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.
3. Take precautions to prevent fire and spontaneous combustion.

I. Shipping:

1. Where pre-coated items are to be shipped to the site, protect coating from damage. Batten coated items to prevent abrasion.
2. Use nonmetallic or padded slings and straps in handling.

1.11 AMBIENT CONDITIONS

A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

B. Minimum Conditions: Do not install materials when temperature is below 55 degrees F or above 90 degrees F.

C. Subsequent Conditions: Maintain above temperature range, 24 hours before, during, and 72 hours after installation of coating.

D. Provide lighting level of 80 fc, measured mid-height at substrate surface.

E. Restrict traffic from area where coating is being applied or is curing.

1.12 WARRANTY

A. Section 01 77 00 – Closeout Procedures: Requirements for warranties.

B. Furnish Manufacturer's extended guarantee or warranty, with OWNER named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the OWNER, removal and replacement of work specified in this Specification section found defective during a period of 1 year after the date of Substantial Completion.

C. Contractor and paint Manufacturer shall jointly and severally furnish guarantee.

D. Include coverage for bond to substrate, and degradation of chemical resistance.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Coating materials shall be especially adapted for use in water and wastewater treatment plants.

B. Coating materials used in contact with potable water supply systems shall be certified to NSF 61.

2.2 HIGH-PERFORMANCE COATINGS

A. Manufacturers:
1. High Performance Coatings Manufacturers: One of the following or equal:
   a. Carboline: Carboline, St. Louis, MO.
   b. Ceilcote: International Protective Coatings, Berea, OH.
   c. Dampney: The Dampney Company, Everett, MA.
   d. Devoe: International Protective Coatings, Louisville, KY.
   e. Dudick: Dudick, Inc., Streetsboro, OH.
   f. GET: Global Eco Technologies, Pittsburg, CA.
   g. Henkel: Henkel North America, Madison Heights MI.
   h. IET: Integrated Environmental Technologies, Santa Barbara, CA.
   i. Induron Protective Coatings, Birmingham, AL.
   j. PPG Amercoat: PPG Protective & Marine Coatings, Brea, CA.
   k. Raven Lining Systems, Broken Arrow, OK.

l. Rustoluem : Rustoleum Corp., Sommerset, NJ.
m. Sanchem: Sanchem, Chicago, IL.
n. Sauereisen: Sauereisen, Pittsburgh, PA
o. Superior: Superior Environmental Products, Inc., Addison, TX.
p. S-W: Sherwin-Williams Co., Cleveland, OH.
q. Tnemec: Tnemec Co., Kansas City, MO.
r. Wasser: Wasser High Tech Coatings, Kent, WA.
s. ZRC: ZRC Worldwide Innovative Zinc Technologies, Marshfield, MA.

2. Preparation And Pretreatment Materials
   a. Metal pretreatment: As manufactured by one of the following or equal:
      1) Henkel: Galvaprep 5.
      2) International: AWLGrip Alumiprep 33.
   b. Surface cleaner and degreaser: As manufactured by one of the following or equal:
      1) Carboline Surface Cleaner No.3.
      2) Devoe: Devprep 88.
      3) S-W: Clean and Etch.
3. Coating Materials
   a. Alkali resistant bitumastic: As manufactured by one of the following or equal:
      1) Carboline: Bitumastic No. 50
      2) Sherwin Williams: Targuard
      3) Wasser: MC-Tar
   b. Wax coating: As manufactured by the following or equal:
      1) Sanchem: No-Ox-Id A special.
   c. High solids epoxy (self-priming) not less than 72 percent solids by volume: As manufactured by one of the following or equal:
      1) Carboline: Carboguard 891.
      2) Devoe: Bar Rust 233H.
      3) Induron: PE-70
      4) PPG Amercoat: Amerlock 2.
      5) S-W: Macropoxy 646.
      6) Tnemec: HS Epoxy Series N140.
   d. Aliphatic or aliphatic-acrylic polyurethane: As manufactured by one of the following or equal:
      1) Carboline: Carbothane 134 VOC.
      2) Devoe: Devthane 379.
      3) PPG Amercoat: Amershield VOC.
      4) S-W: High Solids Polyurethane [CA].
      5) Tnemec: Endura-Shield II Series 1075 (U).
   e. Epoxy Novolac: Multi-component aggregate-filled epoxy system specifically designed for exposure to municipal wastewater. As manufactured by one of the following or equal:
      1) Sauereisen: Sewergard No. 210, 210S, or 210GL
      2) Carboline: Plasite 4550 S
      3) Devoe: Devmat 100
      4) Raven 410
   f. High temperature coating 150 to 350 degrees Fahrenheit: As manufactured by one of the following or equal:
      1) Carboline: Thermaline 4900.
      2) Dampney: Thermalox 245 Silicone - Zinc Dust.
      3) PPG Amercoat: Amerlock 2/400 GFK.
   g. High temperature coating 400 to 1,000 degrees Fahrenheit (dry): As manufactured by one of the following or equal:
      1) Carboline: Thermaline 4700.
      2) Dampney: Thermolox 230C Series Silicone.
      3) Devoe: HT-12, High Heat Silicone.

h. High temperature coating up to 1,400 degrees Fahrenheit: As manufactured by the following or equal:
   1) Dampney: Thermalox 240 Silicone Ceramix.
i. Asphalt varnish: AWWA C 500.
j. Protective coal tar: As manufactured by one of the following or equal:
   1) Not Acceptable
k. Coal tar epoxy: As manufactured by one of the following or equal:
   1) Not Acceptable
l. Coal tar: Where coal tar, coal tar epoxy, or coal tar mastic are specified or indicated on the Drawings, use coal tar epoxy substitute in their place. Coal tar shall not be allowed.
m. Coal tar epoxy substitute: As manufactured by one of the following or equal:
   1) Tnemec: Series 431
n. Vinyl ester: Glass mat reinforced, total system 125 mils DFT. As manufactured by one of the following or equal:
   1) Carboline: Semstone 870.
   2) Ceilcote: 6640 Ceilcrete.
   3) Dudick: Protecto-Flex 800.
   4) Tnemec: Chembloc Series 239SC.
o. Elastomeric polyurethane, 100 percent solids, ASTM D 16, Type V, (Urethane P): As manufactured by the following or equal:
   1) GET: Endura-Flex EF-1988.
p. Anti-slip floor coatings:
   1) PPG: SFT675
q. Concrete floor coatings: As manufactured by one of the following or equal:
   1) Carboline: Semstone 140SL.
   2) Devoe: Devran 124.
   3) Dudick: Polymer Alloy 1000.
   4) Tnemec: Tneme-Glaze Series 282.
r. Waterborne acrylic emulsion: As manufactured by one of the following or equal:
   1) S-W: DTM Acrylic B66W1.
   2) Tnemec: Tneme-Cryl Series 6.
s. Galvanizing Zinc Compound: As manufactured by one of the following or equal:
   1) ZRC: Cold Galvanizing Compound.

2.3 COATING SYSTEMS

A. Coatings:
   1. Description:
      a. Complete multicoat systems formulated and recommended by manufacturer for intended applications and in indicated thicknesses.
      b. Specified number of coats does not include primer or filler coat.
   2. Lead content: None.
   3. Chromium Content as Zinc Chromate or Strontium Chromate: None.
   4. Maximum VOC Content: As required by applicable regulations.
   5. Colors: As selected from manufacturer's standard colors or indicated on Drawings.

B. System 1 Submerged Metals - Potable Water - High-Solids Epoxy Coating or Novalac Epoxy:
   1. Description: High-solids, two-component epoxy.
   2. Exposure: Moderate.
   3. Surface Prep: Abrasive Blast, or Centrifugal Wheel Blast (SP 5)
   4. Number of Coats: One.
   5. Finish: Low gloss
   6. Minimum Solids Content: 78 percent by volume.
   7. Minimum Dry Film Thickness Per Coat: 6 mils.
   8. Primer: High Solids Epoxy (Self Priming)

C. System 2 Submerged Metals – Domestic Sewage - High-Solids Epoxy Coating:
   1. Description: High-solids, two-component
   2. Exposure: Severe.
   3. Surface Prep: Abrasive Blast, or Centrifugal Wheel Blast (SP 5)
   4. Number of Coats: Two.
   5. Finish: Low gloss
   6. Minimum Solids Content: 100 percent by volume.
   7. Minimum Dry Film Thickness Per Coat: 30 mils.
   8. Primer: High Solids Epoxy – As recommended by painting system manufacturer.

D. System 3: Exposed Metal – Highly Corrosive – Epoxy/Polyurethane Coating or Novalac Epoxy:
   1. Description: High-solids, two-component epoxy intermediate coat and solvent-based, two-component, pigmented polyurethane topcoat.
   2. Exposure: Severe.
   3. Surface Prep: Abrasive Blast (SP 10)
   4. Number of Coats: Two.
   5. Finish: Semi-Gloss.
   6. Minimum Epoxy Solids Content: 78 percent by volume.
   7. Minimum Polyurethane Solids Content: 69 percent by volume.
   8. Minimum Dry Film Thickness Per Coat: 4 mils.
   9. Primer: As recommended by painting system manufacturer.

E. System 4: Exposed Metal – Mildly Corrosive - Polyurethane Coating:
   1. Description: Solvent-based, two-component, pigmented polyurethane.
   2. Exposure: Moderate.
   3. Surface Prep: Abrasive Blast (SP 10)
   4. Number of Coats: One.
   5. Finish: Semi-Gloss.
   6. Minimum Solids Content: 69 percent by volume.
   7. Minimum Dry Film Thickness Per Coat: 3 mils.
   8. Primer: As recommended by painting system manufacturer.

F. System 5: Buried Metal – General:
   1. Standard Conditions
      a. Description:
         1) Standard Hot Coal-Tar Enamel, or
         2) Coal-Tar Epoxy Substitute, or
         3) Tape Coat System.
      b. Exposure: Moderate.
      c. Surface Prep: Abrasive Blast (SP 10)
      d. Number of Coats and Minimum Dry Film Thickness Per Coat:
         1) Standard Hot Coal-Tar Enamel: Conform to AWWA C203
         2) Coal-Tar Epoxy Substitute: Conform to AWWA C210
         3) Tape Coat System: Conform to AWWA C214
      e. Primer: As recommended by painting system manufacturer.
   2. For Acidic Soil, Brackish Water, High Bacteria
      a. Description:
         1) Coal-Tar Epoxy Substitute, Double Felt
      b. Exposure: Moderate.
      c. Surface Prep: Abrasive Blast (SP 10)
      d. Number of Coats and Minimum Dry Film Thickness Per Coat:
         1) AWWA C203, App. A, Sec. Al.5
      e. Primer: As recommended by painting system manufacturer.
   3. For Highly Abrasive Soil, Brackish Water
      a. Description:
         1) Coal-Tar Epoxy Substitute, Fibrous Glass, or

2) Tape Coat System
b. Exposure: Moderate.
c. Surface Prep: Abrasive Blast (SP 10)
d. Number of Coats and Minimum Dry Film Thickness Per Coat:
1) Coal-Tar Epoxy Substitute, Fibrous Glass: AWWA C203, App. A, Sec. A1.5
2) Tape Coat System: AWWA C214 with Double Outer Wrap
e. Primer: As recommended by painting system manufacturer.

G. System 6: Moderate-Heat-Resistant Coating for Ferrous Metal (150º - 400º):
1. Description: Solvent-based, pigmented enamel, formulated for service up to 400 degrees F.
2. Exposure: Moderate.
3. Surface Prep: Abrasive Blast (SP 10)
4. Number of Coats: One
5. Minimum Dry Film Thickness Per Coat: 2 mils.
6. Primer: As recommended by painting system manufacturer.

H. System 7: High-Heat-Resistant Coating for Ferrous Metal (400º - 1,000º):
1. Description: Solvent-based, silicone type, aluminum coating, formulated for service up to 1,000 degrees F.
2. Exposure: Severe.
3. Surface Prep: Abrasive Blast (SP 10)
4. Number of Coats: Two.
5. Minimum Solids Content: 46 percent by volume.
6. Minimum Dry Film Thickness Per Coat: 2 mils.
7. Primer: As recommended by painting system manufacturer.

I. System 8: High-Heat-Resistant Coating for Ferrous Metal (1000º - 1,400º):
1. Description: Silicon ceramic matrix and thermally stable pigments., formulated for service up to 1,400 degrees F.
2. Exposure: Severe.
3. Surface Prep: Abrasive Blast (SP 10)
4. Number of Coats: Two.
5. Minimum Dry Film Thickness Per Coat: 1.5 mils.
6. Primer: As recommended by painting system manufacturer.

J. System 10: Galvanized Metal Conditioning - Wash Primer:
1. Description: Wash Primer or Coating Manufacturer's Recommendation.
2. Exposure: Severe.
3. Surface Prep: Solvent Clean (SP 1), followed by Hand Tool (SP 2), or Power Tool (SP 3)
4. Number of Coats: One minimum, additional coats as required by exposure.
5. Minimum Dry Film Thickness Per Coat: 0.4 mils.

K. System 11: Galvanized Metal Conditioning - Zinc Primer:
1. Description: Organic Zinc Rich or Coating Manufacturer's Recommendation.
2. Exposure: Severe.
3. Surface Prep: Solvent Clean (SP 1), followed by Hand Tool (SP 2), Power Tool (SP 3), or Brush-off Blast (SP 7)
4. Number of Coats: One minimum, additional coats as required by exposure.
5. Minimum Dry Film Thickness Per Coat: 3 mils.

L. System 12: Skid-Resistant Walkway Surface Coatings:
1. Description: Aggregated High Solids Epoxy for use on steel, wood, aluminum, brick, block, fiberglass, or concrete.
2. Exposure: Moderate.
3. Surface Prep: Brush-off Blast (SP 7) or Plastic Surface Preparation

4. Number of Coats: One.
5. Minimum Solids Content: 100 percent by volume.
6. Minimum Dry Film Thickness Per Coat: 30 mils.
7. Primer: High Solids Epoxy – As recommended by painting system manufacturer.
8. Aggregate Size: GL-400, grit size 20

M. System 13: Sliding Metal:
1. Description: Wax coating.
2. Surface Prep: Solvent Clean (SP 1), followed by Hand Tool (SP 2), Power Tool (SP 3), or Brush-off Blast (SP 7)
3. Number of Coats: One.
4. Minimum Dry Film Thickness Per Coat: 30 mils.

N. System 14: Exposed PVC – Epoxy/Polyurethane Coating:
1. Description: High-solids, two-component epoxy primer and solvent-based, two-component, pigmented polyurethane topcoat.
2. Exposure: Severe.
3. Surface Prep: Brush-off Blast (SP 7) or Plastic Surface Preparation
4. Number of Coats: Two.
5. Finish: Semi-Gloss.
6. Minimum Epoxy Solids Content: 78 percent by volume.
7. Minimum Polyurethane Solids Content: 69 percent by volume.
8. Minimum Dry Film Thickness Per Coat: 2 mils.

O. System 15: Aluminum and Dissimilar Metal Insulation:
1. Description: Alkali Resistant Bitumastic or Coal-Tar Epoxy Substitute.
2. Surface Prep: Solvent Clean (SP 1)
3. Number of Coats: One.
4. Minimum Dry Film Thickness Per Coat: 18 mils.

P. System 16: Existing Concrete/CMU Repair:
1. Description: High-solids, two-component epoxy, with filler.
2. Exposure: Moderate.
3. Surface Prep: (SP 13)
4. Filler: Per Manufacturer's Recommendations, 10 MDFT
5. Primer: High Solids Epoxy – As recommended by painting system manufacturer, 5 MDFT, min.
6. Number of Coats: One.
7. Finish: Low gloss
8. Minimum Solids Content: 78 percent by volume.
9. Minimum Dry Film Thickness Per Coat: 6 mils.

Q. System 17: New Concrete/CMU Exterior-Epoxy/Polyurethane (as required by application schedule):
1. Description: High-solids, two-component epoxy intermediated coat and, Aliphatic Polyurethane, with filler.
2. Exposure: Moderate.
3. Surface Prep: (SP 13)
4. Filler: Per Manufacturer's Recommendations, 10 MDFT
5. Primer: As recommended by painting system manufacturer.
6. Number of Coats: One.
7. Minimum Epoxy Solids Content: 78 percent by volume.
8. Minimum Polyurethane Solids Content: 69 percent by volume.
9. Minimum Dry Film Thickness Per Coat: 4 mils.

R. System 18: Concrete/CMU Interior or Immersion Mildly Corrosive - Epoxy/Epoxy (as required by application schedule):
   1. Description: High-solids, two-component epoxy intermediate coat and, -solids, two-component epoxy topcoat.
   2. Exposure: Moderate.
   3. Surface Prep: (SP 13)
   4. Filler: Per Manufacturer's Recommendations, 10 MDFT
   5. Primer: As recommended by painting system manufacturer.
   6. Number of Coats: Two.
   7. Minimum Epoxy Solids Content: 78 percent by volume.
   8. Minimum Dry Film Thickness Per Coat: 6 mils.

S. System 19: Concrete/CMU – Immersion Highly Corrosive – Novolac Epoxy:
   1. Description: Epoxy Novolac.
   2. Exposure: Severe.
   3. Surface Prep: (SP 13)
   4. Filler: Per Manufacturer's Recommendations.
   5. Primer: As recommended by painting system manufacturer.
   6. Number of Coats: Two.
   7. Minimum Dry Film Thickness Per Coat: 40 mils minimum or as noted otherwise.

T. System 20: Epoxy Concrete Floor Coating – Moderate Corrosive Areas:
   1. Description: A highly chemical- and solvent-resistant colored novolac glaze.
   2. Exposure: Moderate.
   3. Number of Coats: Two.
   4. Finish: Gloss.
   5. Minimum Solids Content: 100 percent by volume.
   6. Minimum Dry Film Thickness Per Coat: 6 mils.
   7. Primer: As recommended by painting system manufacturer.

U. System 21: Epoxy Concrete Floor and Secondary Containment Coating – Highly Corrosive Areas:
   1. Description: Epoxy Mortar and Fiberglass intermediate coat with a highly chemical- and solvent-resistant colored novolac glaze topcoat.
   2. Exposure: Severe.
   3. Primer: High Solids Epoxy, 6 mils
   4. Intermediate Coat: Novolac Epoxy Mortar, 70 mils
   5. Topcoat: Novolac Epoxy, 6 mils
   6. Finish: Gloss.
   7. Minimum Solids Content: 100 percent by volume.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 77 00 – Closeout Procedures: Requirements for application examination.

B. Substrates:
   1. Verify that substrate surfaces are ready to receive Work of this Section as indicated by coating manufacturer.
   2. Obtain and follow manufacturer instructions for examination and testing of substrates.
   3. Cementitious Substrates: Do not begin application until substrate has cured minimum 28 days and measured moisture content is not greater than 16 percent.

C. Masonry: Verify that masonry joints are struck flush.

D. Wood: Do not begin application if substrate has moisture content greater than 12 percent.

3.2 GENERAL PROTECTION

A. Protect adjacent surfaces from coatings and damage. Repair damage resulting from inadequate or unsuitable protection:

B. Protect adjacent surfaces not to be coated from spatter and droppings with drop cloths and other coverings:

C. Mask off surfaces of items not to be coated or remove items from area.

D. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being coated and in particular, surfaces within storage and preparation area.

E. Place cotton waste, cloths, and material which may constitute fire hazard in closed metal containers and remove daily from site.

F. Remove electrical plates, surface hardware, fittings, and fastenings, prior to application of coating operations. Carefully store, clean, and replace on completion of coating in each area. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finish.

3.3 PREPARATION

A. Section 01 70 00 – Execution Requirements: Requirements for application preparation.

B. Clean surfaces of loose foreign matter.

C. Remove substances that would bleed through finished coatings; if removal is not possible, seal surface with shellac.

D. Remove finish hardware, fixture covers, and accessories and store.

E. Prepare surfaces in accordance with coating manufacturer's instructions, unless more stringent requirements are specified in this Section.

F. Protect following surfaces from abrasive blasting by masking, or other means:
1. Threaded portions of valve and gate stems, grease fittings, and identification plates.
2. Machined surfaces for sliding contact.
3. Surfaces to be assembled against gaskets.
4. Surfaces of shafting on which sprockets are to fit.
5. Surfaces of shafting on which bearings are to fit.
6. Machined surfaces of bronze trim, including those slide gates.
7. Cadmium-plated items, except cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment requiring abrasive blasting.
8. Galvanized items, unless scheduled to be coated.

G. Protect installed equipment, mechanical drives, and adjacent coated equipment from abrasive blasting to prevent damage caused by entering sand or dust.

H. Existing Painted and Sealed Surfaces:
1. Remove loose, flaking, and peeling paint, and feather edge and sand smooth edges of chipped paint.
2. Cleaning of previously coated surfaces:

a. Utilize cleaning agent to remove soluble salts such as chlorides and sulfates from concrete and metal surfaces:
    1) Cleaning agent: Biodegradable non-flammable and containing no volatile organic compounds.
    2) Manufacturer: The following or equal:
        a) Chlor-Rid International, Inc.
b. Or Steam clean and degrease surfaces to be coated to remove oils and grease.
c. Cleaning of surfaces utilizing the decontamination cleaning agent may be accomplished in conjunction with abrasive blast cleaning, steam cleaning, high-pressure washing, or hand washing as approved by the coating manufacturer's representative and the Engineer.
d. Test cleaned surfaces in accordance with the cleaning agent manufacturer's instructions to ensure all soluble salts have been removed. Additional cleaning shall be carried out as necessary.
e. Final surface preparation prior to application of new coating system shall be made in strict accordance with coating manufacturer's printed instructions.

I. Concrete:
1. Allow new concrete to cure for minimum of 28 days before coating.
2. Clean concrete surfaces of dust, mortar, fins, loose concrete particles, form release materials, oil, and grease. Fill voids so that surface is smooth. Etch or brush off-blast clean in accordance with SSPC SP-7 to provide surface profile equal to 40 to 60-grit sandpaper, or as recommended by coating manufacturer. All concrete surfaces shall be vacuumed clean prior to coating application.

J. Galvanized Surfaces:
1. Degrease or solvent clean (SSPC SP-1) to remove oily residue.
2. Power tool or hand tool clean or whip abrasive blast.
3. Test surface for contaminants using copper sulfate solution.
4. Apply metal pretreatment within 24 hours before coating galvanized surfaces that cannot be thoroughly abraded physically, such as bolts, nuts, or preformed channels.

K. Ferrous Metal:
1. Solvent clean.
2. Remove loose rust, loose mill scale, and other foreign substances.
3. Hand Tools: Comply with SSPC-SP 2.
4. Power Tools: Comply with SSPC-SP 3.
5. Blasting: Comply with SSPC-SP 7.
6. Surfaces to Be Finished as Indicated in Coating Schedules
    a. Remove tight rust to bare metal.
    b. Hand Tools: Comply with SSPC-SP 2.
    c. Power Tools: Comply with SSPC-SP 3.
    d. Blasting: Comply with SSPC-SP 10.
    e. Protect from corrosion until coated.

L. Ductile iron pipe and fittings to be lined or coated: Abrasive blast clean in accordance with NAPF 500-03.

M. Sherardized, aluminum, copper, and bronze surfaces: Prepare in accordance with coating manufacturer's instructions.

N. Shop primed metal:
1. Certify that primers applied to metal surfaces in the shop are compatible with coatings to be applied over such primers in the field.

2. Remove shop primer from metal to be submerged by abrasive blasting in accordance with SSPC SP-10, unless greater degree of surface preparation is required by coating manufacturer's representative.
3. Correct abraded, scratched, or otherwise damaged areas of prime coat by sanding or abrasive blasting to bare metal in accordance with SSPC SP-2, SP 3, or SP-6, as directed by the Engineer.
4. When entire shop priming fails or has weathered excessively (more than 25 percent of the item), or when recommended by coating manufacturer's representative, abrasive blast shop prime coat to remove entire coat and prepare surface in accordance with SSPC SP-10.
5. When incorrect prime coat is applied, remove incorrect prime coat by abrasive blasting in accordance with SSPC SP-10.
6. When prime coat not authorized by Engineer is applied, remove unauthorized prime coat by abrasive blasting in accordance with SSPC SP-10.
7. Shop applied bituminous paint or asphalt varnish: Abrasive blast clean shop applied bituminous paint or asphalt varnish from surfaces scheduled to receive non-bituminous coatings.

O. Cadmium-plated, zinc-plated, or sherardized fasteners:
1. Abrasive blast in same manner as unprotected metal when used in assembly of equipment designated for abrasive blasting.
2. Abrasive blast components to be attached to surfaces which cannot be abrasive blasted before components are attached.
3. Grind sharp edges to approximately 1/16-inch radius before abrasive blast cleaning.
4. Remove and grind smooth all excessive weld material and weld spatter before blast cleaning in accordance with NACE SP0178.

P. PVC and FRP Surfaces:
1. Prepare surfaces to be coated by light sanding (de-gloss) and wipe-down with clean cloths, or by solvent cleaning.

Q. Mechanical And Electrical Equipment Preparation
1. Identify equipment, ducting, piping, and conduit as specified in Section 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS.
2. Remove grilles, covers, and access panels for mechanical and electrical system from location and coat separately.
3. Prepare and finish coat-primed equipment with color selected by the Engineer.
4. Prepare and prime and coat insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are covered with prefinished coating.
5. Replace identification markings on mechanical or electrical equipment when coated over or spattered.
6. Prepare and coat interior surfaces of air ducts, convector and baseboard heating cabinets that are visible through grilles and louvers with 1 coat of flat black paint, to limit of sight line.
7. Prepare and coat dampers exposed immediately behind louvers, grilles, convector, and baseboard cabinets to match face panels.
8. Prepare and coat exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.
9. Prepare and coat both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.
10. Color code equipment, piping, conduit, and exposed ductwork and apply color banding and identification, such as flow arrows, naming and numbering, in accordance with Contract Documents.

3.4 APPLICATION

A. General
1. Apply primer to each surface, unless specifically not required by coating manufacturer.
2. Apply coatings in accordance with manufacturer's instructions.
3. Coat metal unless specified otherwise:
4. Aboveground piping to be coated shall be empty of contents during application of coatings.
5. Verify metal surface preparation immediately before applying coating in accordance with SSPC SP COM.
6. Allow surfaces to dry, except where coating manufacturer requires surface wetting before coating.
7. Wash coat and prime sherardized, aluminum, copper, and bronze surfaces, or prime with manufacturer's recommended special primer.
8. Prime shop primed metal surfaces. Spot prime exposed metal of shop primed surfaces before applying primer over entire surface.
9. Multiple coats:
10. Apply minimum number of specified coats.
11. Apply additional coats when necessary to achieve specified thicknesses.
12. Apply coats to thicknesses specified, especially at edges and corners.
13. When multiple coats of same material are specified, tint prime coat and intermediate coats with suitable pigment to distinguish each coat.
14. Lightly sand and dust surfaces to receive high gloss finishes, unless instructed otherwise by coating manufacturer.
15. Dust coatings between coats.
16. Coat surfaces without drops, overspray, dry spray, runs, ridges, waves, holidays, laps, or brush marks.
17. Remove spatter and droppings after completion of coating.
18. Apply coating by brush, roller, trowel, or spray, unless particular method of application is required by coating manufacturer's instructions or these Specifications.
19. Plural component application: Drums shall be premixed each day. All gauges shall be working order prior to the start of application. Ratio checks shall be completed prior to each application. A spray sample shall be sprayed on plastic sheeting to ensure set time is complete prior to each application. Hardness testing shall be performed after each application.
20. Spray application:
    a. Stripe coat edges, welds, nuts, bolts, difficult to reach areas by brush before beginning spray application, as necessary, to ensure specified coating thickness along edges.
    b. When using spray application, apply coating to thickness not greater than that recommended in coating manufacturer's instructions for spray application.
    c. Use airless spray method unless `air spray method is required by coating manufacturer's instruction or these Specifications.
    d. Conduct spray coating under controlled conditions. Protect adjacent construction and property from coating mist, fumes, or overspray.
21. Drying and recoating:
    a. Provide fans, heating devices, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.
    b. For submerged service the Contractor shall provide a letter to the Engineer that the lining system is fully cured and ready to be placed into service.
    c. Limit drying time to that required by these specifications or coating manufacturer's instructions.
    d. Do not allow excessive drying time or exposure which may impair bond between coats.
    e. Recoat epoxies within time limits recommended by coating manufacturer.

f. When time limits are exceeded, abrasive blast clean and de-gloss clean prior to applying another coat.
g. When limitation on time between abrasive blasting and coating cannot be met before attachment of components to surfaces which cannot be abrasive blasted, coat components before attachment.
h. Ensure primer and intermediate coats of coating are unscarred and completely integral at time of application of each succeeding coat.
i. Touch up suction spots between coats and apply additional coats where required to produce finished surface of solid, even color, free of defects.
j. Leave no holidays.
k. Sand and feather into a smooth transition and recoat and recoat scratched, contaminated, or otherwise damaged coating surfaces so damages are invisible to naked eye.

22. Concrete:
    a. Apply first coat (primer) only when surface temperature of concrete is decreasing to eliminate effects of off-gassing on coating.
    b. Prior to priming, patch with masonry filler to produce smooth surface.
23. Wood:
    a. Prior to priming patch with filler to produce smooth, even surface. Wood Items to Receive Transparent Finish:
        1) Remove dust and grit, sealing residue, seal knots, pitch streaks, and sappy sections as indicated by coating manufacturer.
        2) Fill nail holes and cracks with matching tinted filler.

B. ALKALI RESISTANT BITUMASTIC
1. Preparation:
    a. Prepare surfaces in accordance with general preparation requirements.
2. Application:
    a. Apply in accordance with general application requirements and as follows:
        1) Apply at least 2 coats, 8 to 14 mils dry film thickness each.

C. WAX COATING
1. Preparation:
    a. Prepare surfaces in accordance with general preparation requirements.
2. Application:
    a. Apply in accordance with general application requirements and as follows:
        1) Apply at least 1/32-inch-thick coat with 2-inch or shorter bristle brush.
        2) Thoroughly rub coating into metal surface with canvas covered wood block or canvas glove.

D. HIGH SOLIDS EPOXY SYSTEM
1. Preparation:
    a. Prepare surfaces in accordance with general preparation requirements and as follows:
        1) Abrasive blast ferrous metal surfaces to be submerged at jobsite in accordance with SSPC SP-5 prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP-10.
        2) Abrasive blast non-submerged ferrous metal surfaces at jobsite in accordance with SSPC SP-10, prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP 6.
        3) Abrasive blast clean ductile iron surfaces at jobsite in accordance with SSPC SP-7.
2. Application:
    a. Apply coatings in accordance with general application requirements and as follows:
    b. Apply minimum 2-coat system with minimum total dry film thickness (DFT) of 12 mils.

c. Recoat or apply succeeding epoxy coats within time limits recommended by manufacturer. Prepare surfaces for recoating in accordance with manufacturer's instructions.
d. Coat metal to be submerged before installation when necessary, to obtain acceptable finish, and to prevent damage to other surfaces.
e. Coat entire surface of support brackets, stem guides, pipe clips, fasteners, and other metal devices bolted to concrete.
f. Coat surface of items to be exposed and adjacent 1 inch to be concealed when embedded in concrete or masonry.

E. HIGH SOLIDS EPOXY AND POLYURETHANE COATING SYSTEM
1. Preparation:
a. Prepare surfaces in accordance with general preparation requirements and as follows:
1) Prepare concrete surfaces in accordance with general preparation requirements.
2) Touch up shop primed steel and miscellaneous iron.
3) Abrasive blast ferrous metal surfaces at jobsite prior to coating. Abrasive blast clean rust and discoloration from surfaces.
4) Degrease or solvent clean, whip abrasive blast, power tool, or hand tool clean galvanized metal surfaces.
5) Lightly sand (de-gloss) fiberglass and poly vinyl chloride (PVC) pipe to be coated and wipe clean with dry cloths, or solvent clean in accordance with coating manufacturer's instructions.
6) Abrasive blast clean ductile iron surfaces.
2. Application:
a. Apply coatings in accordance with general application requirements and as follows:
1) Apply 3 coat system consisting of:
a) Primer: 4 to 5 mils dry film thickness high solids epoxy.
b) Intermediate coat: 4 to 5 mils dry film thickness high solids epoxy.
c) Topcoat: 2.5 to 3.5 mils dry film thickness aliphatic or aliphatic-acrylic polyurethane topcoat.
b. Recoat or apply succeeding epoxy coats within 30 days or within time limits recommended by manufacturer, whichever is shorter. Prepare surfaces for recoating in accordance with manufacturer's instructions.

F. EPOXY NOVOLAC SYSTEM
1. Preparation:
a. Prepare surfaces in accordance with general preparation requirements and as follows:
b. Prepare concrete to obtain clean, open pore with exposed aggregate in accordance with manufacturer's instructions.
c. Prepare ferrous metal surfaces in accordance with SSPC SP-5, with coating manufacturer's recommended anchor pattern.
d. Complete application of prime coat within 6 hours of abrasive blast cleaning. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP-5.
e. When handling steel, wear gloves to prevent hand printing.
f. Adjust pH of concrete to within 7 to 11 before applying prime coat.
2. Application:
a. Apply coatings in accordance with general application requirements and in accordance with manufacturer’s instructions.
b. Continue to monitor dew point. Dew point shall remain 5 degrees above ambient temperature for a minimum of 8 hours after application of coating.

G. HIGH TEMPERATURE COATING

1. Preparation:
    a. Prepare surfaces in accordance with general preparation requirements and as follows:
        1) Abrasive blast surface in accordance with SSPC SP-10.
2. Application:
    a. Apply coatings in accordance with general application requirements and as follows:
        1) Apply number of coats in accordance with manufacturer's instructions.

H. ASPHALT VARNISH
1. Preparation:
    a. Prepare surfaces in accordance with general preparation requirements.
2. Application:
    a. Apply coatings in accordance with general application requirements and as follows:
        1) Apply minimum 2 coats.

I. VINYL ESTER
1. Preparation:
    a. Prepare surfaces in accordance with coating manufacturer's recommendations and as directed and approved by coating manufacturer's representative.
2. Application:
    a. Apply prime coat, as required by coating manufacturer, base coat, glass mat, and topcoat to total dry film thickness of 125 mils minimum:
        1) Final topcoat on floors shall include non-skid surface, applied in accordance with manufacturer's instructions.
    b. Perform high voltage holiday detection test in accordance with SP0188-06, over 100 percent of coated surface areas to ensure pinhole free finished coating system.
    c. All work shall be accomplished in strict accordance with coating manufacturer's instructions and under direction of coating manufacturer's representative.

J. ELASTOMERIC POLYURETHANE (100 PERCENT SOLIDS)
1. Preparation:
    a. Prepare surfaces in strict accordance with coating manufacturer's instructions and as directed and approved by coating manufacturer's representative.
2. Application:
    a. Apply epoxy primer at DFT of 1 to 2 mils, in strict accordance with manufacturer's instructions.
    b. Apply polyurethane coating at minimum total DFT as follows:
        1) Steel: 60 mils DFT.
        2) Ductile iron and ductile iron pipe coating and lining: 30 mils DFT.
        3) Concrete: 120 mils DFT.
        4) Or as recommended by the coating manufacturer and accepted by the Engineer.
3. For concrete application, provide saw cutting for coating terminations in strict accordance with manufacturer's instructions:
4. Perform high voltage holiday detection test in accordance with SP0188-06, over 100 percent of coated surface areas to ensure pinhole free finished coating system.

K. CONCRETE FLOOR COATINGS
1. Preparation:
    a. Prepare surfaces in accordance with general application requirements and in strict accordance with coating manufacturer’s instructions.
2. Application:
    a. Apply primer if required by coating manufacturer.
    b. Apply 1 or more coats as recommended by coating manufacturer to receive a minimum total dry film thickness of 25 mils, color as selected by OWNER.

3. Final topcoat shall include non-skid surface, applied in strict accordance with coating manufacturer's instructions.

L. WATERBORNE ACRYLIC EMULSION
1. Preparation:
a. Remove all oil, grease, dirt, and other foreign material by Solvent Cleaning in accordance with SSPC SP-1.
b. Lightly sand all surfaces and wipe thoroughly with clean cotton cloths before applying coating.
2. Application:
a. Apply 2 or more coats to obtain a minimum dry film thickness (DFT) of 5.0 mils.

3.5 FIELD QUALITY CONTROL

A. Section 01 75 00 – STARTUP TESTING AND TRAINING: Requirements for testing, adjusting, and balancing.

B. Each coat will be inspected. Strip and remove defective coats, prepare surfaces and recoat. When approved, apply next coat.

C. Control and check dry film thicknesses and integrity of coatings.

D. Measure dry film thickness with calibrated thickness gauge.

E. Dry film thicknesses on ferrous-based substrates may be checked with Elcometer Type 1 Magnetic Pull-Off Gage or Positector 6000.

F. Verify coat integrity with low-voltage sponge or high-voltage spark holiday detector, in accordance with SP0188 06. Allow ENGINEER to use detector for additional checking.

G. Check wet film thickness before coal tar epoxy coating cures on concrete or non-ferrous metal substrates.

H. Arrange for services of coating manufacturer's field representative to provide periodic field consultation and inspection services to ensure proper surface preparation of facilities and items to be coated, and to ensure proper application and curing:
1. Notify Engineer 24 hours in advance of each visit by coating manufacturer's representative.
2. Provide Engineer with a written report by coating manufacturer's representative within 48 hours following each visit.

3.6 CLEANING

A. Section 01 77 00 – Closeout Procedures: Requirements for cleaning.

B. Collect waste material that may constitute fire hazard, place in closed metal containers, and remove daily from Site.

C. Clean surfaces immediately of overspray, splatter, and excess material.

D. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.7 PROTECTION

A. Section 01 77 00 – Closeout Procedures: Requirements for protecting finished Work.

B. Protect adjacent surfaces and materials not receiving coating from overspray.

C. Mask when necessary to provide adequate protection and repair damage.

3.8 SCHEDULE OF ITEMS NOT REQUIRING COATING

A. General: Unless specified otherwise, the following items do not require coating:
   1. Items that have received final coat at factory and not listed to receive coating in field.
   2. Aluminum, brass, bronze, copper, plastic (except PVC pipe), rubber, stainless steel, chrome, Everdur, or lead.
   3. Buried or encased piping or conduit.
   4. Exterior concrete.
   5. Galvanized steel wall framing, galvanized roof decking, galvanized electrical conduits, galvanized pipe trays, galvanized cable trays, and other galvanized items:
      a. Areas on galvanized items or parts where galvanizing has been damaged during handling or construction shall be repaired as follows:
         1) Clean damaged areas by SSPC SP-1, SP-2, SP-3, or SP-7 as required.
         2) Apply 2 coats of a Galvanizing Zinc Compound in strict accordance with manufacturer's instructions.
   6. Grease fittings.
   7. Fiberglass ducting or tanks in concealed locations.
   8. Steel to be encased in concrete or masonry.

3.9 SCHEDULE OF SURFACES TO BE COATED

A. Refer to attached schedule for a list of items to be coated. Schedule may not list all items that require a coating – coat unlisted surfaces with same coating system as similar listed surfaces. Color coat all piping as specified in Section 40 23 39 – PROCESS PIPING - GENERAL.

END OF SECTION

DIVISION 26

ELECTRICAL

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in the General and Supplementary Conditions.

B. This project consists of construction of the new building structures, associated facilities, and all related electrical systems as defined in the plans and in these specifications.

C. The work includes the installation, connection and testing of new electrical equipment, including electrical services, power distribution equipment, lighting equipment, underground electrical work, grounding systems, control systems, conduit and wiring, coordination of traffic flow, temporary power systems, special electrical systems and all appurtenances to construct and demonstrate proper operation of the completed electrical systems.

D. The Contractor shall be responsible for the coordination of power, communication, and controls for the project.

E. The electrical plans do not give exact locations, etc., and do not show all the offsets, control lines, pilot lines, and other installation details. Each contractor shall carefully lay out the work at the sites to conform to the job conditions, to conform to details of installation supplied by the manufacturers of the equipment to be installed, and thereby to provide complete operating systems.

F. The electrical plans show diagrammatically the locations of the various electrical outlets and apparatus and the general method of circuiting and controlling. Exact locations of these outlets and apparatus shall be determined by reference to the general plans and to all detail drawings, etc., by measurements at the buildings, and in cooperation with other crafts, and in all cases shall be subject to the approval of the Owner and Engineer. The Engineer reserves the right to make any reasonable change in location of any outlet or apparatus before installation, without additional cost to the Owner.

G. These specifications and the accompanying drawings are intended to cover systems which will not interfere with the structure of the buildings, which will fit into the several available spaces, and which will ensure complete and satisfactory systems. Each bidder shall be responsible for the proper fitting of the material and apparatus into the buildings.

H. Should the particular equipment which any bidder proposes to install require other space conditions than those indicated on the Drawings, the Bidder shall arrange for such space with the Engineer before submitting the bid. Should changes become necessary on account of failure to comply with this clause, the Contractor shall make such changes at the Contractor’s expense.

I. Where wire sizes, conduit and other items of construction are shown or required for a complete installation, but are not adequately identified as to size or material requirements, the materials furnished shall be in accordance with “Code” requirements as though shown in detail on the Drawings.

J. All equipment shall be leveled and made plumb. Metal junction boxes, equipment enclosures and metal raceways mounted on water or earth-bearing walls shall be separated from walls not less than 1/4 inch by corrosion-resistant spacers. All electrical conduits and items of equipment shall be run or set parallel to walls, floors and other items of construction.

1.2 STANDARDS

A. The Contractor shall perform work specified in Division 26 in accordance with standards listed below. Where these specifications are more stringent, the most stringent standard shall take precedence. In case of conflict, obtain a decision from the Engineer.
   1. Applicable National Fire Protection Association (NFPA) codes, including but not limited to:
      a. NFPA 70 – National Electrical Code.
      b. NFPA 70E – Standard for Electrical Safety in the Workplace.
      c. NFPA 72 - National Fire Alarm Code.
      d. NFPA 101 – Life Safety Code.
      e. NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
      f. Internet Website: http://www.nfpa.org
   2. Applicable Code of Federal Regulations (CFR) codes, including but not limited to:
      a. 29 CFR 1910 – Occupational Safety and Health Standards (OSHA).
      b. 29 CFR 1926 – Safety and Health Regulations for Construction.
      c. Internet Website: http://www.gpo.gov/fdsys
   3. ANSI/IEEE C2 – National Electrical Safety Code.
   4. Applicable Federal, State and Local Fire codes.
   5. Applicable Federal, State and Local Energy Codes.
   6. Applicable Federal, State and Local Building Codes.
   7. Applicable City Electrical Code.
   8. Applicable City Ordinances pertaining to electrical work.
   9. Applicable Federal, State and Local – Environmental, Health and Safety Laws and Regulations.

B. Contractor shall utilize the most current editions of standards, which are current at time of bid and as recognized by the Authority Having Jurisdiction for the respective standard.

1.3 SUBMITTALS

A. Submittals shall comply with Section 01 33 00 SUBMITTAL PROCEDURES and the General and Supplementary Conditions.

B. Submittals shall be furnished by the Contractor for the work involved in sufficient time so that no delay or changes will be caused. Fax copies are not acceptable.

C. Submittals shall consist of manufacturing information, schematics, wiring diagrams, ladder logic diagrams, instrument loop diagrams, outline drawings, clearances and related information. Shop Drawings shall be so marked as to indicate the EXACT items offered.

D. Submittals shall bear Contractor's certification that the item complies in all respects with the item originally specified. It is the Contractor's responsibility to procure the proper sizes, quantities, rearrangements, structural modifications or other modifications in order for the substituted item to comply with the established requirements.

E. The Contractor shall combine each submittal set into one electronic file (pdf format). Group materials submitted by their Specification numbers, but do not submit the entire electrical within one submittal. Provide electronic bookmarks in the pdf to indicate the included equipment types and a title sheet to separate each section.

F. The Contractor shall submit complete descriptions, illustrations, specification data, etc., of all materials, fittings, devices, fixtures, special systems, etc., as required by the individual sections of this Division.

G. Submittal of shop drawings, product data and samples will be accepted only when submitted by the Contractor. Data submitted from subcontractors and material suppliers directly to the Engineer will not be processed.

H. All submittals shall provide the following information:
1. General Contractor.
2. Sub-Contractor.
3. Distributor and/or Supplier.
4. Sales Agency.
5. Submittals not supplying this information will be rejected.

I. Shop Drawings: In addition to the above, submit shop drawings for major materials where called for and when requested by the Engineer.
1. Lockout/Tagout Program.
2. Switchboard, motor control centers, panelboards, surge arresters, and safety switches.
3. Motor starters and contactors including custom wiring diagrams for all motors.
4. Lighting fixtures and lamps including light pole foundation requirements.
5. Wire, cable and conduit.
6. Dry type transformers including weight and dimensions.
7. Wiring devices and plates.
8. Dimensioned layout of electrical room drawn to scale, with equipment location shown therein. Clearances shall be in accordance with NEC and local codes.
9. Dimensioned layout of all below grade conduit installations.
10. Grounding system and layout.
11. Lightning protection system layout.
12. Traffic control system layout and schematics.
13. Seismic protection materials and methods for all electrical equipment.
14. Mounting brackets, supports and assembly for walkway mounted equipment including instruments, lighting and control panels

1.4 QUALITY ASSURANCE

A. Any electrical equipment provided under this Division shall be turned over to the Owner in operating condition. Instruction on further operation and maintenance shall be included in the operating and maintenance instructions.

1.5 PRODUCT LISTING

A. Prepare listing of major electrical equipment and materials for the project.

B. Provide all information requested.

C. Submit this listing as a part of the submittal requirements.

D. When two or more items of same material or equipment are required they shall be of the same manufacturer when available. Product manufacturer uniformity does not apply to raw materials, bulk materials, wire, conduit, fittings, sheet metal, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment kits, and similar items used in Work, except as otherwise indicated.

E. Provide products that are compatible within systems and other connected items.

1.6 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

1.7 WORK SUPERVISION

A. The Contractor shall designate in writing the qualified electrical supervisor who shall provide supervision to all electrical work on this project. The minimum qualifications for the electrical supervisor shall be a master electrician as defined by the statutes of the State of the work being performed. The supervisor or his appointed alternate possessing at least a master electrician license shall be on site whenever electrical work is being performed. The qualifications of the electrical supervisor shall be subject to approval of the Owner and the Engineer.

B. All master and journeyman electricians shall be licensed in accordance with the statutes of the State of the work being performed. No unlicensed electrical workers shall perform work on this project. Apprentice electricians in a ratio of not more than one apprentice per journeyman electrician will be allowed if the apprentices are licensed and actively participating in an apprentice-ship program recognized and approved by the statutes of the State of the work being performed.

1.8 PRIMARY SERVICE

A. The Contractor shall provide primary service trenching and conduit as indicated on the drawings per electric utility company standards. Contractor is responsible for coordinating conduit and trench requirements with the electric utility company.

1.9 SECONDARY SERVICE

A. New electrical work shall be as noted in the drawings. Services shall be 480Y/277 volt, three-phase, four-wire grounded as indicated. All secondary services are to be furnished and installed by the contractor.

B. The Contractor shall be responsible for coordinating all electrical work with the servicing utility prior to construction and providing all equipment, transformer pads, connectors, and accessories to make all final secondary connections.

C. The Contractor shall provide temporary service conductors and raceway system as may be required. The Contractor shall then provide and connect permanent service conductors and raceway system after the permanent installation. The Contractor shall coordinate temporary service, installation, metering and all other items as required with the servicing utility. The Contractor shall be responsible for paying all temporary electric monthly metering charges.

D. Service entrance electrical ducts shall be red blended concrete encased at a depth to provide 18 inches minimum cover over the top of the underground electrical duct, regardless of the soil conditions or substances encountered.

1.10 TELEPHONE WORK

A. The Contractor shall be responsible for coordinating all telephone work with the servicing utility, Owner and Engineer.

1.11 LOCKOUT / TAGOUT PROGRAM

A. The Contractor shall provide a complete copy of and electrical energy source Lockout/Tagout Program to the Owner, with copy to the Engineer. The document shall clearly identify the on-site master electricians and their contact information, including office and mobile telephone numbers.

B. The Lockout/Tagout Program shall comply with Part 1910 - Occupational Safety and Health Standards (OSHA) Subpart S – Electrical, and meet the requirements of 29 CFR 1910.147, The Control of Hazardous Energy (Lockout/Tagout), including requirements listed in 1910.331 through 1910.335.

C. Implementation of the Lockout/Tagout Program and all other related safety requirements are the sole responsibility of the Contractor.

1.12 SAFETY PROGRAM

A. The Contractor shall implement an electrical safety program that complies with NFPA 70E and 29 CFR 1926.

B. Implementation of the Electrical Safety Program, determining and providing proper Personal Protective Equipment (PPE), training and enforcing personnel to wear the prescribed PPE, conducting work area safety inspections (including correcting deficiencies), and all other related safety requirements are the sole responsibility of the Contractor.

1.13 EQUIPMENT CONNECTIONS

A. General: Provide connections for all equipment installed or modified by this contract, regardless of who furnished the equipment.

B. Provide all disconnect switches required by Code whether or not shown on the plans.

C. Contractor shall connect Owner-furnished equipment when specified.

1.14 GENERAL CONDITIONS

A. The work under this heading is subject to the General and Supplementary Conditions, special conditions for mechanical and electrical work, and the Contractor or subcontractor will be responsible for and be governed by all requirements thereunder as though specifically repeated herein.

1.15 COORDINATION

A. The Contractor shall coordinate arrangement, mounting and support of all electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at a required slope.
   4. So connecting raceways, cables and wireways will be clear of obstructions and of the working and access space of other equipment.

B. The Contractor shall coordinate electrical equipment to be mounted on vendor supplied walkways with supplier.

1.16 SPECIAL NOTE

A. The mechanical, structural and process plans and specifications, including the general conditions and all supplements issued thereto, information to bidders, and other pertinent documents issued by the Engineer, are a part of these specifications and the accompanying electrical plans, and shall be complied with in every respect. All the above is included herewith, and shall be examined by all bidders. Failure to comply shall not relieve the Contractor of responsibility or be used as a basis for additional compensation due to omission of mechanical, process and structural details from the electrical drawings.

1.17 CONTINUATION OF SERVICES

A. The Contractor shall install any temporary lines and connections required to maintain electric services and safely remove and dispose of them when complete. The Contractor shall supply emergency power whenever any existing electrical service is without power. In general, the existing facility shall remain operational during construction.

B. Planned outages shall be coordinated two weeks in advance with duration and time of start approved by the Owner. Changeover work which may be required after normal hours or weekends shall not constitute the basis for additional cost to the Owner. When an outage begins, the Contractor shall proceed directly to completion of the work without unscheduled interruptions or delays due to lack of manpower, equipment or tools.

C. The Contractor shall refer to the sequence of construction and shall provide temporary connections as may be required to complete each phase of construction as may be required. The Contractor shall submit proposed electrical service plans for each phase of construction to the Owner and Engineer for consideration.

1.18 LAYOUT

A. The Contractor shall coordinate and establish all bench marks and control lines. The Contractor shall lay out all work. The lay out shall be reviewed by the Engineer and Owner prior to starting any work.

1.19 RELATED WORK SPECIFIED ELSEWHERE

A. Mechanical Equipment: The Contractor shall rough-in for and make final electrical connections to all motor, panels, fixtures, and equipment furnished under other sections of the specifications, providing all material and equipment required for such final connections, except hereinbefore described. This includes, but is not limited to, control panels and other miscellaneous equipment.

B. The Contractor shall refer to other sections of these specifications for all information relating to the requirements of all electrical connections to the equipment and shall furnish and install electrical items required for a complete installation, ready for operation.

C. Roughing-in shall be accomplished from approved shop drawings.

D. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

E. Refer to equipment specifications in other Divisions for rough-in requirements.

1.20 LOCAL CONDITIONS

A. Inspection of Sites: The bidder shall inspect the site, thoroughly acquaint himself with conditions to be met and work to be accomplished. Failure to comply with this shall not constitute grounds for any additional payments.

1.21 RECORD DOCUMENTS

A. Refer to the General and Supplementary Conditions for requirements. The following paragraphs supplement the requirements of the General and Supplementary Conditions:
   1. Mark Drawings to indicate revisions to conduit size and location both exterior and interior; actual equipment locations, dimensioned for column lines; concealed equipment, dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; Change Orders; concealed control system devices.
   2. The Contractor shall locate all underground and concealed work, identifying all equipment, conduit, circuit numbers, motors, feeders, breakers, switches, and starters. The Contractor will certify accuracy by endorsement. Record drawings shall be correct in every detail, such that the Owner can properly operate, maintain, and repair exposed and concealed work.
   3. The Contractor shall store the Record drawings on the site. Drawings shall not be rolled. Make corrections, additions, etc., with pencil, with date and authorization of change.
   4. Mark specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

1.22 OPERATION AND MAINTENANCE DATA

A. Refer to Section 01 33 00 SUBMITTAL PROCEDURES and Section 01 78 23 OPERATION AND MAINTENANCE DATA for procedures and requirements for preparation and submittal of maintenance manuals.

B. In addition to the information required by Sections 01 33 00 and 01 78 23, include the following information:
   1. Installation manual: Description of function, installation and calibration manuals, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
   2. Operations manual: Manufacturer’s printed operating instructions and procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; summer and winter operating instructions; and all programming and equipment settings.
   3. Maintenance manual: Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
   4. Service manual: Servicing instructions and lubrication charts and schedules, including the names and telephone numbers of personnel to contact for both routine periodic and warranty service for equipment and materials provided under this Division.
   5. Final approved equipment shop drawings, clearly labeled.
   6. Final test reports, clearly labeled, including motor certification tests.
   7. Final certified calibration sheets for all equipment and instruments.

C. After approval of the O&M Manuals, the Contractor shall provide three (3) complete electronic copies of all documentation in Adobe PDF file format using a storage media device of the Owner and Engineer’s choosing.

1.23 GUARANTEE

A. The Contractor shall guarantee the work and materials for a period of one (1) year from the date of completion. If there are failures due to faulty material or workmanship, the Contractor shall correct the failure at no cost to the Owner.

B. Refer to the General and Supplementary Conditions for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.
   1. Compile and assemble the warranties specified in Division 26, into a separate set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

D. Upon completion of the installation, the Contractor shall adjust the systems to the satisfaction of the Engineer.

E. This guarantee shall include the capacity and integrated performance of the component parts of the various systems in accordance with the intent of the specifications. The Contractor shall conduct complete tests required by the Engineer to demonstrate the ability of the various systems.

1.24 CLEANING

A. Refer to Section 01 77 00 CLOSEOUT PROCEDURES for general requirements for final cleaning.

B. Clean all light fixtures, lamps and lenses prior to final acceptance. Replace all inoperative lamps.

C. The electrical system shall be thoroughly cleaned inside and outside, of all enclosures to remove all debris, dust, concrete splatter, plaster paint and lint.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. All materials and equipment used in carrying out these specifications shall be new and have UL listing, or listing by other recognized testing laboratory when such listings are available. Specifications and drawings indicate name, type, or catalog numbers of materials and equipment to be used as standards.

2.2 HEAT TRACING

A. Heat trace and insulate all exposed piping, water lines, and valves less than 8” diameter and all equipment where water may collect. Where exact sizes, panels, boxes, conduit, circuitry and other items of construction are shown or required for a complete installation, but are not adequately identified as to size or material requirements, the materials furnished shall be as needed to provide freeze protection requirements as though shown in detail on the Drawings. The Contractor shall be responsible for supplying all items as required for complete heat tracing systems regardless of the level of detail shown on the Drawings.

B. Contractor shall meet all National Electrical code requirements for heat tracing and particularly to Resistance Heating Elements Article 427-21, 22 and 23.

PART 3 - EXECUTION

3.1 SALVAGE

A. All salvage and equipment removed by the work shall remain the property of the Owner unless directed otherwise by the Owner. Material removed from the project shall be stored on the project site where and as directed. Debris shall be removed from the job site and disposed of by the Contractor.

3.2 DEMOLITION AND DISPOSAL

A. All conduit, wire, and other electrical appurtenances associated with equipment removed in this project, and no longer in use, shall be removed and stored or disposed of as directed by the Owner. The Contractor shall patch and apply finish to walls, floors, and other structures from which such items are removed to match surrounding colors, textures, or other visual characteristics.

3.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.

C. Equipment and materials shall be stored in accordance with the manufacturer's recommendations and instructions.

D. All equipment, including but not limited to equipment containing coils and/or electronics, shall be stored in a clean, dry, ventilated and heated building. The storage area shall be free from condensation or other injurious environmental conditions. Freedom from condensation shall be essential and shall be accomplished by the use of auxiliary heaters as required to raise the temperature to 5-degree C above the ambient temperature. The equipment shall be protected from excessive dust.

E. In addition, certain electronic equipment that requires cooling based upon its specific storage temperature range shall be stored in an air-conditioned building.

F. All motors shall be stored in a clean, dry, ventilated and heated building. The storage area shall be free from condensation or other injurious environmental conditions. Freedom from condensation shall be essential and shall be accomplished by the use of auxiliary heaters as required to raise the temperature to 5 degree C above the ambient temperature. The motors shall be protected from excessive dust.

G. Cables and wiring shall be kept in a dry location out of the sun.

H. Outdoor storage, even when protected by a tarpaulin, is unacceptable.

I. Equipment may be rejected if the storage criteria are not followed.

3.4 INSTALLATION

A. Coordinate electrical equipment and materials installation with other building components.

B. Verify all dimensions by field measurements.

C. Arrange for chases, slots, and openings in other building components to allow for electrical installations.

D. The Contractor shall keep ends of conduits, including those extending through roofs, equipment and fixtures covered or closed with caps or plugs to prevent foreign material from entering during construction.

E. Coordinate the installation of required supporting devices and sleeves to be set in concrete and other structural components as they are constructed.

F. Sequence, coordinate, and integrate installations of electrical materials and equipment for maintaining the required operation of the facility. Give particular attention to large equipment requiring positioning prior to closing-in the building.

G. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.

H. Where mounting heights are not detailed or dimensioned, install electrical services and overhead equipment to provide the maximum headroom possible.

I. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

J. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.

K. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

L. Coordinate installation of electrical equipment on vendor supplied walkways with supplier.

3.5 MATERIALS AND WORKMANSHIP

A. All materials shall be new, and shall be of the latest standard design of a manufacturer regularly engaged in the manufacture of that type of equipment. Materials shall be in good condition and shall be free from dents, scratches or other damage incurred in shipment or installation.

B. All equipment shall comply with the National Electrical Code, Underwriters Laboratories or other appropriate agency.

C. Installation shall be made in a neat and workmanlike manner, and all materials shall be installed in accordance with the recommendations of the various manufacturers. The installation shall be subject to the approval of the Owner and Engineer.

D. Incidental materials required to complete the installation as intended by these Specifications shall be of the type and quality in keeping with specified equipment.

3.6 COORDINATION

A. Carefully examine specification and drawings to be thoroughly familiar with items which require electrical connections and coordination. (Electrical drawings are diagrammatic and shall not be scaled for exact sizes.)

B. Notify other tradesmen of any deviations or special conditions necessary for the installation of work. Interference between work of various contractors shall be resolved prior to installation. Work installed not in compliance with specifications and drawings and without properly checking and coordinating as specified above shall, if necessary, be removed and properly reinstalled without additional cost to the Owner. Engineer to be mediating authority in all disputes arising on project.

C. Equipment shall be installed in accordance with manufacturer's recommendation. Where conflicts occur between contract documents and these recommendations, a ruling shall be requested of the Engineer for decision before proceeding with such work.

3.7 CUTTING AND PATCHING

A. Repair or replace routine damage caused by cutting in performance of work under this Division.

B. Correct unnecessary damage caused due to installation of electrical work, brought about through carelessness or lack of coordination.

C. Holes cut through floor slabs to be sleeved or core drilled with drill designed for this purpose. All openings, sleeves, and holes in slabs to be properly sealed, fire proofed and water proofed.

D. Repairs to be performed with materials which match existing materials and to be installed in accordance with appropriate sections of these specifications.

E. All cutting and patching work shall be coordinated in advance with the Engineer and Owner prior to any work.

3.8 TRENCHING, EXCAVATION, BACKFILLING, AND REPAIRS

A. Provide trenching, excavation, and backfilling necessary for performance of work under this Division.

3.9 FOUNDATIONS AND PADS

A. Foundations and pads required for equipment shall be provided as indicated. Proper size and location of foundations, pads and anchor bolts shall be determined under this Division.

B. Provide anchors and bases for electrical equipment to withstand lateral forces and accommodate displacements.

3.10 NOISE AND VIBRATION CONTROL

A. The electrical system as installed shall be free of objectionable noise or vibration. The Contractor shall isolate motors, starters, transformers, equipment, ballasts, etc., as directed or required as to ensure acceptable noise level free from objectionable vibration in all systems.

3.11 TESTS

A. On completion of work, installation shall be completely operational and entirely free from ground, short circuits, and open circuits. Perform a thorough operational test in presence of the Owner and Engineer. Furnish all labor, materials and instruments for above tests.

B. Furnish the Engineer, as part of closing file, a copy of such tests including identification of each circuit and readings recorded. Test information to be furnished to the Engineer includes ampere readings of all panels and major circuit breakers, isolation resistance reading of motors and transformers.

C. Prior to final observation and acceptance test, all electrical systems and equipment shall be in satisfactory operating condition. Including, but not limited to the following:
1. Electrical power and distribution system.
2. Lighting systems.
3. Transformers.
4. Electric motors for all equipment.
5. Telecommunication system.
6. Emergency power system.
7. Special electrical control systems.

D. After installation of the electrical system and before operating equipment, functional checking shall be conducted in accordance with the manufacturer's recommendations, with the contract drawings and as follows:
1. Functional checking shall include inspection, testing and repair, replacement or adjustments as necessary to ensure compliance with the requirements of the specifications. Tests and inspections shall be recorded on appropriate yellow lined contract and shop drawings, standard test forms and checklists to indicate that wiring and controls are in place in accordance with requirements and to form the basis of record drawings.
2. The functional test procedures shall be signed and dated by the Contractor and presented to the Owner's construction observation personnel prior to operating any equipment.
    a. Visual Inspection – The electrical system shall be examined as outlined below:
        1). Parts of components missing
        2). Improper assembly
        3). Parts or components not functioning properly
        4). Finish not as specified
        5). Materials not as specified
        6). Connections not tight
        7). Mounting and supports loose or unsatisfactory
        8). Nameplates missing or inaccurate
    b. Grounding System Tests
        1). Measure the resistance of the counterpoise grounding system by the rate-of-fall of potential method. Record all measurements on an approved standard test form made specifically for the purpose. The resistance of the grounding system to ground shall not exceed NFPA 70 requirements.
    c. Continuity Tests
        1). Each wire and each wire in each cable rated 300 volts and below shall be tested for continuity. Record wire number and pass or fail on checklist for each wire.
    d. Dielectric Tests
        1). Each power conductor rated 600 volts and above shall be tested (meggered) for dielectric strength to ground.
        2). Prior to testing, all components that could be damaged should be disconnected. After testing, the circuit shall still register a resistance value of not

less than 1 megohm at 600 volts, dc. This test shall apply between all insulated circuits and external metal parts. Record equipment name, phase or wire number and all observed values for each wire.

3). Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning of all circuits. Record equipment or circuit number and pass or fail on function test checklist for each circuit.

4). The Contractor shall develop non-conforming material reports for each failure. Repair and report failures all failures to Owner and Engineer.

5). The Contractor shall replace defective parts, correct malfunctioning units, make all repairs and retest to demonstrate compliance. The Contractor shall document all actions taken on appropriate non-conforming material report.

3.12 INSPECTION FEES AND PERMITS

A. Obtain and pay for all necessary permits and inspection fees required for electrical installation.

3.13 IDENTIFICATION OF EQUIPMENT

A. Properly identify all electrical equipment, including but not limited to the following:
1. Switchgear, switchboards, motor control centers, and control panels.
2. Main distribution panel and individual devices within it.
3. Panelboards and individual devices within it.
4. Safety switches and disconnects.
5. Contactors and lighting control center, including all branch circuits.
6. Individually mounted circuit breakers.
7. Relays.
8. Transformers.
9. Generators and automatic transfer switches.
10. Any other type of enclosure that includes electrical equipment.

3.14 TEMPORARY LIGHTS AND POWER

A. Provide a temporary electrical lighting and power distribution system of adequate size to properly serve temporary requirements. Temporary work to be installed in a neat and safe manner in accordance with the National Electrical Code, Article 590, and as required by OSHA or applicable local safety codes.

END OF SECTION

SECTION 26 05 14 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Receptacles with integral GFCI and associated device plates.
   2. Snap switches and wall-box dimmers.

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

1.3 SUBMITTALS

A. Product Data: for each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

C. Samples: One for each type of device and wall plate specified in each color specified.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as type are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers:
   1. Cooper wiring Devices; a division of Cooper Industries, Inc. (Cooper).
   2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20A: Comply with NEMA WD1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the work include, but are not limited to the following:
      a. Cooper; 5351 (single), 5352 (duplex).
      b. Hubbell; HBL5351 (single), CR5352 (duplex).
      c. Leviton; 5891 (single), 5352 (duplex).
      d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD1, NEMA WD6, UL498 and UL 943, Class A and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20A:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:
      a. Cooper; GF20.
      b. Pass & Seymour; 2084.

2.4 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the work include, but are not limited to the following:
      a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
      b. Hubbell; CSI221 (single pole), CSI222 (two pole), CSI223 (three way), CSI224 (four way).
      c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 12224-2 (four way).
      d. Pass & Seymour; 20ACI (single pole), 20AC2 (two pole); 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20A:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the work include, but are not limited to the following:
      a. Cooper; 2221PL for l20 V and 277V.
      b. Hubbell; HPL1221PL for 120 V and 277V.
      c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277V.
      d. Pass & Seymour; PS20ACI-PLR for 120 V.
   2. Description: Single pole, with neon-lighted handle, illuminated when switch is “OFF.”

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Stainless steel or unbreakable nylon in damp areas.
   2. Material: 0.035-inch-(1mm-) thick, satin-finished stainless steel.
   3. Provide in-use covers for all exterior installations and interior damp locations.

2.6 FINISHES

A. Color:
   1. Wiring Devices: As selected by Owner, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
   1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
   2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint and other material that may contaminate the raceway system, conductors and cables.
   3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
   4. Install wiring devices after all wall preparation, including painting is complete.

C. Conductors:
   1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
   2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
   3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
   4. Existing conductors:
      a. Cut back and pigtail or replace all damaged conductors.
      b. Straighten conductors that remain and remove corrosion and foreign matter.
      c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
   1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
   2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
   3. Do not remove surface protection such as plastic film and smudge covers until the last possible moment.
   4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
   5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
   6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
   7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
   8. Tighten unused terminal screws on the device.
   9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

3.2 IDENTIFICATION

A. Comply with Division 26 Section “Identification for Electrical Systems.”
1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:
1. Line voltage: Acceptable range is 105 to 132V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115g).

END OF SECTION

SECTION 26 05 15 - ELECTRIC MOTORS

PART 1 - GENERAL

1.1 SUMMARY

A. This section describes materials, installation and testing of induction motors and applies to motors which are generally provided as part of equipment specified in other sections. The Contractor shall provide motors, accessories, and appurtenances complete and operable in accordance with the individual driven equipment specifications.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Complete motor data shall be submitted, including:
1. Machine name and specification number of driven machine.
2. Motor manufacturer.
3. Motor type or model and dimensional drawing, including weight.
4. Horsepower nominal.
5. Guaranteed minimum full load efficiency. Also, nominal efficiencies at 1/2 and 3/4 load.
6. Full load speed.
7. Full load current at rated horsepower for application voltage.
8. Service factor, minimum 1.15.
9. Voltage, phase and frequency rating.
10. Winding insulation class.
11. Temperature rise class.
12. Frame size.
13. Enclosure.
14. NEMA design.
15. Thermal protection or over temperature protection.
16. Wiring diagram for devices such as temperature switches, space heaters and motor leak detection as applicable.
17. Bearing data, including recommendation of lubricants.
18. Inverter duty motor for all motors connected to variable frequency drive controllers. Include minimum speed at which motors may be operated.
19. Power factor at 1/2, 3/4 and full load.
20. Complete nameplate data, rating and characteristics.
21. Mounting arrangement, size and location of conduit entries, including lugs.
22. Factory test results for each motor.

1.3 QUALITY ASSURANCE

A. Provide routine (short commercial) test data complying with NEMA MG 1-12.51 and MG 1-23.46.

B. Test thermally protected motors in accordance with NEMA MG 1 winding temperature and trip current tests.

C. Comply with NEMA MG 1.

D. Motors for applications in hazardous locations shall bear the UL label listing its use in accordance with the NEC.

1.4 COORDINATION

A. Furnish reviewed shop drawings from motor controller manufacturer for coordination and sizing of the controller.

B. Coordinate supplied motor connection box with conduits sizes indicated in the drawings.

C. Coordinate motor leads and lugs with wire sizes indicated in the drawings.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Unless otherwise specified or specifically required by the manufacturer of the equipment to be driven, all motors shall be single speed, squirrel cage, a-c induction type motors. Electric motors shall be NEMA Design B constant speed squirrel cage induction motors having normal starting torque with low starting current except for motors controlled by variable speed operation and other special motors. In no case shall starting torque or breakdown torque be less than the value specified in ANSI/NEMA MG 1. In all cases, motors shall be suitable for the indicated starting method.

B. Stator winding shall be copper.

C. The maximum motor loading of each motor shall not exceed its nameplate horsepower rating (exclusive of service factor) under any operating condition.

D. Motors shall be sized to start and accelerate the design loading and operate the full range of driven equipment without exceeding any of the specified design requirements. Motors that fail to meet these requirements shall be replaced at no additional cost to the Owner.

E. All three phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C and at the altitudes where the motors will be installed and operated without exceeding Class B temperature rise limits stated in ANSI/NEMA MG1-12, 42. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class. Motors to be operated with variable frequency drives shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dt as defined in NEMA MG 1-31.

F. All motors shall have a minimum service factor of 1.15.

G. Motors for use in hazardous locations shall have enclosures suitable for the classification of the location. Such motors shall be UL listed and stamped.

H. Motors larger than 50 HP located outdoors or in non-conditioned areas shall have 120-volt AC space heaters and temperature sensors.

I. For motors controlled by variable frequency drives, the critical vibration speed of the motor/load combination shall either not fall within the operating range of the drive or such frequencies shall be blocked with the drive critical speed avoidance circuit. All motors connected to variable frequency drives shall be inverter duty rated.

J. Unless otherwise specified, motors shall have no-load sound power levels not to exceed the values specified in NEMA MG 1-12.53.3.

K. Premium Efficiency Motors:

1. Motors with a nameplate rating of 1 horsepower and larger shall be premium efficiency type motors as determined by the testing set forth in ANSI/IEEE 112 – Standard Test Procedure for Polyphase Induction Motors and Generators, Method B. Motors shall be stamped with the efficiency on the nameplate with the caption “NEMA Nominal Efficiency.”
2. Efficiency index, nominal efficiency and minimum efficiency shall be defined in accordance with ANSI/NEMA MG1-12.59 – Efficiency Levels of Energy Efficient Polyphase Squirrel-Cage Induction Motors. All three values are required to be indicated in the submittal.

2.2 MOTOR BEARINGS

A. All motors greater than 2 horsepower shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

B. Motors less than 2 horsepower shall be provided with sealed, permanently lubricated ball bearings.

C. Horizontal motors over 2 horsepower shall be shielded open-type bearing installed with labyrinth sealed end bells with pipe plugs. Bearings shall be regreasable and have provisions for purging old grease.

D. Vertical motors over 2 horsepower shall be provided with relubricatable ball, spherical, roller or plate type trust bearings. Lubrication shall be per manufacturer’s recommendation for smooth operation and long life of the bearing. Drains shall be provided to prevent over lubrication.

2.3 MOTOR THERMAL PROTECTION

A. All single phase motors shall have integral thermal overload protection or shall be current limited.

B. Winding thermostats shall be provided in accordance with NEMA MG-1. Thermostats shall be snap action, bi-metallic, temperature actuated type switches and shall be provided with a normally closed contact. Thermostats shall be precalibrated by the manufacturer and shall be series connected.

2.4 ACCESSORIES

A. All vertical motors and horizontal motors 3 horsepower and larger shall have split-type conduit boxes with a gasketed moisture seal between the conduit box and motor frame. Motors less than 3 horsepower shall have the manufacturer’s standard conduit boxes. Motors other than open drip-proof shall be gasketed.

B. All motors weighing 250 pounds or greater shall have suitable lifting eyes for installation and removal.

C. Motor grounding lugs shall be provided and shall be suitable for terminating ground wires.

D. All motors shall be fitted with permanent stainless steel nameplates indelibly stamped or engraved with NEMA Standard motor data.

E. Refer to equipment specifications for special requirements such as space heaters or motor winding thermal protection.

PART 3 - EXECUTION

3.1 STORAGE

A. Protect motors from exposure to elements for which they are not designed. Install and energize temporary electrical service to motors with electrical heaters.

B. Store motors in an air-conditioned, ventilated or protected environment similar to or better than the destination environment.

3.2 INSTALLATION

A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.

B. Connections, switches, controls, disconnects and other items shall be provided in accordance with the plans and specifications for each motor.

C. The Contractor shall coordinate conduit sizes indicated in the drawings with the supplied motor connection box. The Contractor shall be responsible for providing larger connection boxes as may be required.

3.3 FIELD TESTING

A. Perform insulation resistance tests in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of motor.

B. Inspect the physical and mechanical conditions of each motor installation including any deviations from the nameplate, drawings, specifications and manufacturer's written guidelines. Verify expected rated voltage, phase and frequency for each motor installation. Confirm the presence of and correct application of lubrications for each motor along with proper securing and torque settings for bolted installations of each motor.

C. Check for proper phase and ground connections for each motor are connected. For multi-voltage motors, verify that motors are connected properly for the supplied voltage.

D. Verify that space heaters, where provided, are functional.

E. Test the motor for proper rotation prior to connection to the driven equipment. Measure and record running current and evaluate the current relative to the load conditions and nameplate full-load amps.

F. Simulate operating conditions for each motor to demonstrate proper operation of interlocks and control features.

G. Record operating current in each phase for each motor ½ horsepower and larger. Motors exceeding motor nameplates values shall be repaired or replaced.

H. For motors 50 horsepower and larger or when a discernible abnormal vibration is detectible, a vibration test shall be completed. Vibration shall not exceed 0.25 in./sec. For horizontal motors, the N-S and E-W vibrations shall be measured at the top and bottom of the front and rear bearing housing. For vertical motors, the N-S and E-W vibrations shall be measured at the upper and lower bearing housing.

I. All testing shall be witnessed by the Engineer and Owner.

1. Motor and Motor Protection Tests for motors – In addition to other testing start and stop each motor a minimum of 3 times and perform a run test for vibration, heat, and to document motor protection. The Contractor shall document the settings of the motor overcurrent protection, overload relay and similar data on the provided form – MOTOR TEST REPORT.
2. The Contractor shall develop non-conforming material reports for each failure and repair or report failures.
3. The Contractor shall replace defective parts, correct malfunctioning units, make all repairs and retest to demonstrate compliance. The Contractor shall document action taken on appropriate non-conforming material report.

3.4 MOTOR TEST REPORT

A. The following form is provided for the motor certification specified herein. Master blank forms are available on request.

END OF SECTION

MOTOR TEST REPORT

Each electric motor shall be tested for proper operation. Follow manufacturer's testing recommendations and procedures.

1. Name and Horsepower of Motor Tested:_____

2. Overcurrent Protection:_____

3. Overload Protection: _____

4. Visual Inspection Checklist:

   - ❑ Momentarily Bump Motor Shaft for Proper Rotation
   - ❑ Motor Frame Bolts
   - ❑ Shaft Coupling
   - ❑ Lubricants
   - ❑ Other Comments:

5. Megger motor from wire in motor control center or control panel and record results:

   ϕA-ϕB_____ ϕB-ϕC_____ ϕC-ϕA_____

   ϕA-G_____ ϕB-G_____ ϕC-G_____

6. Record full load voltage and current:

   Vab_____ Van_____ Ia_____

   Vbc_____ Vbn_____ Ib_____

   Vca_____ Vcn_____ Ic_____

7. Motor Nameplate FLA:_____

   Running Amps:_____

   P.F. _____

8. Comments:

Signature Required: _____

Company: _____

Date: _____

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.
   3. Sleeves and sleeve seals for cables.

B. Related Sections include the following:
   1. Division 26 sections

1.2 DEFINITIONS

A. EPDM: Ethylene-propylene-diene monomer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

A. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association (NETA) or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70. No aluminum on project.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW and RHH-RHW-USE.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper, stranded.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type RHH-RHW-USE single conductors in raceway.

B. Exposed Feeders: Type RHH-RHW-USE, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type RHH-RHW-USE, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type RHH-RHW-USE single conductors in raceway.

E. Feeders in Cable Tray: Type RHH-RHW-USE, single conductors in raceway for larger than 4/0 AWG; Otherwise Type TC tray cable.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW, single conductors in raceway.

I. Variable Frequency Drive Branch Circuits: Shielded cable, size adjusted for published ampacity of cable.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. Class 1 Control Circuits: Type THHN-THWN, in raceway.

L. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

D. Cable splicing, in general, will not be allowed. Where applicable, all wiring connections to be made using terminal block type connections. Wire nut use will permitted only where allowed by the Owner and Engineer.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Megger Test of individual conductors to ground after installation.
   2. Visual observation of conductor at accessible locations.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test the following for compliance with requirements.
    a. All panel feeders.
    b. All motor feeders.
    c. All control wires for continuity.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.
   1. Underground distribution grounding.
   2. Common ground bonding with lightning protection system.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 “Field Quality Control” Article, including the following:
   1. Test wells.
   2. Ground rods.
   3. Ground rings.
   4. Grounding arrangements and connections for separately derived systems.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For grounding to include the following in emergency, operation and maintenance manuals.
   1. Instructions for periodic testing and inspection of grounding features at test wells ground rings grounding connections for separately derived systems based on ANSI/NETA MTS.
      a. Test shall be to determine if ground resistance or impedance values remain within specified maximums and instructions shall recommend corrective action if they do not.
      b. Include recommended testing intervals.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare copper Conductors:
   1. Solid Conductors: ASTM B3
   2. Stranded Conductors: ASTM B8.
   3. Tinned Conductors: ASTM B 33.
   4. Bonding Conductor: No. 4 AWG, stranded conductor or per NFPA 70.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
   1. Pipe connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 4/0 AWG minimum.
   1. Bury at least 30 inches below grade.

C. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Bolted connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with ANSI/IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole and Handhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Equipment: Install four ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with utility transformers by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment and components.

E. Metal Poles Supporting Outdoor Lighting fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact or damage.

B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.

C. Ground rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section “Underground Ducts and Raceways for Electrical Systems,” and shall be at least 12 inches deep, with cover.

1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit from building's main service equipment, or grounding bus, to main metal water service entrance to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column and indicated item, extending around the perimeter of building.
   1. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
   2. Bury ground ring not less than 24 inches from building foundation at a depth not less than 30 inches below finished grade.

J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
   1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
   2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at ground test wells. Make tests at ground rods before any conductors are connected.
    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.
3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole and Handhole Grounds: 10 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.2 DEFINITIONS

A. RMC: Rigid metal conduit.

B. NECA: National Electrical Contractors Association.

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Equipment supports.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of cooper Industries.
      c. ERICO International Corporation

d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101. NECA publications are available at www.NECAnet.org.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size and shape of conductor gripping pieces as required to suit individual conductors or cables supported.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes and bars.

F. Mounting, Anchoring and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded 304 stainless steel stud, for use in hardened Portland cement concrete, steel or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
1). Hilti Inc.
2). ITW Ramset/Red Head; a division of Illinois tool works, Inc.
3). MKT Fastening, LLC
4). Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete with tension, shear and pullout capacities appropriate for supported loads and building materials in which used.
a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
1). Cooper B-Line, Inc.; a division of Cooper Industries
2). Empire Tool and Manufacturing Co., Inc.
3). Hilti Inc.
4). ITW Ramset/Red head; a division of Illinois tool works, Inc.
5). MKT Fastening, LLC.
3. Concrete Inserts: Stainless steel, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F 3125.
6. Toggle bolts: All-steel springhead type.
7. Hanger Rods: Threaded 304 stainless steel.
8. Nuts: Match threaded rod or bolt; double nut vertical hanger rods.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES.

A. Description: bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Outdoor locations: Supporting material shall be stainless steel or PVC-Coated galvanized steel or as described within the Drawings.

C. Indoor locations: Supporting materials shall be galvanized in dry areas and stainless steel or PVC-Coated galvanized steel in damp areas, or as described within the Drawings.

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for RMC as required by NFPA 70. Minimum rod size shall be ¼ inch in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lbs.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
   6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
   7. To Light Steel: Stainless steel sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit and place miscellaneous metal supports accurately in location, alignment and elevation to support and anchor electrical materials and equipment.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000 psi, 28-day compressive-strength concrete.

C. Anchor equipment to concrete base.
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:
   1. Division 26 Section “Underground Ducts and Raceways for Electrical Systems” for exterior ductbanks, manholes, and underground utility construction.
   2. Division 26 Section “PVC Coated Conduit.”

1.2 DEFINITIONS

A. LFMC: Liquidtight flexible metal conduit.

B. LFNC: Liquidtight flexible nonmetallic conduit.

C. GRS: Galvanized Rigid Steel Conduit.

D. RNC: Rigid nonmetallic conduit.

E. EMT: Electrical Metallic Tubing.

1.3 SUBMITTALS

A. Product Data: for surface raceways, wireways and fittings, hinged-cover enclosures and cabinets.

B. Custom enclosures and cabinets.

C. Source quality-control test reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. AFC Cable Systems, Inc.
   2. Alflex Inc.
   3. Allied Tube & Conduit; a Tyco International Ltd. Co.
   4. Anamet Electrical, Inc.; Anaconda Metal Hose.
   5. Electri-Flex Co.
   6. Manhattan/CDT/Cole-Flex.
   7. Maverick Tube Corporation.

8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. PVC-Coated Steel Conduit: PVC-coated.
1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.
3. Comply with ETL Verified PVC-001.

D. Joint Compound for Rigid Steel Conduit: Listed for use in cable connector assemblies and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company
12. Thomas & Betts Corporation.

B. RNC: NEMA TC2, Type EPC-40-PVC, unless otherwise indicated.

C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell company.
8. Scott Fetzer Co.; Adalet Division.
9. Spring City Electrical Manufacturing Company.
10. Stahlin Non-Metallic Enclosures.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The)
13. Woodhead, Daniel Company; Woodhead Industries, Inc. subsidiary.

B. Sheet Metal Outlet and Device boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction boxes: NEMA OS 1.

E. Cast-Metal Access, Pull and Junction boxes: NEMA FB 1.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch for conditioned spaces only, unless otherwise indicated.

G. Hinged-Cover Enclosures: NEMA 250, Type 4 Stainless steel, with continuous-hinge cover with latches for outdoor, process buildings, above and below grade structures and damp locations, unless otherwise indicated.

2.4 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A, 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated “wall pipe,” equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052-or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with Engineer.

2.5 SLEEVE SEALS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Advance Products & systems, Inc.
   2. Calpico, Inc.
   3. Metraflex Co.
   4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
   1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   2. Pressure Plates: Stainless steel. Include two for each sealing element.
   3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: apply raceway products as specified below, unless otherwise indicated:
   1. Exposed: PVC-Coated Rigid Steel
   2. Concealed: PVC-Coated Rigid Steel.
   3. Underground: RNC, Schedule 40 in concrete encasement.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

B. Indoors:
   1. Exposed: Galvanized Rigid Steel or as noted in the Drawings.

2. Concealed: Galvanized Rigid Steel or as noted in the Drawings.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic. Pneumatic, Electric Solenoid or Motor-Driven Equipment): LFMC.
4. Damp or Wet Locations: PVC-coated Rigid Steel or as noted in the Drawings.

C. Minimum Raceway Size: ¾-inch trade size; 1-inch trade size for below grade installation.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section “Hangers and Supports for Electrical Systems.”

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of four 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Raceways Embedded in Slabs:
1. Run conduit larger than 1 inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Do not install conduits in such a manner as to compromise the structural integrity of walls, roofs, ceilings or floor. Where necessary, provide additional supporting members to support conduit runs. Below grade conduits 1 1/2” and larger shall be routed 24” below the concrete floor slabs.
4. Comply with Chapter 6 of ACI 318.
5. Change from nonmetallic conduit to Galvanized Rigid Steel or PVC-Coated Rigid Steel Conduit before rising above the floor.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer’s written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

K. Install raceway sealing fittings at suitable, approved and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

L. Expansion-Joint Fittings: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg. F, and that has straight-run length that exceeds 25 feet.
   1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
      c. Indoor Spaces: connected with the Outdoors without Physical Separation: 125 deg F temperature change.
      d. Attics: 135 deg F temperature change.
   2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
   3. Install each expansion-joint fitting with position, mounting and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

M. Flexible conduit connections: Use maximum of 36 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement, and for transformers and motors.
   1. Use LFMC in damp or wet locations subject to severe physical damage.
   2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

N. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application Engineer.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Size pipe sleeves to provide ¼-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

G. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.

I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with fire-stop materials.

J. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground, Exterior-Wall Penetrations: Install cast-iron “wall pipes” for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.4 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.6 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 05 33.13 - PVC COATED CONDUIT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes PVC-coated raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:
1. Division 26 Section “Raceway and Boxes for Electrical Systems”.

1.2 SUBMITTALS

A. Product Data: for surface raceways, wireways and fittings, hinged-cover enclosures and cabinets.

B. Custom enclosures and cabinets.

C. Source quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. All the conduit, fittings, and supporting products shall be provided by the same manufacturer to ensure that a five-year product warrantee is achieved.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
1. Perma-Cote
2. Plasti-Bond
3. KorKap

2.2 MATERIALS

A. PVC-coated, Galvanized Rigid Conduit (GRC) and fittings shall meet all the performance standards specified herein and such performance standards shall require verification by a nationally recognized testing agency including American Society for Testing and Materials (ASTM) and Underwriter Laboratories (UL).

B. The PVC coated galvanized rigid conduit shall be UL Listed. The PVC coating shall have been investigated by UL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations shall be UL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating shall be UL listed. All conduits and fittings must be new, unused material. Applicable UL standards shall include: UL

6 Standard for Safety, Rigid Metal Conduit, UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.

C. The PVC coated galvanized rigid conduit shall be Electrical Testing Laboratory (ETL) Verified to the Intertek ETL SEMKO High Temperature H_2O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit shall bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.

D. The conduit shall be hot dip galvanized inside and out with hot galvanized threads.

E. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.

F. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.

G. Form 8 Condulets, 1/2" through 2" diameters, shall have a v-seal tongue-in-groove gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 in. of mercury (vacuum) for 72 hours shall be available. Form 8 Condulets shall be supplied with plastic encapsulated stainless steel cover screws.

H. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.

I. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F (-1°C).

J. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.

K. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.

L. Independent certified test results shall be available to confirm coating adhesion under the following conditions:
   1. Conduit and condulet exposure to 150°F (65°C) and 95% relative humidity with a minimum mean time to failure of 30 days (ASTM D1151).
   2. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
   3. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating which has been wetted with acetone (ASTM D1308).
   4. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.

M. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. All U bolts will be supplied with plastic encapsulated nuts that cover the exposed portions of the threads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All clamping, cutting, threading, bending, and assembly instructions listed in the manufacturer's installation guide should be vigorously followed.

B. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer's Installation Manual. To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit.

C. Installer certification, before installation, is required.

D. Clamps, bolts, angles, pipe straps, struts, rods, nuts and other supporting products for PVC-coated conduits shall be PVC-coated or stainless steel.

E. The Contractor shall use equipment specifically designed for PVC-coated conduit when cutting, clamping, reaming, threading, bending, assembling or performing other installation procedures. PVC-coating shall be protected.

F. Touch-up compound for PVC-coated conduit shall not be allowed. All conduits with damaged coatings shall be removed and replaced at no cost to owner.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Identification for conductors and communication and control cable.
   2. Warning labels and signs.
   3. Instruction signs.
   4. Equipment identification labels.
   5. Miscellaneous identification products.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with NFPA 70E

D. Comply with 29 CFR 1910.145.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION – AND CONTROL-CABLE IDENTIFICATION MATERIALS.

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABEL AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145 and NFPA 70E.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door or other access to equipment unless otherwise indicated.

C. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend and size required for application. ¼ inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

D. Sample warning label and sign shall include, but are not limited to the following legends:
   1. Multiple Power source Warning: “DANGER – ELECTRICAL SHOCK HAZARD – EQUIPMENT HAS MULTIPLE POWER SOURCES.”
   2. Workspace Clearance Warning: “WARNING - OSHA REGULATION – AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES.”
   3. WARNING – ARC FLASH AND SHOCK HAZARD –APPROPRIATE PPE REQUIRED.

2.3 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sized.
   1. Engraved legend with black letters on white face.
   2. Punched or drilled for mechanical fasteners.
   3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.4 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark gray background. Minimum letter height shall be 3/8 inch.

B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS.

A. Cable ties: fungus-inert, self-extinguishing, 1-piece, self-locking, type 6/6 nylon cable ties.
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength: 50 lb minimum.
   3. Temperature Range: Minus 40 to plus 185 degrees F.
   4. Color: Black, except where used for color-coding.

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Outlet Boxes for Receptacles: Identify branch circuit by panel name and circuit number.

B. Power-Circuit Conductor Identification: of secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.

D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
   1. Identify conductors, cables and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker type designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

E. Warning Labels for Indoor Cabinets, Boxes and Enclosures for Power and Lighting: comply with 29 CFR 1910.145 and apply metal-backed, butyrate warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover or other access.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to the following:
      a. Power transfer switches
      b. Controls with external control power connections.
   2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

F. Instruction Signs:
   1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
   2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8 inch high letters for emergency instructions at equipment used for power transfer.

G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with ½-inch high letters on 1-1/2-inch high label; where 2 lines of text are required, use labels 2 inches high.
      b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   2. Equipment to Be Labeled:
      a. Panelboards, electrical cabinets and enclosures.
      b. Access doors and panels for concealed electrical items.
      c. Electrical switchgear and switchboards.
      d. Transformers.
      e. Motor-control centers.
      f. Disconnect switches.

g. Enclosed circuit breakers.
h. Motor starters.
i. Push-bottom stations.
j. Power transfer equipment.
k. Contactors.
l. Remote-controlled switches and control devices.
m. Power-generating units.
n. Voice and data cable terminal equipment.
o. Terminals, racks and patch panels for voice and data communications and for signal and control functions.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder and branch-circuit conductors.
1. Color shall be factory applied or, for sized larger than No. 6 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 480/277-V Circuits:
   a. Phase A: Brown
   b. Phase B: Orange
   c. Phase C: Yellow
3. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Distribution and lighting and appliance panelboards.

1.2 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers:
   1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:
   1. NEMA PB 1 - Panelboards.
   2. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

D. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

E. UL:
   1. UL 50 - Cabinets and Boxes
   2. UL 67 - Safety for Panelboards.
   3. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
   4. UL 1449 - Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker, and fusible switch arrangement and sizes.
   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Include evidence of NRTL listing for series rating of installed devices.
   6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

D. Source Quality control submittals: Indicate results of tests and inspections.

E. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.

F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals.
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

B. Operation and Maintenance Data: Submit spare parts listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:
1. Furnish two of each panelboard key. Panelboards keyed alike to Owner's current keying system.

1.6 QUALITY ASSURANCE

A. Qualifications
1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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 NEMA PB 1.

F. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.8 PROJECT CONDITIONS

A. Environmental Limitations:
   1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: 0 deg F to 122 deg F.

1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 PANELBOARDS

A. Description: NEMA PB 1, panelboards with bolt-on type circuit breakers.

B. Manufacturers:
   1. Eaton
   2. Schneider Electric – Square D
   3. ABB
   4. Siemens

C. Enclosures:
   1. Surface mounted unless shown as recessed on contract drawings.
   2. Rated for the environmental conditions at the installed location:
      a. Interior Dedicated Locations (Electrical Rooms): Type 1
      b. Interior Dry Locations (Non-Dedicated Spaces subject to Dust, Dirt only): Type 12.
      c. Interior Wet Locations (Wash-Down or Corrosive): Type 4X
      d. Exterior Locations: Type 4X.
   3. Finish: Manufacturer's standard gray enamel

D. Panelboard Bus: Copper, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard. Full-size neutral bus shall be included for panelboards shown with neutral.

E. Interrupting Ratings:
   1. Panelboards shall be fully rated – series rated panelboards are not acceptable.
   2. For Lighting and Appliance Panelboards rated 240VAC and less, provide interrupting rating as indicated on contract drawings, but not less than 10kAIC.
   3. For Distribution Panelboards rated 480VAC, provide interrupting rating as indicated on contract drawings, but not less than 14kAIC.

F. Mechanical style lugs, suitable for quantity, size, and material of specified conductors.

G. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

H. Future Devices:
   1. For 480VAC distribution panels, provide a minimum of 6 unused circuit spaces for future use, in addition to any breakers indicated on the contract drawings as spares.
   2. Provide mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

I. For lighting and appliance panelboards rated 240VAC and less, fill unused circuit spaces with spare 20A single pole breakers.

J. Doors: Secured with latch with tumbler lock; keyed alike.

K. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

2.2 MOLDED CASE CIRCUIT BREAKERS

A. Description: UL 489, molded-case circuit breaker: Standard frame sizes, trip ratings and number of poles.
   1. Lugs: Mechanical Compression style, suitable for number, size, trip ratings and material of conductors.
   2. Application Listing: Appropriate for application: Type SWD for switching fluorescent lighting loads; type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Interrupting capacity to match the rating of the panelboard assembly.

B. Thermal Magnetic Trip Circuit Breaker: Circuits breakers indicated on drawings as “TM”, or 250 amperes and smaller not designated with adjustable electronic trip features, shall be thermal magnetic type with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Thermal magnetic breakers larger than 150 ampere frame size shall have changeable trip units with adjustable magnetic trip settings.

C. Solid State Electronic Trip Circuit Breaker: Circuit breakers indicated on drawings with long-time (L), short-time (S), instantaneous (I), or ground fault (G) trip features, or any circuit breaker larger than 250 ampere frame size, shall be electronic trip type with the features identified on drawings. If no trip features are identified on the drawings, provide LSI as standard for electronic trip breakers less than 800 ampere frame size, and provide LSIG for breakers 800 amperes and larger.

D. Arc Reduction Maintenance Mode: Provide arc reduction maintenance mode (ARMS) feature for all circuit breakers rated 1200 amperes and larger, or where indicated on drawings.

E. GFCI Circuit Breakers: Class A ground-fault protection (6-mA trip).

F. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

2.3 SURGE PROTECTION DEVICES

A. Include surge protective devices factory-installed integral to each panelboard, whether or not indicated on the contract drawings, meeting the following requirements:
   1. Comply with UL 1449, Type 2.

2. Connect through a panelboard circuit breaker for disconnection.
3. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 160 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
4. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:
    a. Line to Neutral: 1200 V.
    b. Line to Ground: 1200 V.
    c. Line to Line: 2000 V.
5. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
    a. Line to Neutral: 700 V.
    b. Line to Ground: 700 V.
    c. Line to Line: 1200 V.
6. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
    a. Line to Neutral: 700 V.
    b. Line to Ground: 700 V.
    c. Line to Line: 1200 V.
7. SCCR: Equal or exceed the short circuit current rating of the panelboard.
8. Nominal Rating: 20kA.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards according to NEMA PB 1.1.

B. Install panelboards plumb.

C. Install recessed panelboards flush with wall finishes.

D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Install filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads. Identify each circuit as to its clear, evident and specific purpose of use.

G. Install engraved plastic nameplates according to Section 26 05 53.

H. For recessed panelboards, Install spare conduits to accessible location above ceiling or below floor, as applicable. Minimum spare conduits: five empty 1 inch. Identify each as spare.

I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels according to NFPA 70.

3.3 FIELD QUALITY CONTROL

A. Inspect and test according to NETA ATS.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Perform the following infrared scan tests and inspections and prepare reports:
   1. After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
   2. Instruments and Equipment:
      a. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 ADJUSTING

A. Load Balancing: Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

B. Set field-adjustable circuit-breaker trip ranges as indicated by Power System Study, or as recommended by manufacturer.

END OF SECTION

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fuses.

1.2 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
   1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
      a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
      b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
   2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
   1. Ambient temperature adjustment information.
   2. Current-limitation curves for fuses with current-limiting characteristics

D. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

C. 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.

D. Comply with NEMA FU 1 for cartridge fuses.

E. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Cooper Bussmann; Eaton.
   2. Edison Fuse, Inc.
   3. Ferraz Shawmut, Inc.
   4. Littelfuse Inc.

2.2 DESIGN REQUIREMENTS

A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for the following components: wire, cable, bus structures, and other equipment. Design system to maintain component damage within acceptable levels during faults.

B. Select fuses to coordinate with time current characteristics of other overcurrent protective elements, including other fuses, circuit breakers, and protective relays. Design system to maintain operation of device closest to fault operates.

2.3 FUSES

A. Dimensions and Performance: NEMA FU 1, Class as specified or as indicated on Drawings.
   1. Feeders: Class RK1, RK5, or L, fast acting
   2. Motor Branch Circuits: Class RK1 or RK5, time delay
   3. Control Circuits: Class CC fast acting.

B. Voltage: Rating suitable for circuit phase-to-phase voltage.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fuse with label oriented so manufacturer, type, and size are easily read.

B. Install labels complying with requirements for identification specified in Section 26 05 53, “Identification for Electrical Systems” and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers (MCCBs).
   4. Molded-case switches.
   5. Enclosures.

1.2 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories and finishes.
   1. Enclosure types and details for all types indicated, including NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Include evidence of Nationally Recognized Testing Laboratory listing for series rating of installed devices.
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: for power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Field quality-control reports.
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category from single manufacturer.

B. 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.

C. Comply with NFPA 70.

1.4 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
   1. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   4. Lugs: Mechanical type, suitable for number, size and conductor material.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Features and Accessories:
   1. Standard frame sizes, trip ratings and number of poles.

2.4 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
   1. Square D; a brand of Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:
   1. Standard frame sizes and number of poles.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

   1. Indoor Clean and Dry Locations: NEMA 1
   2. Outdoors: NEMA 4X Stainless Steel
   3. Indoor Wet or Corrosive Locations: NEMA 4X Stainless Steel

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Installation height of disconnect devices shall be in conformance with NFPA 70, Article 240.24.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts form enclosures and components.

D. Furnish and install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section “Identification for Electrical Systems.”
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION

SECTION 26 29 13.13 - ACROSS-THE-LINE MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes full-voltage manual and magnetic motor controllers in individual enclosures.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   4. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
   5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:
   1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. Underwriters Laboratories Inc.:
   1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Shop Drawings: for each enclosed controller: Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
   1. Show tabulations of the following:
      a. Each installed unit’s type and details.
      b. Factory-installed devices.
      c. Nameplate legends.
      d. Short-circuit current rating of integrated unit.
      e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
      f. Features, performance, electrical characteristics, ratings, enclosure types and finishes, and factory settings of individual OCPDs in combination controllers.
   2. Wiring Diagrams: For power, signal, and control wiring.

D. Field quality-control reports.

E. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation and maintenance manuals, including the following:
   1. Routing maintenance requirements for enclosed controllers and installed components.
   2. Manufacturer’s written instructions for testing and adjusting circuit breaker trip settings.
   3. Manufacturer’s written instructions for setting field-adjustable overload relays.

F. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

G. Load-Current and List 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.

H. Test Reports: Indicate field test and inspection procedures and test results.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by UL and marked for intended location and application.

B. Comply with NFPA 70.

C. Use of IEC rated components is prohibited.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years' documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating.

1.7 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:
   1. Eaton.
   2. Schneider Electric; Square D.
   3. Allen-Bradley.
   4. Siemens.
   5. ABB.

2.2 Enclosures

A. NEMA enclosure type to meet environmental conditions at the installed location.
   1. Interior Dedicated Locations (Electrical Rooms): Type 1
   2. Interior Dry Locations (Non-Dedicated Spaces subject to Dust, Dirt only): Type 12.

3. Interior Wet Locations (Wash-Down or Corrosive): Type 4X
4. Exterior Locations: Type 4X.
5. Hazardous Locations: Type 7/8 Explosion Proof

2.3 MANUAL MOTOR CONTROLLER

A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, red pilot light, NO and NC auxiliary contact, and push button and toggle operator.

B. Enclosure: NEMA ICS 6, See Enclosures section for type to meet conditions of installation.

2.4 FRACTIONAL-HORSEPOWER MANUAL CONTROLLER

A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, with red and green pilot light, and key toggle operator.

B. Enclosure: NEMA ICS 6, See Enclosures section for type to meet conditions of installation.

2.5 MOTOR STARTING SWITCH

A. Product Description: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with red and green pilot light and key toggle operator.

B. Enclosure: NEMA ICS 6, See Enclosures section for type to meet conditions of installation.

2.6 FULL-VOLTAGE NON-REVERSING CONTROLLERS

A. Product Description: NEMA ICS 2, AC general-purpose Class A solid-state controller for induction motors rated in horsepower.

B. Control Voltage: 120 volts, 60 Hertz.

C. Overload Relay: NEMA ICS 2;. Solid state type, electronic design with a 5:1 adjustment range, current based measurement protection, thermal memory, integrated I/O points, and enhanced phase loss protection.

D. Product Features:
1. Auxiliary Contacts: NEMA ICS 2, 2 each normally open and closed, field convertible contacts, in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oiltight type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
4. Pushbuttons: Unguarded type.
5. Indicating Lights: LED type.
6. Selector Switches: Rotary type.
7. Relays: NEMA ICS 5.
8. Control Power Transformers: 120 volt secondary, 500 VA minimum, in each motor starter. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

E. Controllers shall include control features as indicated on the contract documents, which may include but is not limited to the following:
1. Motor control selector switch
2. Remote start input

3. Stop pushbutton (normally closed)
4. Start pushbutton (normally open)
5. Running indicator light
6. Overload reset pushbutton
7. Dry status contacts for motor running and overload
8. Other indication and control devices as indicated on the contract drawings

F. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to UL 489, with integral thermal and instantaneous magnetic trip in each pole.

G. Enclosure: NEMA ICS 6, See Enclosures section for type to meet conditions of installation. Fabricate enclosure from steel finished with manufacturer's standard gray.

2.7 ACCESSORIES

A. Elapsed Time Meters: Heavy duty with digital readout in hours.

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.

2.8 FULL-VOLTAGE REVERSING CONTROLLERS

A. Product Description: NEMA ICS 2, AC general-purpose Class A solid-state controller for induction motors rated in horsepower. Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.

B. Control Voltage: 120 volts, 60 Hertz.

C. Overload Relay: NEMA ICS 2;. Solid state type, electronic design with a 5:1 adjustment range, current based measurement protection, thermal memory, integrated I/O points, and enhanced phase loss protection.

D. Product Features:
1. Auxiliary Contacts: NEMA ICS 2, 2 each normally open and closed, field convertible contacts, in addition to seal-in contact.
2. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty oil-tight type.
3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
4. Pushbuttons: Unguarded type.
5. Indicating Lights: , LED type.
6. Selector Switches: Rotary type.
7. Relays: NEMA ICS 5.
8. Control Power Transformers: 120 volt secondary, 500 VA minimum, in each motor starter. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.

E. Controllers shall include control features as indicated on the contract documents, which may include but is not limited to the following:
1. Motor control selector switch
2. Remote start input
3. Stop pushbutton (normally closed)
4. Start pushbutton (normally open)
5. Running indicator light

6. Overload reset pushbutton
7. Dry status contacts for motor running and overload
8. Other indication and control devices as indicated on the contract drawings

F. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to UL 489, with integral thermal and instantaneous magnetic trip in each pole.

G. Enclosure: NEMA ICS 6, see Enclosures section for type to meet conditions of installation. Fabricate enclosure from steel finished with manufacturer's standard gray.

H. Elapsed Time Meters: Heavy duty with digital readout in hours.

I. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

J. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install enclosed controllers plumb.

B. Height: 5 feet to operating handle.

C. Select and install overload elements in motor controllers to match installed motor characteristics.

D. Install engraved plastic nameplates. Refer to Section 26 05 53 for product requirements and location.

E. Neatly type label and place inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS.

B. Acceptance Testing Preparation:
1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components and equipment.
   2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder and control circuits.
   3. Test continuity of each circuit.
   4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer before starting the motor(s).
   5. Test each motor for proper phase rotation.
   6. Perform each electrical test and visual and mechanical inspection stated in National Electrical Testing Association Acceptance Testing Specification. Certify compliance with test parameters.
   7. Correct malfunctioning units on-site, where possible and retest to demonstrate compliance; otherwise, replace with new units and retest.
   8. Test and adjust controls, remote monitoring and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.4 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

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 ampere ratings 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.

3.5 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

END OF SECTION

DIVISION 33

UTILITIES

SECTION 33 01 30.71 – PIPE CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Defining machinery used, responsibilities, and results of pipeline cleaning.
   2. The Contractor is to remove foreign materials including, but NOT limited to, grease, debris, mud, rock, sand, and other materials that would block accurate inspection of the line or of installation of pipeline rehabilitation materials.
   3. High-velocity hydraulic cleaning equipment or mechanically powered equipment may be used to remove the foreign material from the pipeline.

1.2 SUBMITTALS

A. Submit documentation that equipment planned for use on the project conforms to the requirements listed.

1.3 PROJECT/SITE CONDITIONS

A. Verify site conditions prior to start of work. Starting work constitutes acceptance of existing conditions.

1.4 PRECAUTIONS

A. During pipeline cleaning operations, satisfactory precautions shall be taken in the use of cleaning equipment. When using hydraulically propelled cleaning tools (that depend upon water pressure to provide their cleaning force), the Contractor shall take necessary precautions to ensure that damage or flooding of does NOT occur.

B. The Contractor shall be responsible for any damage caused by his actions during this project.

1.5 CONTRACTOR RESPONSIBILITIES

A. The Contractor shall be responsible for any damage to property resulting from his work and shall repair to a condition equivalent to or better than that existing prior to this work or otherwise make whole such damage at no cost to Owner subject to the Engineer’s approval.

B. The Contractor shall be solely responsible for safety during the performance of all Work.

C. The Contractor shall review all available information pertinent to the site of the project including drawings, construction specifications, pipeline system records, etc., as provided by Owner.

D. The Contractor shall obtain all fresh water necessary for performance of work under the contract from suitable designated sources approved by the Owner. All costs associated with obtaining fresh water for performance of work are the responsibility of the Contractor.

E. The Contractor shall dispose of all materials removed from the cleaning conducted by the Contractor at an approved facility. Costs associated with the removal, transport, and discharge of such materials shall be considered incidental to the project and shall be the responsibility of the Contractor.

PART 2 - PRODUCTS

2.1 CLEANING EQUIPMENT

A. HIGH-VELOCITY JET (HYDROCLEANING) EQUIPMENT:
1. All high-velocity pipeline cleaning equipment shall be constructed for ease and safety of operation.
2. The Contractor shall have a selection of two or more high-velocity nozzles which shall be capable of producing a scouring action from 10-degrees to 45-degrees in all sizes of pipelines designated to be cleaned.
3. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel.
4. For pipelines of 18 inches in diameter or greater, a minimum operating pressure of 2,300 psi @ 80 gpm is required.
5. Equipment shall also include a high-velocity gun for washing and scouring designated areas. The gun shall be capable of producing flow from a fine spray to a solid stream.
6. The equipment shall be satisfactory to the Engineer and shall be capable of removing dirt, grease, rocks, sand, and other materials or obstructions from the pipelines.

B. MECHANICALLY POWERED EQUIPMENT:
1. Bucket machines shall be in pairs with sufficient power to perform the work in an efficient manner.
2. Machines shall be belt operated or have an overload device.
3. Machines with direct drive that could cause damage to the pipe shall NOT be allowed.
4. A power rodding machine shall be either sectional or continuous rod type capable of holding a minimum of 750 feet of rod.
5. The rod shall be specifically heat-treated steel.
6. To ensure safe operation the machine shall be fully enclosed and have an automatic safety clutch or relief valve.
7. Mechanically powered equipment shall only be used when authorized by the Engineer and shall be done only when other cleaning methods are shown to be ineffective.

PART 3 - EXECUTION

3.1 CLEANING

A. The pipeline shall be cleaned using approved equipment.

B. The Contractor shall provide a mechanism to prevent debris from moving downstream from the line segment being cleaned.

C. All sludge, dirt, sand, rocks, grease, broken pipe, and other solid or semisolid material shall be removed at either the upstream or downstream access points of the pipeline section being cleaned. Passing material from line segment to line segment shall NOT be permitted.

D. All solids or semi-solids resulting from the cleaning operations shall become the property of Contractor and shall be removed by the Contractor from the pipeline and disposed of at a location approved by the Owner. All materials shall be removed from the site no less often than at the end of each workday. Under NO circumstances shall the Contractor be allowed to accumulate disposal material on the site of work beyond the stated time. The Contractor’s trucks shall have permits in accordance with all applicable State and Local regulations.

3.2 FINAL ACCEPTANCE

A. Acceptance of pipeline cleaning shall be made upon the successful completion of cleaning and shall be to the satisfaction of the Engineer. Verification of adequate cleaning shall be obtained by pulling a double squeegee, matching the pipe diameter, through each pipe section.

END OF SECTION

DIVISION 40

PROCESS INTEGRATION

SECTION 40 05 00 – PIPING SYSTEMS TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Test requirements for piping systems.

B. Related Sections:
   1. Section 01 50 00 – Temporary Facilities and Controls.
   2. Section 40 23 39 – Process Piping General.

1.2 REFERENCES

A. NFGC (National Fuel Gas Code):
   1. ANSI Z 223.1 or NFPA 54.

B. ASME (American Society of Mechanical Engineers):
   1. B31.8 – Gas Transmission and Distribution Piping Systems.
   2. B31.1 – Power Piping.
   3. B31.3 – Process Piping.

1.3 TESTING REQUIREMENTS

A. General Requirements:
   1. Testing requirements are stipulated in Laws and Regulations; are included in the Piping Schedule in Section 40 23 39; are specified in the specifications covering the various types of piping; and are specified herein.
   2. Requirements in Laws and Regulations supersede other requirements of Contract Documents, except where requirements of Contract Documents are more stringent, including higher test pressures, longer test times, and lower leakage allowances.
   3. Test plumbing piping in accordance with Laws and Regulations and UL requirements.
   4. When testing with water, the specified test pressure is considered to be the pressure at the highest point of the piping section under test. Lower test pressure as necessary to prevent testing the lowest point above a safe test pressure.

B. Furnish necessary personnel, materials, and equipment, including bulkheads, restraints, anchors, temporary connections, pumps, water, pressure gauges, and other means and facilities required to perform tests.

C. Water for Testing, Cleaning, and Disinfecting:
   1. Water for testing, cleaning, and disinfecting will be provided as specified in Section 01 50 00.

D. Pipes to be Tested:
   1. Test only those portions of pipes that have been installed as part of this Contract. Test new pipe sections prior to making final connections to existing piping. Furnish and install test plugs, bulkheads, and restraints required to isolate new pipe sections. Do not use existing valves as test plug or bulkhead.

E. Unsuccessful Tests:
   1. Where tests are not successful, correct defects or remove defective piping and appurtenances and install piping and appurtenances that comply with the specified requirements.

2. Repeat testing until tests are successful.

F. Test Completion:
1. Drain and leave piping clean after successful testing.

G. Test Water Disposal:
1. Dispose of testing water at the facility in accordance with requirements of federal, state, county, and city regulations governing disposal of waste in the location of the Project and disposal site.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures.

B. Schedule and Notification of Tests:
1. Submit a list of scheduled piping tests by noon of the working day preceding the date of the scheduled tests.
2. Notification of Readiness to Test:
a. Immediately before testing, notify Engineer in writing of readiness, not just intention, to test piping. Have personnel, materials, and equipment specified in place before submitting notification of readiness.

1.5 SEQUENCE

A. Clean piping before pressure or leak tests.

B. Test gravity piping underground, including sanitary sewers, for visible leaks before backfilling and compacting.

C. Underground pressure piping may be tested before or after backfilling when not indicated or specified otherwise.

D. Backfill and compact trench or provide blocking that prevents pipe movement before testing underground piping with a maximum leakage allowance.

E. Test underground piping before encasing piping in concrete or covering piping with slab, structure, or permanent improvement.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING, ALIGNMENT, GRADE, AND DEFLECTION

A. Alignment and Grade:
1. Visually inspect the interior of gravity piping with artificial light, reflected light, or laser beam.
2. Consider inspection complete when no broken or collapsed piping, no open or poorly made joints, no grade changes that affect the piping capacity, or no other defects are observed.

B. Deflection Test:
1. Pull a mandrel through the clean piping section under test.
2. Perform the test not sooner than 30 days after installation and not later than 60 days after installation.

3. Use a 9-rod mandrel with a contact length of not less than the nominal diameter of the pipe within ±1%.
4. Consider test complete when the mandrel can be pulled through the piping with reasonable effort by 1 person, without the aid of mechanical equipment.

3.2 AIR TESTING METHOD FOR PRESSURE PIPING

A. Air test piping, indicated with “AM” in the Piping Schedule, with air or another nonflammable or inert gas.

B. Test gas, air, liquefied petroleum gas, liquid chlorine, and chlorine gas piping by the air test method:
1. Test chlorine piping with dry air or nitrogen having a dew point of minus 40°F or less. Supply temporary air dryers as necessary.

C. Test at pressure as specified in Piping Schedule in Section 40 23 39:
1. Provide temporary pressure relief valve for piping under test. Set at the lesser of 110% of the test pressure or 50 lbs/in^2 gauge over the test pressure.
2. Air method test pressures shall not exceed 110% of the piping maximum allowable working pressure calculated in accordance with the most stringent of ASME B31.1. ASME B31.3, ASE B31.8, or the pipe manufacturer’s stated maximum working pressure.
3. Gradually increase test pressure to an initial test pressure equal to the lesser of one-half the test pressure or 25 lbs/in^2 gauge.
4. Perform initial check of joints and fittings for leakage.
5. Gradually increase test pressure in steps no larger than the initial pressure. Check for leakage at each step increase until test pressure is reached.
6. At each step in the pressure, examine and test piping being air tested for leaks with soap solution.
7. Consider examination complete when piping section under test holds the test pressure for 15 minutes without losses.

3.3 TESTING GRAVITY FLOW PIPING

A. Test Gravity Flow Piping indicated with “G” in the Piping Schedule, as follows:
1. Unless specified otherwise, subject gravity flow piping to the following tests:
   a. Alignment and grade.
   b. For plastic piping test for deflection.
   c. Visible leaks and pressure with maximum leakage allowance, except for storm drains and culverts.
2. Inspect piping for visible leaks before backfilling. Provide temporary restraints when needed to prevent movement of piping. Pressure test piping with maximum leakage allowance after backfilling.
3. With the lower end plugged, fill piping slowly with water while allowing air to escape from high points. Keep piping full under a slight head for the water at least 24 hours.
   a. Examine piping for visible leaks. Consider examination complete when no visible leaks are observed.
   b. Maintain piping with water or allow a new water absorption period of 24 hours for the performance of the pressure test with maximum leakage allowance.
   c. After successful completion of the test for visible leaks and after the piping has been restrained and backfilled, subject piping to the test pressure for minimum of four hours while accurately measuring the volume of water added to maintain the test pressure.
      1) Consider the test complete when leakage is equal to or less than the following maximum leakage allowances:
         a) For Concrete Piping with Rubber Gasket Joints:
            i. 80 gpd per inch of diameter per mile of piping under test.

b) Advise manufacturer of concrete piping with rubber gasket joints of more stringent than normal maximum leakage allowance.
c) For Vitrified Clay and Other Piping:
   i. 500 gpd per inch of diameter per mile of piping under test.

3.4 TESTING HIGH-HEAD PRESSURE PIPING

A. Test piping for which the specified test pressure in the Piping Schedule is 20 lbs/in^2 gauge or greater, by the high head pressure test method, indicated “HH” in the Piping Schedule.

B. General:
1. Test connections, hydrants, valves, blowoffs, and closure pieces with the piping.
2. Do not use installed valves for shutoff when the specified test pressure exceeds the valve’s maximum allowable seat differential pressure. Provide blinds or other means to isolate test sections.
3. Do not include valves, equipment or piping specialties in test sections if test pressure exceeds the valve, equipment or piping specialty safe test pressure allowed by the item’s manufacturer.
4. During the performance of the tests, test pressure shall not vary more than ±5lbs/in^2 gauge with respect to the specified test pressure.
5. Select the limits of testing to sections of piping. Select sections that have the same piping material and test pressure.
6. When test results indicate failure of selected sections, limit tests to piping:
   a. Between valves.
   b. Between a valve and the end of the piping.
   c. Less than 500 feet long.
7. Test piping for a minimum of 2 hours for visible leaks test and minimum of 2 hours for the pressure test with maximum leakage allowance.

C. Testing Procedures:
1. Fill piping section under test slowly with water while venting air. Use potable water for all potable waterlines and where they are noted on the Piping Schedule.
2. Before pressurizing for the test, retain water in piping under slight pressure for a water absorption period of minimum 24 hours.
3. Raise pressure to the specified test pressure and inspect piping visually for leaks. Consider visible leakage testing complete when no visible leaks are observed.

D. Pressure Test with Maximum Leakage Allowance:
1. Leakage allowance is zero for piping systems using flanged, National Pipe Thread threaded and welded joints.
2. Pressure test piping after completion of visible leaks test.
3. For piping systems using joint designs other than flanged threaded or welded joints, accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period.
   a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage and no damage to piping and appurtenances has occurred.
   b. Successful completion of the pressure test with maximum leakage allowance shall have been achieved when the observed leakage during the test period is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.
   c. Successful completion of the pressure test with maximum leakage allowance shall have been achieved with the observed leakage during the test period is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.
   d. When leakage is allowed, calculate the allowable leakage by the following formula:

$$L = \frac{S\,D\,\sqrt{P}}{148{,}000}$$

Where:

L = testing allowance (makeup water) (gph)
S = length of pipe tested (ft)
D = nominal diameter of the pipe (in.)
P = average test pressure during the hydrostatic test (psi [gauge])

3.5 TESTING LOW-HEAD PRESSURE PIPING

A. Test piping for which the specified test pressure is less than 20 psi gauge, by the low head pressure test method, indicated "LH" in the Piping Schedule.

B. General:
   1. Test pressures shall be as scheduled in Section 40 23 39 - Process Piping - General.
   2. During the performance of the tests, test pressure shall not vary more than ±2 psi gauge with respect to the specified test pressure.
   3. Test connections, blowoffs, vents, closure pieces, and joints into structures, including existing bell rings and other appurtenances, with the piping.
   4. Test piping for a minimum of 2 hours for visible leaks test and minimum of 2 hours for the pressure test with maximum leakage allowance.

C. Visible Leaks Test:
   1. Subject piping under test to the specified pressure measured at the lowest end.
   2. Fill piping section under test slowly with water while venting air. Use potable water for all potable waterlines and where they are noted on the Piping Schedule.
   3. Before pressurizing for the tests, retain water in piping under slight pressure for the water absorption period of minimum 24 hours.
   4. Raise pressure to the specified test pressure and inspect piping visually for leaks. Consider testing complete when no visible leaks are observed.

D. Pressure Test with Maximum Leakage Allowance:
   1. Pressure test piping after completion of visible leaks test.
   2. Accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period.
      a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage of 80 gallons per inch of nominal diameter, per mile of piping section under test after 24 hours and no damage to piping and appurtenances has occurred.
      b. Successful completion of the leakage test shall have been achieved when the observed leakage is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.

E. Optional Joint Test:
   1. When Joint Testing Is Allowed by Note in the Piping Schedule, the Procedure Shall Be as Follows:
      a. Joint testing will be allowed only for low head pressure piping.
   2. Joint testing may be performed with water or air.
   3. Joint test piping after completion of backfill and compaction to the top of the trench.
   4. Joint Testing with Water:
      a. Measure test pressure at the invert of the pipe. Apply pressure of 4 feet plus the inside diameter of the pipe in water column within 0.20 feet in water column.
      b. Maintain test pressure for one minute.
      c. Base the allowable leakage per joint on 80 gallons per inch nominal diameter, per mile of piping, per 24 hours equally distributed to the actual number of joints per mile for the type of piping.

d. Consider the pressure test to be complete when makeup water added is less than the allowable leakage.
e. Successful completion of the joint test with water shall have been achieved when the observed leakage is equal or less than the allowable leakage.

5. Joint Testing with Air:
a. Apply test pressure of 3 lbs/in^2 gauge with an allowed variation of 0.00-0.20 lbs/in^2.
b. Maintain test pressure for 2 minutes.
c. Consider the pressure test to be complete when the test pressure does not drop below 2.7 lbs/in^2 for the duration of the test.

3.6 PNEUMATIC TEST FOR PRESSURE PIPING

A. Test piping as indicated in pipe schedule.

B. DO NOT perform on:
1. PVC or CPVC pipe.
2. Piping larger than 18 inches.
3. Buried and other non-exposed piping.

C. Fluid: Oil-free, dry air.

D. Procedure:
1. Apply preliminary pneumatic test pressure of 25 psig maximum to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections, examine for leakage.
2. Correct visible leaks and repeat preliminary test until visible leaks are corrected.
3. Gradually increase pressure in system to half of specified test pressure. Thereafter increase pressure in steps of approximately one-tenth of specified test pressure until required test pressure is reached.
4. Maintain pneumatic test pressure continuously for minimum of 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.
5. Correct visible leakage and retest as specified.

E. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.

F. After testing and final cleaning, purge with nitrogen those lines that shall carry flammable gases to assure no explosive mixtures shall be present in system during filling process.

3.7 PNEUMATIC TEST FOR GRAVITY PIPING 12-INCH AND SMALLER

A. Equipment:
1. Calibrate gauges with standardized test gauge at start of each testing day.
2. Install gauges, air piping manifolds, and valves at ground surface.
3. Provide pressure release device, such as rupture disc or pressure relief valve, to relieve pressure at 6 psi or less.
4. Restrain plugs used to close sewer lines to prevent blowoff.

B. Procedure:
1. Require that no person enter manhole where pipe is under pressure.
2. Slowly introduce air into pipe section until internal air pressure reached 4 psi greater than average back pressure of groundwater submerging pipe.
3. Allow 2 minutes minimum for air temperature to stabilize.

C. Allowable Leakage:

1. Test section shall be considered *defective* when time required for pressure to decrease from 3.5 to 2.5 psi greater than average back pressure of groundwater submerging pipe is less than that computed utilizing values from following table:

TABLE 1*

A	B	C	D	E	F
Pipe Diameter (Inches)	**Time per Foot up to Length in Col C (Seconds)**	**Test Length (Feet)**	**Test Time Between Col C & E (for any Length)**	**Length (Col F Applies) (Feet)**	**Time per Foot for Total Length (Seconds)**
	0.18	636	1:54	1.114	0.10
	0.40	424	2:50	743	0.23
	0.71	318	3:47	557	0.41
10	1.11	255	4:43	446	0.63
12	1.60	212	5:40	371	0.91
15	2.50	170	7:05	297	1.42
18	3.62	141	8:30	248	2.06
21	4.92	121	9:55	212	2.81
24	6.42	106	11:20	187	3.67
EXAMPLE: 15-inch diameter pipe: For 150 feet, T = 2.50 sec (Col B) x 150 ft = 375 sec – 6:15 For 250 feet, T = 7:05 (Col D) For 500 feet, T = 1.42 sec (Col F) x 500 ft = 710 sec = 11:50					
* Based on 0.003 cfm per square foot with a minimum significant loss of 2 cfm and a maximum loss of 3.5 cfm.					

D. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration shall be considered *defective* even if pipe previously passed a leakage test.

E. *Defective* Piping Sections:
   1. Replace or test and seal individual joints, and retest as specified.

3.8 FIELD QUALITY REQUIREMENTS

A. Test Report Documentation:
   1. Test date.
   2. Description and identification of piping tested.
   3. Test fluid.
   4. Test pressure.
   5. Remarks, including:
      a. Leaks (type, location).
      b. Repair/replacement performed to remedy excessive leakage.
   6. Signed by Contractor and Engineer to represent that test has been satisfactorily completed.

END OF SECTION

SECTION 40 05 06 – PROCESS PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pipe penetrations.
2. Restrained joints.
3. Flexible metal hose connections.
4. Expansion joints.
5. Expansion loops.
6. Sleeve-type couplings.
7. Unrestrained Flanged Coupling Adapters.
8. Restrained Flanged Coupling Adapters.
9. Restrained dismantling joints.
10. Service saddles.
11. Annular pressure seals.
12. Insulating flanges, couplings, and unions.
13. Strainers.
14. Spray nozzles.
15. Quick couplings.
16. Quick disconnect cam operating couplings for chemical service.
17. Chemical injection quills.

B. Related Requirements:
1. Section 01 33 00 – Submittal Procedures.
2. Section 01 60 00 – Product Requirements.
3. Section 09 96 00 – High Performance Coatings.
4. Section 40 23 39 – Process Piping General.

1.2 DEFINITIONS

A. Firestopping (Through-Penetration Protection System):
1. The sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire-rated construction.

B. FM:
1. Factory Mutual Insurance Company; FM Global is the communicative name of the company.

C. WH:
1. Warnock Hersey; indicates compliance to relevant building codes, association criteria, and product safety and performance standards.

1.3 REFERENCES

A. American Water Works Association:
1. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.

B. American Welding Society:
1. AWS D1.1 - Structural Welding Code - Steel.

C. ASME International:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.
2. ASME B31.3 - Process Piping.
3. ASME B31.9 - Building Services Piping.
4. ASME Boiler and Pressure Vessel Code (BPVC), Section IX - Welding, Brazing, and Fusing Qualifications.

D. ASTM International:
1. D2000 - Standard Classification System for Rubber Products in Automotive Applications.
2. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
3. E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
4. E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
5. E1966 - Standard Test Method for Fire-Resistive Joint Systems.

E. Expansion Joint Manufacturers Association, Inc.:
1. EJMA Standards.

F. NSF International:
1. 61 - Drinking Water System Components - Health Effects.
2. 372 - Drinking Water System Components - Lead Content.

G. UL:
1. 263 - Fire Tests of Building Construction and Materials.
2. 1479 - Fire Tests of Through-Penetration Firestops.
3. 2079 - Tests for Fire Resistance of Building Joint Systems.

1.4 COORDINATION

A. Coordinate Work of this Section with installation of valves and equipment.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:
1. Submit manufacturer catalog information for each specified product.
2. Firestopping: Submit data on product characteristics, performance, and limitation criteria.
3. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
4. Expansion Joints: Indicate maximum temperature, pressure rating, and expansion compensation.

C. Shop Drawings:
1. Identification:
   a. Submit list of wording, symbols, letter size, and color coding for pipe identification.
   b. Comply with ASME A13.1.
2. Indicate restrained joint details and materials.
3. Submit layout drawings showing piece numbers and location, indicating restrained joint locations.
4. Indicate layout of piping systems, including flexible connectors, expansion joints and compensators, loops, offsets, and swing joints.

D. Firestopping Schedule:

1. Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings for maintenance of fire-resistance rating of adjacent assembly.

E. Include following Paragraph for submission of physical samples for selection of finish, color, texture, and other properties.

F. Manufacturer's Certificate:
1. Certify that products meet or exceed specified requirements.

G. Welder Certificates:
1. Certify welders and welding procedures employed on Work, verifying ASME qualification within previous 12 months.

H. Include separate Paragraphs for additional certifications.

I. Include following Paragraph when Contractor is responsible for designing products or assemblies. List affected products when Section specifies more than one product.

J. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for:
1. Flexible connectors.
2. Expansion joints.
3. Pipe Restraints:
   a. Determine restrained lengths and submit joint restraint details.
   b. Use joint restraint devices specifically designed for applications as described in manufacturer data.
4. Firestopping Engineering Judgments: For conditions not covered by UL- or WH-listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction to accept as meeting fire-protection code requirements.

K. Manufacturer Instructions:
1. Submit special procedures and setting dimensions.

L. Source Quality-Control Submittals:
1. Indicate results of shop tests and inspections.

M. Field Quality-Control Submittals:
1. Indicate results of Contractor-furnished tests and inspections.

N. Qualifications Statements:
1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.
3. Welders: Qualify procedures and personnel according to ASME BPVC-IX.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents:
1. Record actual locations of piping appurtenances.

B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Materials in Contact with Potable Water:

1. Certified to NSF Standards 61 and 372.

B. Perform Work according to ASME B31.9 for installation of piping systems and according to ASME BPVC-IX for welding materials and procedures.

C. Perform Work according to ASME B31.3, ASME B31.9, and Local Building Codes for installation of piping systems.

D. Through-Penetration Firestopping of Fire-Rated Assemblies:
1. Comply with UL 1479 or ASTM E814.
2. Minimum Positive Pressure Differential: 0.1-inch WG to achieve fire F-ratings and temperature T-ratings as indicated on Drawings, but not less than one hour.
3. Wall Penetrations: Fire F-ratings as indicated on Drawings, but not less than one hour.
4. Fire-rated firestopping may not be required for non-rated floors and roofs. Coordinate with following non-fire-rated assemblies.
5. Floor and Roof Penetrations:
   a. Fire F-ratings and Temperature T-ratings: As indicated on Drawings, but not less than one hour.
   b. Floor Penetrations within Wall Cavities: T-rating is not required.

E. Through-Penetration Firestopping of Non-fire-rated Floor and Roof Assemblies:
1. Materials to resist free passage of flame and products of combustion.
2. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
3. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.

F. Fire-Resistive Joints in Fire-Rated Floor, Roof, and Wall Assemblies:
1. Comply with ASTM E1966 or UL 2079.
2. Rating: As indicated on Drawings for assembly in which joint is installed.

G. Fire-Resistive Joints between Floor Slabs and Exterior Walls:
1. Comply with ASTM E119.
2. Minimum Positive Pressure Differential: 0.1-inch WG to achieve fire-resistance rating as indicated on Drawings for floor assembly.

H. Surface-Burning Characteristics:
1. Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.

1.8 QUALIFICATIONS

A. Coordinate following Paragraphs with requirements specified in SUBMITTALS Article.

B. Manufacturer:
1. Company specializing in manufacturing products specified in this Section with minimum three years' experience.

C. Installer:
1. Company specializing in performing Work of this Section with minimum three years' experience and approved by manufacturer.

D. Welders:
1. ASME qualified within previous 12 months for employed weld types.

E. Licensed Professional:
   1. Professional engineer experienced in design of specified Work and licensed in State of Alabama.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection:
   1. Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:
   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
   3. Provide additional protection according to manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:
   1. Verify field measurements prior to fabrication.
   2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

A. Furnish 1-year manufacturer's warranty.

PART 2 - PRODUCTS

2.1 UNRESTRAINED FLANGED COUPLING ADAPTERS

A. Provide flange coupling adapters with anchor lugs or anchor wedge restraints.

B. Manufacturers and Products:
   1. Steel Pipe:
      a. Smith-Blair – Series 913 (3 inch & Larger)
      b. Dresser Industries, Inc. – Style 128-W (2 – 24 inch)
      c. Romac – FC400 (12 – 96 inch)
   2. Ductile Iron Pipe:
      a. Smith-Blair – Series 912 (3 – 12 inch)
      b. Dresser Industries, Inc.; Style 128-W (3 – 12 inch)
      c. Romac – FCA501 (3 – 16 inches)
      d. EBAA Iron Series 1000 E-Z Flange Adapter

C. Pressure Rating:
   1. When properly installed on a pipe that is within the coupling manufacturer’s tolerances, Flanged Coupling Adapters can work at pressures up to the maximum rating of the flange. Flanges are rated for a maximum working pressure of 300 psi.
   2.

2.2 QUICK DISCONNECT CAM OPERATING COUPLINGS FOR CHEMICAL SERVICE

A. Type:
   1. Twin cam arm actuated, male and female, locking, for chemical loading and transfer.

B. Material:
   1. Glass-filled polypropylene and PVDF with Teflon gaskets and as recommended for the service by Manufacturer.

C. End Connections:
   1. NPT threaded or flanged to match piping connections.

D. Hose shanks for chemical installations.

E. Plugs and Caps:
   1. Female dust cap for each male end, male dust plug for each female end.

F. Pressure Rating:
   1. 125 psi, minimum at 70° F.

G. Manufacturers:
   1. OPW – Kamlok (3/4 – 4 inch)
   2. Ryan Herco – 1300 Series
   3. Goodall – Basic Eight

2.3 FLEXIBLE PIPE COUPLING

A. Materials:
   1. Elastomeric PVC main body
   2. Stainless steel clamps

B. Pressure Rating:
   1. 4 psi, minimum at 70°F

C. Manufacturers:
   1. Fernco

2.4 INSULATION

A. As indicated on Drawings or pipe schedule.

2.5 FINISHES

A. Prepare piping appurtenances for field finishes as specified in Section 09 96 00 – High-Performance Coatings.

2.6 EXAMINATION

A. Verify that field dimensions are as indicated on Drawings.

B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.

C. Verify that pipe plain ends to receive sleeve-type couplings are smooth and round for 12 inches from pipe ends.

D. Verify that pipe outside diameter conforms to sleeve manufacturer's requirements.

2.7 PREPARATION

A. Cleaning:
   1. Thoroughly clean end connections before installation.

B. Close pipe and equipment openings with caps or plugs during installation.

C. Surface Preparation:
   1. Clean surfaces to remove foreign substances.

2.8 INSTALLATION

A. According to ASME B31.3.

B. Coating:
   1. Finish piping appurtenances as specified in Section 09 96 00 – High-Performance Coatings.

C. Flexible Connections:
   1. Install flexible couplings at connections to equipment and where indicated on Drawings or as required by equipment or piping manufacturer.

2.9 PIPING FLEXIBILITY PROVISIONS

A. General:
   1. Install thrust protection.
   2. Install flexible couplings to facilitate piping installation, in accordance with approved shop drawings.

B. Flexible Joints at Concrete Backfill or Encasement:
   1. Install within 18” or one-half pipe diameter, whichever is less, from the termination of any concrete backfill or concrete encasement.

C. Flexible Joints at Concrete Structures:
   1. Install 18” or less from the face of structures; joint may be flush with face.
   2. Install a second flexible joint, whether shown or not.
      a. Pipe Diameter 18” and smaller: Within 18” of the first joint.
      b. Pipe Diameter Larger than 18”: Within one pipe diameter of the first joint.

2.10 PIPING TRANSITION

A. Applications:
   1. Provide complete closure assembly where pipes meet other pipes or structures.
   2. Pressure Pipeline Closures: Plain end pieces with double flexible couplings, unless otherwise shown.
   3. Restrained Joint Pipe Closures: Install with thrust tie-rod assemblies as shown or in accordance with NFPA 24.
   4. Gravity Pipe Closures: As specified for pressure pipelines, or concrete closures.
   5. Concrete Closures: Use to make connections between dissimilar pipes where standard rubber gasketed joints or flexible couplings are impractical, as approved.
   6. Elastomer sleeves bonded to pipe ends are not acceptable.

B. Installation:

1. Flexible Transition Couplings:
    a. Install in accordance with coupling Manufacturer's instructions to connect dissimilar pipe and pipes with a small difference in outside diameter.
2. Concrete Closures:
    a. Locate away from structures so that there are at least two flexible joints between the closure and pipe entering the structure.
    b. Clean pipe surface before closure collars are placed.
    c. Wet non-metallic pipe thoroughly prior to pouring collars.
    d. Prevent concrete from entering pipe.
    e. Extend collar a minimum of 12" on each side of joint with minimum thickness of 6" around outside diameter of pipe.
    f. Make entire collar in one placement.
    g. After concrete has reached initial set, cure by covering with well¬ moistened earth.

2.11 FLEXIBLE PIPE CONNECTIONS TO EQUIPMENT

A. Tie Bolts:
    1. Tighten snug prior to applying any pressure to the system.

2.12 MISCELLANEOUS SPECIALTIES

A. Install in accordance with manufacturer's instructions.

2.13 FIELD QUALITY CONTROL

A. After installation, inspect for proper supports and interferences.

B. Repair damaged coatings with material equal to original coating.

2.14 CLEANING

A. Keep equipment interior clean as installation progresses.

END OF SECTION

SECTION 40 05 07 – HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipe hangers and supports.
   2. Hanger rods.
   3. Structural attachments.
   4. Pipe guides.
   5. Formed steel channel.

B. Related Requirements:
   1. Section 03 11 00 – Concrete Formwork.
   2. Section 03 30 00 – Cast-in-Place Concrete.
   3. Section 09 96 00 – High-Performance Coatings.
   4. Section 22 07 00 – Plumbing Insulation.
   5. Section 40 05 51 – Common Requirements for Process Valves.
   6. Section 40 23 39 – Process Piping – General.
   7. Section 40 23 39.13 – Ductile, Malleable, and Cast Iron Alloys Process Piping.
   8. Section 40 23 39.33 – Galvanized Steel Pipe and Malleable Iron Fittings Data Sheet.
   9. Section 40 23 39.36 – Stainless Steel Pipe and Fittings Data Sheet.

C. General Requirements:
   1. Contractor to provide pipe support design by a pipe support design engineer. All piping shall be adequately supported by the Contractor as determined by their design engineer's calculations and as specified herein. Where the Drawings show support types and/or locations, they shall be analyzed for adequacy to support loads and stresses calculated by the pipe support design engineer, modified if required, installed generally where shown, and integrated with the pipe support system design provided by the Contractor. Additional supports may be required and shall be the responsibility of the Contractor.

1.2 REFERENCES

A. ASME (American Society of Mechanical Engineers):
   1. B31.1 - Power Piping.
   2. B31.9 - Building Services Piping.

B. ASTM International:
   1. A36 - Standard Specification for Carbon Structural Steel.
   2. A47 - Standard Specification for Ferritic Malleable Iron Castings.
   3. A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
   4. A181 - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

C. AWS (American Welding Society):
   1. D1.1 - Structural Welding Code Steel - Reference Manual.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacturer, Selection, Application, and Installation.

1.3 COORDINATION

A. Section 01 30 00 – Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Product Data:
   1. Submit manufacturer's catalog data including load capacity.

C. Shop Drawings:
   1. Indicate system layout with location - including critical dimensions, sizes, and pipe hanger and support locations - and detail of trapeze hangers, anchors, and guides.

D. Welders' Certificate:
   1. Submit welders' certification of compliance with ASME Section IX, verifying qualification within previous 12 months.

E. Delegated Design Submittals:
   1. Engage the services of an independent registered professional engineer licensed in the State of Work ordinarily engaged in the business of pipe support systems analysis and design, to analyze system piping and service conditions, and to develop a detailed support system design, specific to the piping material, pipe joints, valves, and piping appurtenances proposed for use.
      a. The proposed support system engineer shall have at least 5 years of experience in the analysis and design of similar systems, including the use of commercial and custom pipe supports and in the use of commercial pipe stress software programs.
      b. The Contractor shall provide Certification of Compliance with these requirements.
   2. The support system design shall include:
      a. Criteria by piping system.
      b. Summary of related components including joints, class, valves, appurtenances, etc., and commercial supports and especially including pipe materials.
      c. Dead weight and dynamic analysis, including system thermal effects and pressure thrusts.
         1) Show the resolved and resultant force and moment systems, as well as all recommended hangers, supports, anchors, restraints, and expansion/flexible joints.
      d. Submit signed and sealed support system design to the Engineer for review.
      e. All aspects of the analysis and design to comply with the provisions of ANSI B31.3 and the referenced standards.
   3. Coordinate support arrangements to eliminate interference with similar systems to be installed under HVAC, Plumbing, and Electrical; to account for structural expansion joints and to maintain access for both personnel and for the removal of equipment.

F. Manufacturers' Instructions:
   1. Submit special procedures and assembly of components.

G. Qualifications Statements:
   1. Submit qualifications for manufacturer, fabricator, installer, and licensed professional.
   2. Submit manufacturer's approval of installer.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 77 00 – Closeout Procedures: Requirements for maintenance materials.

B. Spare Parts:
   1. Furnish one set of manufacturer's recommended spare parts.

C. Tools:
   1. Furnish special tools and other devices required for Owner to maintain the supplied products.

1.6 QUALITY ASSURANCE

A. Perform Work according to AWS D1.1 for welding hanger and support attachments to building structure.

B. Perform Work according to AWWA standards, State and Local building codes.

1.7 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing Products specified in this Section with minimum three years' experience.

B. Fabricator:
   1. Company specializing in fabricating products specified in this Section with minimum three years' experience.

C. Installer:
   1. Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

D. Licensed Professional:
   1. Professional engineer experienced in design of specified Work and licensed in the State of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection:
   1. Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.

C. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

1.9 AMBIENT CONDITIONS

A. Section 01 50 00 – Temporary Facilities and Controls:
   1. Requirements for ambient condition control facilities for product storage and installation.

1.10 EXISTING CONDITIONS

A. Field Measurements:
   1. Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

A. See Section 01 78 36 – Warranties and Bonds for requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment.

D. Support pipe and appurtenances connected to equipment to prevent any strain being imposed on the equipment. Comply with manufacturer's requirements regarding piping loads being or not being transmitted to their equipment.

E. Design all supports to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact. Any structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 05 50 00 – Metal Fabrications and shall be furnished and installed under this Section.

F. Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.

G. Pipe supports:
   1. Shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.
   2. Provide supports at changes in direction and elsewhere as shown in the Drawings or as specified herein.
   3. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless specifically directed or authorized by the Engineer.
   4. Provide pipe supports to minimize lateral forces through valves, both sides of flexible split ring type couplings and sleeve type couplings, and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.
   5. Effects of thermal expansion and contraction of the pipe to be accounted for in the pipe support selection and installation.

H. Design Criteria:
   1. Consider the content of the pipes in load calculations. All items shall be designed with strength and stiffness to support, restrain, and allow expansion of the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces.
   2. Minimum Gauge Thickness: 12 gauge.
   3. Allowable Stress of Channels:
      a. Steel Channels: The lesser of 25,000 pounds per square inch, or 0.66 times yield stress of steel.
      b. Stainless Steel Channels: 0.66 times the yield stress of the stainless-steel alloy.
   4. Maximum Deflection: 1/240 of span.

5. Allowable Column Loads: As recommended by manufacturer in published instruction for column's unsupported height and "K" value for calculating effective column length of not less than 1.0.
6. Future Loads:
    a. Support systems indicated on the Drawings may include spaces intended to accommodate future pipes.
    b. Assume such spaces are occupied by 6-inch diameter ductile iron pipes. Only the number of pipes that would physically fit into the space need be considered.
    c. Include the weight of the pipe contents in determining future loads. Assume pipe contents are water.
7. Seismic Design Criteria: As specified in Division 01 specifications for mechanical equipment.
8. Spacing of Supports: As required to comply with design requirements.

I. Supports below the top of walls of water bearing structures: Use Type 316 stainless steel for support system components.
    1. Supports in other locations: Use hot-dipped galvanized components unless other materials are specifically indicated on the Drawings.

2.2 DESIGN REQUIREMENTS

A. General:
    1. Contractor shall be responsible for the design, size, and location of process piping support systems in accordance with the requirements specified herein and in general conformance with the Drawings and the Design Details. The design shall be provided by a company specifically specializing in the design of support systems. The pipe support system design company shall demonstrate that they have at least five years of experience in pipe support design and have successfully completed at least three designs in the previous year. The Contractor shall provide Certification of Compliance with these requirements.
    2. Seismic Load: See Division 01 specification sections and structural notes found on the Drawings.
    3. Piping smaller than 30”: Supports are shown only where specific types and locations are required; additional pipe supports may be required.
    4. Piping 30” and larger: Support systems have been designed for piping shown.
    5. Meet requirements of MSS SP 58, MSS SP 69, and MSS SP 89.

B. Pipe Support Systems:
    1. Support Load: Dead loads imposed by weight of pipes filled with water, except air and gas pipes, plus insulation and capable of supporting combined weight of supported systems, system contents, and test water.

2. Maximum Support Spacing and Minimum Rod Size:
   a. Steel or Ductile Iron Piping:

Pipe Nominal Diameter (in.)	Support Span (ft.)	Length of channel (in.)	Channel Depth (in.)	Support Bolt Size (in.)
3	20			3/4
4	20			3/4
6	20			3/4
8	20			3/4
10	20			1
12	20			1
14	20			1 1/4
16	20			1 1/4
18	20			1 1/4
20[1]	19			1 1/4
24	15	26	5	1 1/2
30	12	36	6	1 7/8
36	9	42	6	1 7/8
42	7	48	8	1 7/8
48	5	54	8	1 7/8

Note:

1. All piping 20" diameter and smaller shall be supported by clevis style hangers, all larger pipe shall be supported by trapeze style hangers.
2. Channel length indicates the distance between the two support bolts holding up either end of the channel. Channel depth is the vertical distance from where the pipe is supported by the channel to the This is only applicable to trapeze style hangers.
3. Refer to standard details for clevis style and trapeze style hangers.
4. This table assumes one pipe support for one pipe. Submit design and calculations to support multiple pipes per trapeze.

   b. Copper Piping:
      1) Maximum Support Spacing: 2 feet less per size than listed for steel pipe, with 1" and smaller pipe supported every 5 feet.
      2) Minimum Hanger Rod Sizing: Same as listed for steel pipe.
   c. Plastic and Fiberglass Piping:
      1) Maximum support spacing: As recommended by manufacturer for flow temperature in pipe.
      2) Minimum Hanger Rod Sizing: Same as listed for steel pipe.

2.3 FRAMING SUPPORT SYSTEM:

A. Beams:
   1. Size such that beam stress does not exceed 25,000 psi and maximum deflection does not exceed 1/240 of span.

B. Column Members:
   1. Size in accordance with Manufacturer's recommended method.

C. Support Loads:
   1. Calculate using weight of pipes filled with water.

D. Maximum Spans:
   1. Steel and Ductile Iron Pipe, 3” Diameter and Larger:
      a. 10-foot centers, unless otherwise shown.
   2. Other Pipelines and Special Situations:
      a. May require supplementary hangers and supports.

E. Electrical Conduit Support:
   1. Include in design of framing support system.

F. Anchoring Devices:
   1. Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

G. Vertical Sway Bracing:
   1. 10-foot maximum centers, or as shown.

H. Existing Support Systems:
   1. Use existing supports systems to support new piping only if Contractor can show that they are adequate for additional load, or if they are strengthened to support the additional load.

2.4 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated by catalogs.

B. Special support and hanger details are shown for cases where standard catalog supports are inapplicable.

C. Materials:
   1. Wetted and Submerged: Stainless steel.
   2. Atmospheric Exposed:
      a. Galvanized or painted steel in accordance with Section 09 96 00 – Painting and Coating.
   3. Corrosive Areas: FRP
   4. Stainless Steel (Type 304 or 316): Use in all submerged locations, above water level but below top of wall inside water bearing structures, and where specifically indicated on the Drawings:
      a. Shop-Fabricate: At the shop, perform pickling and passivation on all surfaces inside and out.
      b. Field welding is prohibited.
   5. Hot-Dip Galvanized Steel:
      a. Use in areas other than above and where specifically indicated on the Drawings. Hot-dip galvanize pipe supports after fabrication.
   6. Plastic, aluminum, FRP, and other miscellaneous materials:
      a. Use where specifically indicated on the Drawings.
   7. Non-metallic pipe support systems shall be used in areas where exposed to reactive chemicals such as chemical pumping area and chemical storage area.
   8. Fiberglass Resin:
      a. Corrosion resistant premium grade vinylester.
   9. Injection Molded Components:
      a. Polyurethane thermoplastics.
   10. Flame Spread of Fiberglass:
      a. Vinylester Fiberglass (Series VF): Class 1, ASTM E 84.
      b. Polyurethane: V-O UL 94V.

11. Physical Properties of Fiberglass:

	Longitudinal	Transverse
Tensile Strength	37,500 lbs/in^2, (psi)	10,000 lbs/in^2, (psi)
Tensile Modules	3.0 X 10^6 psi	1.0 X 10^{6}psi
Flexural Strength	37,500 psi	14,000 psi
Flexural Modules	2.0 X 10^{6}psi	1.0 X 10^{6}psi
Compressive Strength	37,500 psi	20,000 psi
Shear Strength	6,000 psi	5,500 psi
Izod Impact	30 ft-lbs/in^2	5 ft-lbs/in^2

12. Surface Veil:
    a. Fiberglass channel shall have polyester surface veil over 100% of the surface to provide protection against degradation from ultraviolet light.
13. Touch-Up Resin:
    a. Manufacturers (ONE of the following):
        1) Krylon, 7006-Satin Polyurethane Clear Finish.
        2) Or Approved Equal.

2.5 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
1. Carpenter & Paterson, Inc.
2. Empire Industries, Inc.
3. Globe Pipe Hanger Products Incorporated.
4. Haydon Corporation.
5. Hilti, Inc.
6. PHD Manufacturing, Inc.
7. Anvil International.
8. Substitutions: Section 01 60 00 – Product Requirements.

B. Description:
1. Conform to MSS SP58.
2. Provide means of vertical adjustment after erection.
3. Pipe Sizes 1/2 to 1-1/2 in: ASTM A36, steel, adjustable swivel, split ring.
4. Pipe Sizes 2 in and Larger: ASTM A36, steel, adjustable, clevis.
5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
6. Wall Support for Pipe Sizes 3 in and Smaller: Cast iron J-hook.
7. Wall Support for Pipe Sizes 4 in and Larger: Welded steel bracket.
8. Vertical Support: Riser clamp.
9. Floor Supports: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

C. Performance and Design Criteria:
1. Pipe Hangers:
    a. Allow for expansion and contraction of piping while eliminating undue stress on piping appurtenances and equipment.
    b. Provide linkage to permit lateral or axial movement where anticipated.
    c. Where horizontal pipe movement is greater than 1/2 in, or where hanger rod deflection from the vertical is greater than 4 degrees from cold to hot position of pipe, hanger rod and structural attachment shall be offset to maintain rod vertical in hot position.
2. Heat Transmission: Design supports, hangers, anchors, and guides to prevent excessive heat from being transmitted to building structure, equipment, or piping appurtenances.

3. Riser Supports: Support risers on each floor with riser clamps and lugs, independent of connected horizontal piping.
4. Point Loads:
    a. Support plastic piping containing meters, valves, appurtenances, and other point loads on both sides.
    b. Avoid point loads on plastic piping by providing extra wide pipe saddles or galvanized steel shields.
5. Noise Reduction: Wrap copper tubes located within buildings with a 2-in-wide strip of rubber at each pipe support, bracket, clip, or hanger.

2.6 HANGER RODS

A. Hanger Rods:
1. ASTM A576, steel.
2. All-thread.
3. Diameter: ASME B31.1.

2.7 STRUCTURAL ATTACHMENTS

A. Manufacturers:
1. ERICO International Corporation.
2. Grinnell Mechanical Products.
3. Unistrut; Part of Atkore International.
4. Anvil International.
5. Substitutions: Section 01 60 00 - Product Requirements.

B. Concrete Inserts:
1. Manufacturers:
    a. Carpenter & Patterson, Inc.
    b. National Pipe Hanger Corporation
    c. Piping Technology & Products, Inc.
    d. Rilco Manufacturing Co.
    e. Value Engineered Products, Inc.
    f. Anvil International.
    g. Substitutions: Section 01 60 00 - Product Requirements.
2. Description:
    a. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms.
    b. Size inserts to suit threaded hanger rods.

C. Mounting Brackets:
1. ASTM A36, welded steel.

D. Beam Clamps:
1. Manufacturers:
    a. B-line, an Eaton Business.
    b. ERICO International Corporation.
    c. Grinnell Mechanical Products.
    d. Anvil International.
    e. Substitutions: Section 01 60 00 - Product Requirements.
2. Description:
    a. ASTM A36, steel or ASTM A181, forged steel; MSS SP-58.
    b. Clamp Size: Based on load to be supported and load configuration.
    c. Anchoring: Locknuts and cup-point set screws.
    d. Reversible top or bottom flange.

E. Riser Clamps:
1. Manufacturers:
a. B-line, an Eaton Business.
b. ERICO International Corporation.
c. Grinnell Mechanical Products.
d. Substitutions: Section 01 60 00 - Product Requirements.
2. Description:
a. ASTM A36, steel.
b. Support of Copper Tubing: Provide copper-plated clamps.

F. Offset Clamps:
1. Manufacturers:
a. B-line, an Eaton Business,
b. ERICO International Corporation, or
c. Grinnell Mechanical Products.
d. Anvil International.
e. Substitutions: Section 01 60 00 - Product Requirements.
2. Description:
a. Double leg, two-piece.

2.8 PIPE GUIDES

A. Intermediate Guides:
1. Pipes 6 in and Smaller: Pipe clamp with oversize pipe sleeve.
2. Pipes 8 in and Larger: U-bolts with double nuts.

B. Alignment Guides:
1. Pipes 8 in and Smaller: Galvanized steel Spider type.
2. Pipes 10 in and Larger: Galvanized steel Roller type.

2.9 FORMED STEEL CHANNEL

A. Fabricate preformed channel pipe support system using, as a minimum, parts specified below and meeting the requirements specified under Design Criteria.
1. Manufacturers (ONE of the following):
a. Unistrut, Series P1000 or P1001; P5500 or P5501.
b. Allied Support Systems, Power Strut, Figure PS-200 or PS-200 2TS; PS-150 or PS-150 2TS.
c. B-Line Systems, Inc., Channel Type B22 or B22A; B12 or B12A.
d. Anvil, Figure 45
e. Or Approved Equal.

B. Preformed Channel Concrete Inserts:
1. Minimum 12 inches long.
2. Manufacturers (ONE of the following):
a. Unistrut, Series P-3200.
b. Allied Support Systems, Figure 282.
c. B-Line Systems, Series B32I.
d. or approved equal.

C. 90-Degree Angle Fittings:
1. Manufacturers (ONE of the following):
a. Unistrut, P1026.
b. Allied Support Systems, Power Strut, P603.
c. Or Approved Equal.

D. Pipe Straps:
   1. For Pipes 8 Inches in Diameter and Smaller: Use 2-piece universal strap with slotted hex head screw and nut.
   2. Manufacturers (ONE of the following):
      a. Unistrut, Series P1109 through P1126.
      b. Allied Support Systems, PS1100.
      c. B-Line Systems, Inc., Series B2000.
      d. Or Approved Equal.
   3. For Pipes Greater Than 8 Inches in Diameter: Unless different material is otherwise indicated on the Drawings use 1-piece 1 inch wide by 1/8-inch-thick steel strap, hot-dip galvanized after fabrication.
   4. For Stainless Steel Pipes: Use type of strap required for the pipe sizes specified above but use Type 316 stainless steel materials.

E. Touch-Up Paint Galvanized Surfaces:
   1. Manufacturers (ONE of the following):
      a. Galvinox, Galvo-Weld.
      b. Or Approved Equal.
   2. Touch-Up Paint for Painted Surfaces: Same formulation as factory paint.
   3. Hot-dip galvanize support system components after fabrication to required length and shape.
   4. Do not galvanize or paint stainless steel components.

2.10 NON-METALLIC PIPE SUPPORT SYSTEM

A. Manufacturers:
   1. StrutTech.
   2. Unistrut.

B. Supply all materials from a single manufacturer with sole responsibility for the pipe support system.

C. The supplied system, including pipe clamps, shall be interchangeable with industry standard 1-5/8-inch steel and fiberglass channel framing systems.

D. Channel Framing:
   1. All channel framing shall be supplied with integral notches 1 inch on center.
   2. Locate notches on interior flange to prevent slippage of pipe clamps and fittings after installation.

E. Pipe Clamps:
   1. Adjustable Type: Non-metallic and non-conductive.
   2. Fixed Type:
      a. Pipe clamps for pipe less than 6 inches in diameter shall be non-metallic and non-conductive.
      b. Pipe clamps for pipe equal to and greater than 6 inches in diameter shall be fiberglass.

F. Channel Fittings:
   1. Make fittings and post bases from glass-filled polyurethane or polyester.

G. Fasteners:
   1. Make fasteners from one of the following materials:
      a. Glass-filled polyurethane.
      b. Vinylester fiberglass.

2.11 TRAPEZE PIPE HANGERS

A. Description:
   1. MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.12 METAL FRAMING SYSTEMS

A. Description:
   1. MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:
   1. B-Line Systems, Inc.; a division of Cooper Industries.
   2. Power-Strut Div.; Tyco International, Ltd.
   3. Thomas & Betts Corporation.
   4. Tolco Inc.
   5. Unistrut Corp.; Tyco International, Ltd.

C. Coatings:
   1. Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings:
   1. Plastic coating, jacket, or liner.

2.13 THERMAL-HANGER SHIELD INSERTS

A. Description:
   1. 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. PHS Industries, Inc.
   4. Pipe Shields, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping (ONE of the following):
   1. Water-repellent treated, ASTM C533
   2. Water-repellent treated, ASTM C533, Type I calcium silicate
   3. ASTM C552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping:
   1. Water-repellent treated (ONE of the following):
      a. ASTM C533, Type I calcium silicate
      b. ASTM C552, Type II cellular glass

E. Trapeze or Clamped Systems:
   1. Insert and shield shall cover entire circumference of pipe.

F. Clevis or Band Hangers:
   1. Insert and shield shall cover lower 180° of pipe.

G. Insert Length:
1. Extend 2” beyond sheet metal shield for piping operating below ambient air temperature.

2.14 FASTENER SYSTEMS

A. Powder-Actuated Fasteners:
1. Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
2. Manufacturers:
a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors:
1. Insert-wedge-type stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
2. Manufacturers:
a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01 60 00 – Product Requirements: Requirements for installation examination.

B. Verify field dimensions as indicated on Drawings.

3.2 HANGER AND SUPPORT APPLICATIONS

A. Building Attachments (Unless otherwise indicated and except as specified in piping system Sections, install the following types):
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

B. Saddles and Shields (Unless otherwise indicated and except as specified in piping system Sections, install the following types):
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

C. Pipe Hangers and Supports:
1. Install according to: MSS SP 58.
2. Support horizontal piping as indicated on Drawings or as indicated on Shop Drawings.
3. Install hangers with minimum 1/2 in space between finished covering and adjacent Work.
4. Place hangers within 12 in of each horizontal elbow.
5. Use hangers with 1-1/2 in minimum vertical adjustment.
6. Support horizontal cast iron pipe adjacent to each hub, with 5 ft maximum spacing between hangers.
7. Support vertical piping at every other floor. Support vertical cast iron pipe at each floor at hub.
8. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
9. Support riser piping independently of connected horizontal piping.
10. Provide copper-plated hangers and supports for copper piping.
11. Design hangers for pipe movement without disengagement of supported pipe.
12. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
13. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
14. Use beam clamps where piping is to be suspended from building steel.
15. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.
16. Use offset clamps where pipes are indicated as offset from wall surfaces.

D. Spring Hangers and Supports (Unless otherwise indicated and except as specified in piping system Sections, install the following types):
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4".
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25% to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

3.3 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation:
1. Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation:
1. Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
2. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
3. Field fabricate from ASTM A36, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Fiberglass Pipe Hanger Installation:
1. Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation:
1. Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Thermal-Hanger Shield Installation:
1. Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4” thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool Manufacturer. Install fasteners according to powder-actuated tool Manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to Manufacturer's written instructions.

G. Pipe Positioning System Installation:
1. Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation:
   1. Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution:
   1. Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes:
   1. Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

O. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature:
         1) Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature:
         1) Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option:
         1) Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180°.
      a. Option:
         1) Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   4. Shield Dimensions for Pipe (Not less than the following):
      a. NPS 1/4 to NPS 3-1/2: 12” long and 0.048” thick.
      b. NPS 4: 12” long and 0.06” thick.
      c. NPS 5 and NPS 6: 18” long and 0.06” thick.
      d. NPS 8 to NPS 14: 24” long and 0.075” thick.
      e. NPS 16 to NPS 24: 24” long and 0.105” thick.
   5. Pipes NPS 8 and Larger:
      a. Include wood inserts.
   6. Insert Material:
      a. Length at least as long as protective shield.
   7. Thermal-Hanger Shields:
      a. Install with insulation same thickness as piping insulation.

3.4 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting:
   1. Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.5 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding:
   1. Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
      a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
      b. Obtain fusion without undercut or overlap.
      c. Remove welding flux immediately.

D. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.6 ADJUSTING

A. Hanger Adjustments:
   1. Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2”.

3.7 INSTALLATION

A. General:
   1. Obtain permission from Engineer before using powder-actuated anchors.
   2. Do not drill or cut structural members.
   3. Install support systems in accordance with MSS SP 69, Pipe Hangers and Supports-Selection and Application and MSS SP 89, Pipe Hangers and Supports-Fabrication and Installation, unless shown otherwise.
   4. Support piping connections to equipment by pipe support and not by the equipment.
   5. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
   6. Support no pipe from the pipe above it.
   7. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
   8. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
   9. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.
   10. Install lateral supports for seismic loads at all changes in direction.

11. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
12. Repair mounting surfaces to original condition after attachments are made.
13. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
14. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
15. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
16. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

B. Inserts:
1. Install inserts for placement in concrete forms.
2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 in and larger.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

C. Insulation:
1. Provide clearance in hangers and from structure and other equipment for installation of insulation.
2. Conform to Section 40 42 13 – Process Piping Insulation.

D. Equipment Bases and Supports:
1. Suspended Equipment:
   a. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
   b. Provide lateral bracing, to prevent swaying, for equipment supports.
2. Ground Mounted Equipment:
   a. Provide housekeeping pads of concrete, minimum 6 in thick and extending 6 in beyond supported equipment and valves or as detailed on the Drawings. Comply with Section 03 30 00 – Cast-in-Place Concrete.
   b. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.8 PAINTING

A. Prime Coat:
1. Prime coat exposed steel hangers and supports.
2. Conform to Section 09 96 00 – High-Performance Coatings.
3. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

B. Paint exposed surfaces immediately after erecting hangers and supports as specified in Section 09 96 00 – High-Performance Coatings.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 40 05 51 – COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Valves.
   2. Valve actuators.

B. Related Requirements:
   1. Section 40 05 07 – Hangers and Supports for Process Piping.
   2. Section 40 05 57 – Actuators for Process Valves and Gates.
   3. Division 40 Valve Specifications

1.2 REFERENCES

A. AWWA (American Water Works Association):
   1. C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
   2. C542 - Electric Motor Actuators for Valves and Slide Gates.
   3. C550 - Protective Interior Coatings for Valves and Hydrants.

B. ASTM International:
   1. B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
   2. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

C. MSS (Manufacturers Standardization Society):
   1. SP-25 - Standard Marking System for Valves, Fittings, Flanges, and Unions.

D. NEMA (National Electrical Manufacturers Association):
   1. 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. NFPA:
   1. 70 - National Electrical Code (NEC).

F. NSF International:
   1. 61 - Drinking Water System Components - Health Effects.
   2. 372 - Drinking Water System Components - Lead Content.

G. UL:
   1. Equipment Directory.

1.3 COORDINATION

A. Coordinate Work of this Section with piping, equipment, and appurtenances.

1.4 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures for general submittal requirements.

B. Product Data:
   1. Submit manufacturer information for actuator with model number and size indicated.
   2. Submit valve cavitation limits.

C. Shop Drawings:
   1. Indicate parts list, materials, sizes, position indicators, limit switches, actuator mounting, wiring diagrams, and control system schematics.

D. Valve-Labeling Schedule:
   1. Indicate valve locations and nametag text.

E. Manufacturer's Certificate:
   1. Certify that products meet or exceed specified requirements.

F. Certification of Valves Larger Than 12 Inches:
   1. Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.

G. Include separate Paragraphs for additional certifications.

H. Include following Paragraph when Contractor is responsible for designing products or assemblies. List affected products when Section specifies more than one product.

I. Delegated Design Submittals:
   1. Submit signed and sealed Shop Drawings with design calculations and assumptions for sizing of control valves.

J. Manufacturer Instructions:
   1. Submit installation instructions and special requirements.

K. Source Quality-Control Submittals:
   1. Indicate results of factory tests and inspections.

L. Field Quality-Control Submittals:
   1. Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

M. Manufacturer Reports:
   1. Certify that equipment has been installed according to manufacturer instructions.

N. Qualifications Statement:
   1. Submit qualifications for manufacturer and licensed professional.

O. Closeout Submittals
   1. Section 01 77 00 – Closeout Procedures: Requirements for submittals.
   2. Project Record Documents:
      a. Record actual locations of valves and actuators.

1.5 QUALITY ASSURANCE

A. Maintain clearances as indicated on Drawings and Shop Drawings.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.6 QUALIFICATIONS

A. Manufacturer:

1. Company specializing in manufacturing products specified in this Section with minimum three years' experience.

B. Licensed Professional:
1. Professional engineer experienced in design of specified Work and licensed in State of Work.

1.7 SOURCE QUALITY CONTROL

A. Requirements for testing, inspection, and analysis as specified in Section 01 40 00 – Quality Requirements.

B. Test and install valves according to AWWA valve standards.

1.8 EXISTING CONDITIONS

A. Field Measurements:
1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.9 WARRANTY

A. Furnish manufacturer's warranty for valves and actuators as indicated in valve specification sections.

B. See Section 01 78 36 – Warranties and Bonds for additional requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where a manufacturer's standard equipment name and/or model number is listed, the equipment system shall be provided and modified as required to conform to the performance, functions, features, and materials of construction as specified herein.

B. Like items of equipment shall be the end products of one manufacturer to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer’s services.

C. Design Requirements:
1. Valve class shall meet the requirements of the connecting line or as indicated in the valve schedule or on the drawings.
2. Bubble-tight at rated pressure, or any pressure lower than rated, applied from either side with the valve mounted in any orientation.
3. Suitable for applications involving frequent throttling and applications requiring valve actuation after long periods of inactivity.

2.2 VALVES

A. Description:
1. Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required.

B. Valve Ends:
1. Compatible with adjacent piping system.

C. Operation:
   1. Open by turning counterclockwise; close by turning clockwise.
   2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

D. Valve Marking and Labeling:
   1. Marking: Comply with MSS SP-25.
   2. Provide buried valves with valve boxes, covers, and extensions.

E. Valve Construction:
   1. Bodies: Rated for maximum temperature and pressure to which valve will be subjected as specified in valve Sections.
   2. Bonnets:
      a. Clamped, screwed, or flanged to body and of same material and pressure rating as body.
      b. Furnish glands, packing nuts, or yokes as specified in valve Sections.
   3. Stems and Stem Guides:
      a. Materials and Seals: As specified in valve Sections.
      b. If subject to dezincification, consider specifying bronze valve stems to conform to ASTM B62. Where dezincification is not a problem, bronze conforming to ASTM B584 may be considered.
      c. Bronze Valve Stems: According to ASTM B62.
      d. Space stem guides 10 feet o.c.
      e. Submerged Stem Guides: Type 304 stainless steel.
   4. Nuts and Bolts: As specified in Section 05 50 00 – Metal Fabrications.

2.3 VALVE ACTUATORS

A. As specified in Section 40 05 57 – Actuators for Process Valves and Gates.

2.4 FINISHES

A. Valve Lining and Coating:
   1. Comply with AWWA C550.

B. Exposed Valves:
   1. As specified in individual valve specifications. In the absence of specification, provide manufacturer’s standard.

C. Do not coat flange faces of valves unless otherwise specified.

2.5 SOURCE QUALITY CONTROL

A. Section 01 60 00 - Product Requirements: Requirements for testing, inspection, and analysis.

B. Testing:
   1. Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

C. Include one or both of following Paragraphs to require Owner's inspection or witnessing of test at factory.

D. Owner Witnessing:
   1. Allow witnessing of factory inspections and test at manufacturer's test facility as requested by the Owner.

2. Notify Owner at least seven days before inspections and tests are scheduled.

E. Certificate of Compliance:
1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection:
1. Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:
1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
3. Provide additional protection according to manufacturer instructions.

3.2 EXAMINATION

A. Verify that piping system is ready for valve installation.

3.3 INSTALLATION

A. Install valves, actuators, extensions, valve boxes, and accessories according to manufacturer instructions.

B. Firmly support valves to avoid undue stresses on piping.

C. Coat studs, bolts, and nuts with anti-seizing lubricant.

D. Clean field welds of slag and splatter to provide a smooth surface.

E. Install valves with stems upright or horizontal, not inverted.

F. Install brass male adapters on each side of valves in copper-piped system and solder adapters to pipe.

G. Install 3/4-inch ball valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and equipment.

H. Install valves with clearance for installation of insulation and to allow access.

I. Provide access where valves and fittings are not accessible.

J. Pipe Hangers and Supports:

1. As specified in Section 40 05 07 – Hangers and Supports for Process Piping.

K. Valve Applications:
1. For connections at existing lines, tees, and connections to equipment less than 3”, install ball valves for water service.
2. For connections at new/existing lines containing solids (i.e., tees and connections to equipment less than 3”), install plug valves for wastewater service.

3.4 FIELD QUALITY CONTROL

A. Section 01 60 00 – Product Requirements: Requirements for inspecting and testing.

B. Valve Field Testing:
1. Test for proper alignment.
2. Field test equipment to demonstrate operation without undue noise, vibration, or overheating.
3. Engineer will witness field testing.
4. Valves may be either tested while testing pipelines, or as a separate step.
5. Test that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, in both directions for two-way valves and applications.
6. For multi-turn valves, count and record number of turns to open and close valve. Account for any discrepancies with Manufacturer’s data.

3.5 MANUFACTURER’S SERVICES

A. A Manufacturer’s representative for each type of valve installed shall be present at the jobsite for the minimum person-days listed for the services herein under, travel time excluded:
1. 1 person-days for installation assistance, inspection, and certification of the installation. Provide certificate.
2. 1 person-days for functional and performance testing.
3. 1 person-days for pre-startup classroom or jobsite training of Owner’s personnel.

B. Training of Owner’s personnel shall be at such times and at such locations as requested by Owner.

C. See Section 01 75 00 – Startup Testing and Training.

3.6 VALVE TYPE SCHEDULE

A. The following schedule lists valve identifiers and types that are referenced throughout the contract drawings and specifications. Not all valves listed are included on the project – refer to drawings and section schedules.

VALVE TYPE SCHEDULE		
Valve Type	**Description**	**Section**
V300	Metal Body Ball Valve, less than 6 Inches	40 05 63 – Ball Valves
V330	PVC/CPVC Ball Valves	40 05 63 – Ball Valves
V404	Eccentric Plug Valve, 1/2 Inch through 3 Inches	40 05 62 – Plug Valves
V405	Eccentric Plug Valve, 4 Inches through 12 Inches	40 05 62 – Plug Valves

END OF SECTION

SECTION 40 05 57 – ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manual actuators.
   2. Electric motor actuators.
   3. Pneumatic rotary vane actuators.

B. Related Requirements:
   1. Section 01 33 00 – Submittal Procedures.
   2. Section 01 60 00 – Product Requirements.
   3. Section 05 50 00 – Metal Fabrications.
   4. Section 40 05 07 – Hangers and Supports for Process Piping.
   5. Section 40 05 51 – Common Requirements for Process Valves.

1.2 GENERAL

A. The Contractor shall coordinate between the valve actuator/control valve supplier and the control system supplier to provide a complete and fully operational system. It will be the valve/actuator supplier's responsibility to provide actuators that can send and accept the necessary signals from the control system. The valve/actuator supplier shall provide any limit switches, positioners, or other devices necessary to enable the status of the valves to be monitored and controlled by the control system.

B. Valve and gate operators may be provided as part of a vendor equipment package. The Contractor shall be responsible for test, inspection, and assisting the equipment suppliers in start-up services as required to the place the operators into continuous, reliable operation.

1.3 REFERENCES

A. ABMA (American Bearing Manufacturers Association):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. AWWA (American Water Works Association):
   1. C500 - Metal-Seated Gate Valves for Water Supply Service.
   2. C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
   3. C542 - Electric Motor Actuators for Valves and Slide Gates.

C. NFPA:
   1. 70 - National Electrical Code.

D. National Electrical Manufacturer’s Association (NEMA)

1.4 COORDINATION

A. Coordinate Work of this Section with installation of valves and accessories.

1.5 SUBMITTALS

A. Section 01 33 00 – SUBMITTAL PROCEDURES: Requirements for submittals.

B. Product Data:
   1. Submit manufacturer information for actuator with model number and size indicated.

C. Shop Drawings:
   1. Indicate parts list, materials, sizes, position indicators, limit switches, control system, actuator mounting, wiring diagrams, control system schematics on assembly drawings.
   2. Submit actuator Shop Drawings with valve and gate submittal.
   3. Product data sheets for make and model.
   4. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
   5. Complete motor nameplate data.
   6. Open/close and throttle actuators sizing calculations including factor of safety used and final torques used for actuation selection.
   7. Operating torque calculations, including factor of safety used and final torques used for actuation selection, for each gate size, valve size and class.
   8. Maximum starting and normal operating torques for the operators supplied. Size operator for maximum starting torque.
   9. Refer to specific valve type for additional submittal requirements.

D. Quality Control Submittals:
   1. Special shipping, storage and protection, and handling instructions.
   2. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
   3. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Include separate Paragraphs for additional certifications.

G. Manufacturer Instructions: Submit special procedures and placement requirements.

H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

J. Qualifications Statements:
   1. Submit qualifications for manufacturer and installer.
   2. Submit manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 77 00 – CLOSEOUT PROCEDURES: Requirements for submittals.

B. Project Record Documents: Record actual locations and types of actuators.

1.7 QUALITY ASSURANCE

A. Valve Actuators in NEC Class I, Group D, Division 1 or 2 Hazardous Locations: Provide actuators bearing agency approvals for installed hazardous location.

B. Perform Work according to AWWA standards.

C. Actuator/operator manufacturer shall coordinate with the valve/gate manufacturer and submit calculations showing the maximum and normal operating torques for the valves/gates and operators supplied.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with Section 01 60 00 – PRODUCT REQUIREMENTS: Requirements for transporting, handling, storing, and protecting products.

B. Inspection:
   1. Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Supplier shall provide storage instructions to ensure that materials are stored according to manufacturer instructions.

D. Protection:
   1. Supplier shall provide storage instructions for General Contractor.
   2. General Contractor’s basic storage requirements include:
      a. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
      b. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
      c. Provide additional protection according to manufacturer instructions.

1.10 SOURCE QUALITY CONTROL

A. Section 01 60 00 – Product Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assemblies.

1.11 EXISTING CONDITIONS

A. Field Measurements:
   1. Where required, Supplier shall verify field measurements prior to fabrication.
   2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

A. See Specification 01 78 36 – WARRANTIES AND BONDS for requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish gear and power actuators with position indicators.
   1. Tail rods on hydraulic cylinders, or dial indicators with clear full-open and closed position indicators, calibrated in number of turns or percentage of opening.

B. Valve handles to take a padlock and wheels a chain and padlock.

C. Worm Gear Operators:
   1. 1. Provide gearing on worm gear operators that is self-locking with gear ratio such that torque more than 160 foot-pounds will not need to be applied to operate valve at most adverse conditions for which valve is designed.

D. Traveling Nut Operators:
   1. Capable of requiring maximum 100 foot-pounds of torque when operating valve under most adverse condition; limit stops on input shaft of manual operators for fully open and closed positions; non-moving vertical axis of operating nut when opening or closing valve.

E. Open Direction Indicator:
   1. Cast arrow and legend indicating direction to rotate operator on handwheel, chain wheel rim, crank, or other prominent place.

F. Operation:
   1. Counterclockwise to open with suitable and adequate stops, capable of resisting at least twice normal operating force to prevent overrun of valve or gate in open or closed position.

G. Provisions for Alternate Operation:
   1. Where specified or indicated on the Drawings, position and equip crank- or handwheel-operated geared valve operators or lifts for alternate operation with tripod mounted portable gate operators.

H. Manual or Power Operator Size:
   1. Sized to deliver maximum force required under most severe specified operating condition, including static and dynamic forces, seat and wedge friction, and seating and unseating forces with safety factor of 5, unless otherwise specified.

I. Wall Brackets or Haunches:
   1. As indicated on the Drawings.

J. Stems:
   1. Stainless steel; sized to match output of operator; minimum gate or valve operating stem diameter; maximum 200 slenderness ratio.

K. Stem Couplings:
   1. Stainless steel; internally threaded to match stem; lockable to stem by set screw.

L. Stem Guides:
   1. Cast iron with silicon bronze bushing; maximum 200 slenderness ratio; capable of being mounted with a wall bracket; adjustable in 2 directions.

M. Wall Brackets:
   1. Cast iron, capable of withstanding the output of the operator; adjustable in 2 directions.

N. Stem Stuffing Boxes:
   1. Cast iron, with adjustable gland and packing.

O. Fasteners and Anchor Bolts:
   1. 316 stainless steel.

P. Geared Valve Operators:
   1. Provided with cut gears, either spur or worm; sized to operate valves at most adverse design condition; with maximum 40-pound pull at handwheel or chain wheel rim.

Q. Geared Valve Traveling Nut Operators:
1. Acceptable only where specified or indicated on the Drawings.

R. Accessory Equipment for Valves and Gates Requiring Remote Operators:
1. Operating stems, stem couplings, stem guides, wall brackets, and stem stuffing boxes.

2.2 MANUAL ACTUATORS

A. Exposed Actuators
1. Valves Smaller than 6 Inches:
a. Infinite-position lever handle with memory stop.
2. Valves 6 Inches and Larger:
a. Comply with AWWA C500-19.
3. Drive Type:
a. Worm gear.
4. Bearings:
a. Ball or roller type.
b. Bearing life is percent failure at rated hours; for example, L10 life at 50,000 hours means 10 percent of bearings may be expected to fail at 50,000 hours.
c. Minimum L10 Life: 100,000 hours.
5. Gear-Assisted Manual Actuators:
a. Provide totally enclosed gears.
b. Maximum Operating Force: not to exceed 40 pounds under any operating condition, including initial breakaway, add gear reduction operator when force exceeds 40 pounds.
c. Bearings: Permanently lubricated bronze.
d. Packing: Accessible for adjustment without requiring removal of actuator from valve.
e. Gearing: Designed for 100 percent overload.
6. Handwheel:
a. Manufacturers: One of the following, or pre-approved equal:
1) Rodney Hunt Company.
2) Waterman Industries, Incorporated.
b. Minimum 24-inch diameter.
c. Galvanized and painted hand wheels
d. Mounting: Floor stand or bench stand. Unless otherwise indicated on the Drawings position operator 36 inches (nominal) above top of walkway surface.
e. Pull to Operate: Maximum 40 pounds pull at most adverse design condition.
f. Stem Travel Limiting Device: Setscrew locked stop nuts above and below lift nut.
g. Grease Fittings: Suitable for lubrication of bearings.
7. Hand-Cranked Geared Operators
a. Cranks on gear type operators for gates or pedestal mounted gearing.
b. Type: Single removable crank; fully enclosed.
c. Mounting: Floor and Bench Stand. Unless otherwise indicated on the Drawings, position the operator 36-inches (nominal) above the top of the walkway surface.
d. Operating Nut: When scheduled for portable operators.
e. Geared Lifts: 2-speed with minimum ratio of 4 to 1.
f. Teeth on Gears, Spur Pinions, Bevel Gears, and Bevel Pinions: Cut.
g. Lift Nuts: Cast manganese bronze.
h. Exterior Surfaces on Cast Iron Lift Parts: Smooth.
i. Bearings above and below Flange on Lift Nuts: Ball or roller; capable of taking thrust developed by opening and closing of gates under maximum operating head; with bronze sleeve bearings and sufficient grease fittings for lubrication of moving parts, including bearings and gears.
j. Crank Rotation Indicator: Cast arrow with word OPEN in prominent, readily visible location indicating correct rotation of crank to open gate.

k. Hand Cranks: 15-inch radius; requiring maximum 25 pounds pull to operate gate at maximum operating head with:
l. Revolving brass sleeves.
m. Gears, spur pinions, bevel gears, and bevel pinions with cut teeth.
n. Cast manganese bronze lift nuts.
o. Cast iron lift parts with smooth exterior surfaces.
p. Indicator: Dial position type mounted on gear operator; enclosed in cast-iron or aluminum housing with clear plastic cover; marked with fully open, 3/4, 1/2, 1/4, and closed positions.

B. Chain Actuators:
1. Description:
a. Chain actuators for shutoff valves mounted 6'-9" feet and greater above operating floor level.
b. Chain guides and hot-dip galvanized operating chain extending to 5-1/2 feet above operating floor level.
2. Chain Wheels: Sprocket rim type.
3. Furnish chain storage if chains may interfere with pedestrian traffic.
4. Chain:
a. Galvanized or cadmium-plated.
5. Manufacturers and Products:
a. Clow Valve – F-5680
b. Walworth Co. – Figure 804
c. DeZurik – G-Series

2.3 MOTORIZED ACTUATORS

A. Motorized operators for gates and valves shall be the product of a single supplier for each type of gate or valve.

B. Approved Manufacturers:
1. Auma.
2. Limitorque Company.
3. EIM Company.
4. Rotork.

C. Design:
1. Sized to move gates or valves from full open to closed position at minimum 12 inches per minute, plus or minus 10 percent, under maximum load.
2. Actuator:
a. Provide with built-in device to allow motor to reach full speed before engaging valve or gate load; in manual operating mode when motor is not energized; in electrical operating mode when motor is energized.
b. Actuators shall be suitable for indoor and outdoor use, in an ambient temperature ranging from -10 deg F to 160 deg F.
3. Handwheels for Manual Operation:
a. Metallic with arrows to indicate "open" rotation; incapable of rotation during motor operation; unaffected by fused motor; maximum 80 pound pull on rim when rotating.
4. Declutch Lever:
a. Padlockable, capable of mechanically disengaging motor and related gearing positively when motor is deenergized and freeing handwheel for manual operation.
5. Position Indication:
a. Shall be accomplished by means of a digital display in full step at all times with valve or slide gate travel during either power or manual operation.

D. Actuator Gearing:
   1. Valve Actuator Gearing:
      a. Multiple reduction type with hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set in drive train to maintain valve position.
   2. Gate Actuator Gearing:
      a. Multiple reduction type with hardened alloy steel spur gear, bevel pinion and bevel gears; self-locking to maintain gate position.
   3. Power Gearing:
      a. Hardened alloy steel; accurately cut to assure minimum backlash; anti-friction bearing with caged balls or rollers throughout.
   4. Stem Nuts:
      a. High tensile manganese bronze; accurately machined and mounted in heavy ball or roller bearings; minimum 2-1/4 times stem diameter for length of thread in lift nuts.
   5. Actuator Gear Housing:
      a. Ductile iron.
   6. Lubrication:
      a. Rotating power train components immersed in grease with provisions for inspection and re-lubrication without disassembly.
      b. Lubricants:
         1) Suitable for ambient conditions of (-20)–150°F.
      c. Provide seals on shafting.

E. Motors:
   1. Type: Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
   2. Motor Insulation: Minimum NEMA Class F, with a maximum continuous temperature rating of 311°F, rise plus ambient.
   3. Motor Windings: Epoxy treated.
   4. Thermal Protection: Provide winding thermal protection.
   5. Size: Sufficient to open and close valves at maximum stated torque.
   6. Voltage Tolerance: Capable of operating at within 10% of specified voltage.
   7. Motor Duty Ratings: 15-minute duty rating for open and close service; continuous duty rating for modulating service.
   8. Accessories: Internal thermal contacts, heaters in motor and switch compartment, and ground lug.
   9. Power Supply: As scheduled or as indicated on the Drawings.
   10. Enclosures for Motors, Switches, and Other Electrical Compartments:
      a. Where explosion-proof construction is indicated on the Drawings, provide NEMA 7 enclosures.
      b. Other Locations: Provide NEMA 4X enclosures.

F. Controls:
   1. Voltage Transformer: As required to step down power supply to control voltage.
   2. Control Station:
      a. Integral with operator. Provide separate remote-mounted control enclosure if indicated on drawings.
         1) Where explosion-proof construction is indicated on the Drawings, provide NEMA 7 enclosure.
         2) For other locations, provide NEMA 4X enclosure.
      b. Provide integral LOCAL/OFF/REMOTE selector switch and OPEN/CLOSE/STOP pushbuttons.
         1) “LOCAL” position provides operation from push buttons.
         2) “REMOTE” position enables control from a remote source.
      c. Provide OPEN/CLOSE/STOP indicating lights and 0 to 100 percent position indication.

d. Provide the following contacts for remote connection:
    1) Switch in Remote Position
    2) Fully Closed
    3) Fully Open
    4) Fault

3. Limit switches and associated gearing shall be integral with valve actuator.
    a. Gearing: Intermittent type; bronze or stainless steel; grease lubricated; totally enclosed.
    b. Contacts: Heavy duty and silver plated with wiping action.
    c. Remote Indication Contacts: As indicated on the Drawings.
    d. Switches: Adjustable; allowing for trip points from fully open to closed positions of valve travel; not subject to breakage or slippage due to over-travel; permits visible verification of switch position without disassembly.
4. Torque Limit Switch:
    a. Capable of interrupting control circuit in both opening and closing when valve torque overload occurs.
    b. Silver plated contacts.
    c. Graduated dials for both open and close directions of travel, each independently adjustable.
    d. Positive means to limit adjustability to avoid exceeding actuator output torque capability with Belleville activating spring pack.
    e. Permits visible verification of switch position without disassembly.

G. Operation:
1. Open-Close Service:
    a. Operators shall operate automatically by remote signal specified and as indicated on the Drawings.
    b. When the selector switch is in the REMOTE position, the self-contained electromechanical reversing starter shall cause valve or gate to open or close on receiving a remote signal.
    c. When the selector switch is in the ON position, the local control station will control the motorized operator.
2. Controller System:
    a. Rated for continuous duty.

H. Valve Limit Switches:
1. Mechanical cam gear for remote operation, indication, and other control; compatible with associated operation and suitable for service intended; for valves specified and indicated on the Drawings; with racks, gears, cam, linkage mountings, and accessories.
2. Contact Ratings: 120 volt alternating current, 20 amperes at 75-100% power factor, and 24 volt direct current, 5 amperes minimum.
3. Enclosures:
    a. Watertight and oiltight for normal service.
4. Valve box:
    a. Large enough to contain and to allow easy adjustment of limit switch without switch's removal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field dimensions are as indicated on Shop Drawings.

3.2 SHIPPING, STORAGE, HANDLING, AND PROTECTION

A. As specified in Section 01 60 00 – PRODUCT REQUIREMENTS.

3.3 INSTALLATION

A. Complete equipment installation with controls, safety devices and auxiliary support systems necessary to start the equipment and verify that the equipment functions correctly under no load conditions. Turn rotating equipment by hand to check. Complete cleaning and testing of piping systems. Inspect and clean equipment, devices, piping, and structures of debris and foreign material.

B. Securely mount actuators using brackets or hardware specifically designed for attachment to valves.

C. Extend chain actuators to 5-1/2 feet above operating floor level.

D. Install operators in accordance with Manufacturer’s instructions.

E. Remove temporary bracing supports and other construction debris that may damage equipment.

F. Remove protective coatings and oils used for protection during shipment and installation.

G. Flush, fill, and grease lubricated systems in accordance with Manufacturer's instructions.

H. Install temporary connections and devices required to fill, operate, checkout and drain the system. Provide temporary valves, gauges, piping, test equipment, and other materials and equipment necessary to conduct testing and startup.

I. Check equipment for correct direction of rotation and freedom of moving parts.

J. Align equipment to Manufacturer's tolerances. Adjust clearances and torques.

K. Check installation prior to start-up for conformance to Manufacturer's instructions.

L. Adjust or modify equipment to ensure proper operation.

M. Correct any deficiencies or problems noted in Manufacturer's representative's installation reports.

3.4 FIELD QUALITY CONTROL

A. After installation, inspect for proper supports and interferences.

B. Repair damaged coatings with material equal to original coating as specified in Section 09 96 00 – HIGH PERFORMANCE COATINGS.

C. Verify that structures, equipment, pipes, valves, fittings, and other appurtenances are compatible. Coordinate field devices, voltages, signal types, power needed, and programming with valve operator to provide proper functioning system.

3.5 MANUFACTURER'S REPRESENTATIVE

A. The services of the manufacturer's technical representative shall be provided for pre-startup installation checks, startup assistance, training of Owner’s personnel, troubleshooting, acceptance testing, and other services as required within these Contract Documents.

B. Manufacturer's representative shall:

1. Approve installation in writing to Engineer before operation.
2. Verify conformance to all specified requirements.
3. Fully instruct all designated personnel for the plant on proper care, maintenance, and operation of all equipment and appurtenances.
4. Perform specified acceptance tests and operate system to verify satisfactory operation of all equipment in presence of Owner's personnel and Engineer.
5. Check all equipment for excessive noise or vibration, proper alignment, general operation, etc.
6. Operate the equipment through the design performance range consistent with available flows. Adjust, balance, and calibrate and verify that the equipment, safety devices, controls, and process system operate within the design conditions. Each safety device shall be tested for proper setting and signal. Response shall be checked for each equipment item and alarm. Simulation signals may be used to check equipment and alarm responses.
7. Place each piece of equipment in the system in operation until the entire system is functioning. All components shall continue to operate without alarms or shutdowns, except as intended, for 8 consecutive hours to be considered started up.
8. Submit certified written field reports as required by Section 01 33 00 – SUBMITTAL PROCEDURES.
9. Provide a certificate by the valve actuator supplier indicating proper installation and start-up procedures have been followed. This certificate shall be required and included as part of the final operation and maintenance manuals in order to validate the specified three (3) year warranty.
10. Revisit job sites as often as necessary beyond minimum services specified to correct deficiencies to satisfaction of ENGINEER.

3.6 ACTUATOR MOUNTING

A. Actuator Mounting Responsibility: Valves to be actuated shall be shipped to the manufacturer's approved Valve Automation Fabricator (see AWWA C504-94, Section 1.6, Assembly) for complete assembly, calibration, and testing in order to validate the warranty. A certification of the calibration, testing, and warranty shall be included in the final O&M manuals.

B. Retrofit Actuators: Valves to be retrofit with new pneumatic actuators shall remain in place during retrofit process unless otherwise shown on the plans. Each size and model valve shall be field surveyed by the Valve Automation Fabricator. The survey by actuator representative shall include supervising the removal of the existing actuator if necessary in order to measure the top works of the valve. The actuator supplier shall supervise the mounting, installation, and testing of the new retrofit actuators.

3.7 ACCEPTANCE TEST

A. Upon completion of the installation of each valve actuator, an acceptance test will be conducted to verify the satisfactory operation and performance of each actuator. Each valve shall be opened and closed using the plant control system as applicable (AUTO) and manually. The control valves shall also be tested under power loss to verify proper closure.

B. The test shall be conducted in a manner approved by and in the presence of the ENGINEER. The equipment and piping will be completely checked for leakage, general operation, etc.

C. Each valve actuator must perform in a manner acceptable to the ENGINEER before the OWNER will make final acceptance.

END OF SECTION

SECTION 40 05 59.99 –SLIDE GATE REHABILITATION

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all labor, materials, equipment and incidentals required to repair the existing headworks gates as shown on the Drawings and as specified herein.

B. The gates and appurtenances shall be supplied in accordance with the latest edition of AWWA C561 standard for fabricated stainless steel slide gates as modified herein.

1.2 QUALITY ASSURANCE

A. Rodney Hunt, Inc of Orange, MA is the manufacturer of the existing gates and shall supply the items specified herein.

PART 2 - PRODUCTS

2.1 SEALS

A. All gates shall be supplied with new UHMW polyethylene seat/seals to restrict leakage and to prevent metal to metal contact between the frame and slide.

B. All gates shall be supplied with a new resilient seal to seal the bottom portion of the gate.

2.2 ELECTRIC MOTOR ACTUATORS

A. See section 40 05 57 – Actuators for Process Valves and Gates

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Two (2) trips, two (2) days on-site each trip of a factory field service technician shall be included to inspect installation and operation of the rehabilitated slide gates.

END OF SECTION

SECTION 40 05 62 - PLUG VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Type V404: Eccentric Plug Valve, 1/2 Inch through 3 Inches.
   2. Type V405: Eccentric Plug Valve, 4 Inches through 12 Inches.

B. Related Requirements:
   1. Section 40 05 51 – Common Requirements for Process Valves.
   2. Section 40 05 57 – Actuators for Process Valves and Gates.

1.2 REFERENCES

A. American Water Works Association:
   1. AWWA C517 - Resilient-Seated Cast-Iron Eccentric Plug Valves.
   2. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.
   3. AWWA C606 - Grooved and Shouldered Joints.

B. ASME International:
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
   3. B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
   4. B1.20.1 - Pipe Threads, General Purpose, Inch.

C. ASTM International:
   1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. A536 - Standard Specification for Ductile Iron Castings.
   3. B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

D. NSF (National Science Foundation):
   1. 61 - Health Effects for Drinking Water System Components.
   2. 372 - Lead Content for Drinking Water System Components.

1.3 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures for general submittal requirements.

B. Product Data:
   1. Submit manufacturer information for system materials and component equipment.

C. Shop Drawings:
   1. Indicate system materials and component equipment.
   2. Submit installation and anchoring requirements, fasteners, and other details.
   3. Indicate valve identification number, location, service, type, size, design pressure, operator details, stem details, and loads.

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

E. Delegated Design Submittals:

1. Submit signed and sealed Shop Drawings with design calculations and assumptions for seating and unseating pressure.

F. Manufacturer Instructions:
1. Submit detailed instructions on installation requirements, including storage and handling procedures.

G. Source Quality-Control Submittals:
1. Indicate results of factory tests and inspections.

H. Field Quality-Control Submittals:
1. Indicate results of Contractor-furnished tests and inspections.

I. Manufacturer Reports:
1. Certify that equipment has been installed according to manufacturer instructions.
2. Indicate activities on Site, adverse findings, and recommendations.

J. Closeout Submittals
1. Section 01 77 00 – Closeout Procedures: Requirements for submittals.
2. Project Record Documents:
a. Record actual locations of installed valves and components.

1.4 QUALITY ASSURANCE

A. Materials in Contact with Potable Water:
1. Certified to NSF Standard 61 and NSF Standard 372.

1.5 QUALIFICATIONS

A. Manufacturer:
1. Company specializing in manufacturing products specified in this Section with minimum five years' experience.

B. Licensed Professional:
1. Professional engineer experienced in design of specified Work and licensed in the State of the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection:
1. Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:
1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.7 WARRANTY

A. Furnish three-year manufacturer's warranty for valves.

B. See Section 01 78 36 – Warranties and Bonds for additional requirements.

PART 2 - PRODUCTS

2.1 TYPE V404: ECCENTRIC PLUG VALVE, ½ INCH THROUGH 3 INCHES

A. Manufacturers:
1. DeZURIK.
2. Henry Pratt.

B. General:
1. Type:
   a. Non-lubricated.
   b. Eccentric.
2. Working Pressure: 175 psig CWP
3. Maximum Process Fluid Temperature: 300 deg. F.
4. Ports:
   a. Configuration: Rectangular.
   b. Minimum Port Area: 80 percent of nominal pipe area.
5. Stem Bearings: Self-lubricating.
6. Stem Seals:
   a. Type: V-ring.
   b. Material: Buna-N or NBR.
7. Packing and Gland: Accessible and externally adjustable.
8. End Connections:
   a. Threaded NPT full size inlets
   b. Hexagonal for a wrench connection

C. Operation:
1. Actuators as specified in valve schedule or 40 05 57 - Actuators for Process Valves and Gates.
2. Provide valves with wrench level manual operator.

D. Materials:
1. Body:
   a. Cast iron, ASTM A126 Class B or stainless steel where indicated.
   b. Lining: Epoxy, in accordance with AWWA C550 unless otherwise specified.
2. Plug:
   a. Plug cast iron with round or rectangular port of no less than 80% of connecting pipe area and coated with Buna-N or Hycar.
3. Seats: Nickel.
4. Stem: Type 316 stainless steel.
5. Stem Bearings: Stainless steel.
6. Seals: PTFE.
7. Connecting Hardware: Type 316 stainless steel.

E. Finishes:
1. Match adjoining pipe.

2.2 TYPE V405: ECCENTRIC PLUG VALVE, 4 INCHES THROUGH 12 INCHES

A. Manufacturers:
1. DeZURIK.
2. Val-Matic.
3. Henry Pratt.

B. General:
   1. Type:
      a. Non-lubricated.
      b. Eccentric.
   2. Working Pressure: 175 psig CWP
   3. Maximum Process Fluid Temperature: 300°F.
   4. Ports:
      a. Configuration: Rectangular.
      b. Minimum Port Area: 80 percent of nominal pipe area.
   5. Stem Bearings: Self-lubricating.
   6. Stem Seals:
      a. Type: V-ring.
      b. Material: Buna-N or NBR.
   7. Packing and Gland: Accessible and externally adjustable.
   8. End Connections:
      a. Flanged: Comply with ASME B16.1, or
      b. Grooved ends in accordance with AWWA C606 for rigid joints,
      c. Mechanical joint ends for buried valve.

C. Operation:
   1. Actuators as specified in valve schedule or 40 05 57 - Actuators for Process Valves and Gates.
   2. 4” valve with wrench lever manual operator and 6 through 12” valve with totally enclosed, geared, manual operator with hand wheel, 2” nut, or chain wheel.

D. Materials:
   1. Body:
      a. Cast iron, ASTM A126 Class B or stainless steel where indicated.
      b. Lining: Epoxy, in accordance with AWWA C550 unless otherwise specified.
   2. Plug:
      a. Plug cast iron with round or rectangular port of no less than 80% of connecting pipe area and coated with Buna-N or Hycar.
   3. Seats: Nickel.
   4. Stem: Type 316 stainless steel.
   5. Stem Bearings: Stainless steel.
   6. Seals: PTFE.
   7. Connecting Hardware: Type 316 stainless steel.

E. Finishes:
   1. Lining: In accordance with AWWA C550 unless otherwise specified.
   2. Coating: Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as “fusion” or “fusion boded” epoxy.
   3. Finish Coat: Match adjoining pipe.

PART 3 - EXECUTION

3.1 INSTALLATION

A. According to AWWA C517.

B. Horizontal Piping:
   1. Stem horizontal.

C. Vertical Piping:
   1. Plug at top when closed.

D. Plugs:
   1. On top when open and on pressure side when closed.

3.2 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, in both directions for two-way valve and applications.

C. Count and record number of turns to open and close valve; account for any discrepancies with Manufacturer's data.

3.3 MANUFACTURER'S SERVICES

A. A Manufacturer's representative for the equipment specified herein shall be present at the jobsite for the minimum person-days listed for the services herein under, travel time excluded:
   1. 2 person-days for installation assistance, inspection, and certification of the installation. Provide certificate.
   2. 2 person-days for functional and performance testing.
   3. 2 person-days for pre-startup classroom or jobsite training of Owner's personnel.

B. Training of Owner's personnel shall be at such times and at such locations as requested by Owner.

C. See Section 01 75 00 – Startup Testing and Training.

3.4 MANUFACTURER'S CERTIFICATE(S)

A. Provide Manufacturer's certificate(s) in accordance with Section 01 75 00 – Startup Testing and Training.

END OF SECTION

SECTION 40 05 63 – BALL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. V300 - Metal Body Ball Valve, less than 6 Inches.
   2. V330 - PVC/CPVC Ball Valves.

B. Related Requirements:
   1. Section 40 05 51 – Common Requirements for Process Valves.
   2. Section 40 05 57 – Actuators for Process Valves and Gates.

1.2 REFERENCES

A. AWWA (American Water Works Association):
   1. C507 - Ball Valves, 6 In. Through 60 In. (150 mm Through 1,500 mm).

B. ASME International:
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
   3. B16.11 - Forged Fittings, Socket-Welding and Threaded.
   4. B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
   5. B1.20.1 - Pipe Threads, General Purpose, Inch.

C. ASTM International:
   1. A48 - Standard Specification for Gray Iron Castings.
   2. D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   3. D3222 - Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
   4. D4101 - Standard Specification for Polypropylene Injection and Extrusion Materials.

D. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

A. See Section 01 33 00 – Submittal Procedures for general submittal requirements.

B. Product Data:
   1. Submit manufacturer information for system materials and component equipment.

C. Shop Drawings:
   1. Indicate system materials and component equipment.
   2. Submit installation and anchoring requirements, fasteners, and other details.
   3. Indicate valve identification number, location, service, type, size, design pressure, operator details, stem details, and loads.

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

E. Delegated Design Submittals:
   1. Submit signed and sealed Shop Drawings with design calculations and assumptions for seating and unseating pressure.

F. Manufacturer Instructions:
   1. Submit detailed instructions on installation requirements, including storage and handling procedures.

G. Source Quality-Control Submittals:
   1. Indicate results of factory tests and inspections.

H. Field Quality-Control Submittals:
   1. Indicate results of Contractor-furnished tests and inspections.

I. Manufacturer Reports:
   1. Certify that equipment has been installed according to manufacturer instructions.
   2. Indicate activities on Site, adverse findings, and recommendations.

J. Closeout Submittals:
   1. Section 01 70 00 – Execution Requirements: Requirements for submittals.
   2. Project Record Documents:
      a. Record actual locations of installed valve and components.

1.4 QUALITY ASSURANCE

A. Materials in Contact with Potable Water:
   1. Certified to NSF Standard 61 and NSF Standard 372.

1.5 QUALIFICATIONS

A. Manufacturer:
   1. Company specializing in manufacturing products specified in this Section with minimum five years' experience.

B. Licensed Professional:
   1. Professional engineer experienced in design of specified Work and licensed in the State of the Work.

1.6 SOURCE QUALITY CONTROL

A. Requirements for testing, inspection, and analysis as specified in Section 01 40 00 – Quality Requirements.

B. Test and install butterfly valves according to AWWA C507.

1.7 WARRANTY

A. Furnish minimum three-year manufacturer's warranty for valves.

B. See Section 01 78 36 – Warranties and Bonds for additional requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where a manufacturer's standard equipment name and/or model number is listed, the equipment system shall be provided and modified as required to conform to the performance, functions, features, and materials of construction as specified herein.

B. Like items of equipment provided herein shall be the end products of one manufacturer to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

C. Design Requirements:
1. Valve class shall meet the requirements of the connecting line or as indicated in the valve schedule or on the drawings.
2. Bubble-tight at rated pressure, or any pressure lower than rated, applied from either side with the valve mounted in any orientation.
3. Suitable for applications involving frequent throttling and applications requiring valve actuation after long periods of inactivity.

D. Operator:
1. As specified in valve schedules and Section 40 05 57 – Actuators for Process Valves and Gates.

2.2 TYPE V300: METAL BODY BALL VALVE, LESS THAN 6 INCHES

A. Manufacturers:
1. NIBCO –
   a. T-585-S6-R-66-LL (available in 1/4" – 2") for threaded connections
   b. F-515-S6-F-66-FS (available in 1/2" – 12") for flanged connections
2. Apollo – 76 Series
3. Milwaukee Valve – F20 Series (available in 1" – 12") for flanged connections

B. Typical Service:
1. Water
2. Drain
3. Sample locations
4. Compressed Air
5. RO Sample Panel

C. General:
1. Comply with MSS SP 110 (threaded or socket-welded valves)
2. Type: Non-lubricated and capable of sealing in either flow direction.
3. Minimum Working Pressure: As indicated on piping schedule.
4. Maximum Process Fluid Temperature: As indicated on piping schedule.
5. Port: Full.
6. End Connections:
   a. Threaded or socket weld for 2 inch and smaller.
   b. Class 150 flanged for sizes 3 inch and larger. Flanges shall conform to ANSI/ASME B16.1 standards.

D. Operation:
1. Operator: Hand lever unless specified otherwise in valve schedule or 40 05 57 - Actuators For Process Valves And Gates.

E. Materials:
1. Body:
a. Type: Two piece.
b. Materials:
1) All 316 Stainless steel compatible with service designated.
2) Ball: Type 316 Stainless steel.
2. Seats: PTFE.
3. Stem: [Stainless steel].
4. Stem Seals: PTFE or Viton
5. Bearings: Self-lubricated, corrosion resistant material that will not contaminate potable water.

F. Finishes:
1. Finish coat: Match adjoining pipe

2.3 TYPE V330: PVC/CPVC BALL VALVES

A. Manufacturers:
1. Georg Fischer – 546 Pro (available in 3/8” – 4”)
2. Asahi/America, Inc.
3. NIBCO/Chemtrol –
a. PVC – U-45TB-V (available in 1/2” – 2”) or S-45TB-V (available in 3” – 6”)
b. CPVC – U-51TB-V (available in 1/2” – 2”) or S-51TB-V (available in 3” – 6”)
4. Hayward Flow Control – TBH Series True Union (available in 1/4” – 6”)
5. Spears – True Union 2000 (available in 1/2” – 8”)

B. Typical Service:
1. Water
2. Chemicals
3. Drain
4. Sample locations

C. General:
1. Type: Non-lubricated and capable of sealing in either flow direction.
2. Working Pressure:
a. 1/2 inch to 2 inch – 250 psi.
b. 2-1/2 inch to 6 inch – 150 psi.
3. Maximum Process Fluid Temperature: As indicated on piping schedule.
4. Ports: Full size.
5. All ball valves on sodium hypochlorite lines and/or chlorine dioxide lines shall be venting type valves
6. End Connections:
a. True union: solvent or heat welded to piping. Defer to manufacturer’s recommendation for installation.

D. Operation:
1. Operator: Hand lever unless specified otherwise in valve schedule or 40 05 57 - Actuators For Process Valves And Gates.

E. Materials:
1. Body and Ball:
a. PVC, ASTM D1784 when adjoining to PVC pipe,
b. CPVC, ASTM D1784 when adjoining to CPVC pipe
2. Seats: PTFE.
3. O-rings: Viton (FKM)

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection:
   1. Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store materials according to manufacturer instructions.

D. Protection:
   1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
   2. Provide additional protection according to manufacturer instructions.

3.2 INSTALLATION

A. Valves installed according to AWWA C507.

3.3 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, in both directions for two-way valve and applications.

C. Count and record number of turns to open and close valve, account for any discrepancies with Manufacturer’s data.

3.4 MANUFACTURER’S SERVICES

A. A Manufacturer’s representative for the equipment specified herein shall be present at the jobsite for the minimum person-days listed for the services herein under, travel time excluded:
   1. 1 person-day for installation assistance, inspection, and certification of the installation. Provide certificate.
   2. 1/2 person-day for functional and performance testing.
   3. 1 person-day for pre-startup classroom or jobsite training of OWNER’S personnel.

B. Training of OWNER’S personnel shall be at such times and at such locations as requested by OWNER.

C. See Section 01 75 00 – STARTUP TESTING AND TRAINING.

3.5 MANUFACTURER’S CERTIFICATE(S)

A. Provide Manufacturer’s certificate(s) in accordance with Section 01 75 00 – Startup Testing and Training.

END OF SECTION

SECTION 40 23 39 – PROCESS PIPING – GENERAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Basic Process Piping Materials, Methods, and Appurtenances.

B. Related Sections:
   1. Section 01 60 00 – Product Requirements.
   2. Section 03 30 00 – Cast-In-Place Concrete.
   3. Section 09 96 00 – High-Performance Coatings.
   4. Section 40 05 00 – Piping Systems Testing.
   5. Section 40 05 06 – Process Piping Specialties.
   6. Section 40 42 00 – Process Mechanical Insulation.

1.2 REFERENCES

A. AASHTO (American Association of State Highway and Transportation Officials):
   1. Standard Specifications for Highway Bridges.

B. ANSI (American National Standards Institute):
   1. A21.52, Ductile Iron Pipe, Centrifugally Cast, for Gas.
   2. B1.20.1, Pipe Threads, General Purpose (Inch).
   3. B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
   4. B16.3, Malleable Iron Threaded Fittings.
   5. B16.5, Pipe Flanges and Flanged Fittings.
   6. B16.9, Factory-Made Wrought Steel Butt welding Fittings.
   7. B16.11, Forged Fittings, Socket-Welding and Threaded.
   8. B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250.
   9. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
   10. B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   11. B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 900, 1500, and 2500.
   12. B16.25, Butt Welding Ends.
   13. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300.

C. API (American Petroleum Institute):
   1. 5L, Specification for Line Pipe.

D. ASME (American Society of Mechanical Engineers):
   1. Boiler and Pressure Vessel Code, Section VITI, Division 1, Pressure Vessels.
   2. Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
   3. B31.1, Power Piping.
   4. B31.3, Process Piping.
   5. B31.9, Building Services Piping.
   6. B36.10M, Welded and Seamless Wrought Steel Pipe.

E. ASNT (American Society for Nondestructive Testing):
   1. SNT-TC-1A, Recommended Practice for Nondestructive Testing Personnel Qualifications.

F. ASTM (American Society for Testing and Materials):
   1. A47, Standard Specification for Ferritic Malleable Iron Castings.

2. A53 Rev A, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. A105, Standard Specification for Carbon Steel Forgings for Piping Applications
4. A106, Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service.
5. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
6. A135, Standard Specification for Electric-Resistance-Welded Steel Pipe.
7. A139 Rev A, Standard Specification for Electric-Fusion (Arc) -Welded Steel Pipe (NPS 4 and over).
8. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
9. A181 Rev A, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
10. A182 Rev C, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
11. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.
12. A193 Rev A, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
13. A194, Standard Specification for Carbon Steel, Stainless Steel, and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or both.
14. A197, Standard Specification for Cupola Malleable Iron.
15. A216, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
16. A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Services.
17. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
18. A276, Standard Specification for Stainless Steel Bars and Shapes.
19. A283 Rev A, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
20. A285, Standard Specification for Pressure Vessel Plates, Carbon Steel, Low and Intermediate Tensile Strength.
21. A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
22. A312, Standard Specification for Seamless and Welded Austenitic Stainless-Steel Pipes.
23. A320, Standard Specification for Alloy Steel and Stainless-Steel Bolting Materials for Low-Temperature Service.
24. A395, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
25. A403 Rev A, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
26. A409, Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service.
27. A536, Standard Specification for Ductile Iron Castings.
28. A563, Standard Specification for Carbon and Alloy Steel Nuts.
29. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
30. A774, Standard Specification for As-Welded Wrought Austenitic Stainless-Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
31. A778 Rev A, Standard Specification for Welded, Un-annealed Austenitic Stainless Steel Tubular Products.
32. B32, Standard Specification for Solder Metal.
33. B43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
34. B61, Standard Specification for Steam or Valve Bronzed Casting.
35. B62, Standard Specification for Composition Bronzed or Ounce Metal Castings.
36. B75, Standard Specification for Seamless Copper Tube.

37. B88 Rev A, Standard Specification for Seamless Copper Water Tube.
38. B98, Standard Specification for Copper-Silicone Alloy Rod, Bar, and Shapes.
39. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment.
40. D412, Standard Testing Method for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
41. D413, Standard Testing Methods for Rubber Property-Adhesion to Flexible Substrate.
42. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
43. D1784, Standard Classification System and Basics for Specifications for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
44. D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
45. D2000, Standard Classification System for Rubber Products in Automotive Applications.
46. D2310, Standard Classification for Machine-Made “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
47. D2464, Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
48. 2466, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
49. D2467, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
50. D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
51. D2665, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe for Drain, Waste, and Vent Pipe and Fittings, Schedule 40.
52. D2996, Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
53. D3222 Rev A, Standard Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
54. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
55. D4101 Rev B, Standard Specification for Propylene Plastic Injection and Extrusion Materials.
56. F437, Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
57. F439 Rev A, Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
58. F441, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
59. F491 Rev A, Standard Specification for Poly (Vinylidene Fluoride) (PVDF) Plastic-Lined Ferrous Metal Pipes, and Fittings.
60. F493 Rev A, Standard Specification for Solvent Cements for Chlorinated Poly Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
61. F714, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) based on outside diameter.

G. AWS (American Welding Society):
   1. A5.8, Specification for Filler Metals for Brazing and Braze Welding.
   2. QC 1, Specification for AWS Certification of Welding Inspectors.

H. AWWA (American Water Works Association):
   1. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
   2. C110/A21.10, Ductile-Iron and Gray-Iron Fittings, 3” through 48”for Water and Other Liquids.
   3. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   4. C115/A21.15, Flanged Ductile-Iron Pipe with Threaded Flanges.

5. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
6. C153/A21.53, Ductile-Iron Compact Fittings 3” through 16”, for Water and Other Liquids.
7. C200, Steel Water Pipe – 6” and Larger.
8. C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe-4” and Larger-Shop Applied.
9. C207, Steel Pipe Flanges for Water Works Service, Sizes 4” through 144”.
10. C208, Dimensions for Fabricated Steel Water Pipe Fittings.
11. C213, Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
12. C606, Grooved and Shouldered Type Joints.
13. M11, Steel Pipe - A Guide for Design and Installation.

I. MSS (Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.):
1. SP 43, Wrought Stainless Steel Butt-Welding Fittings Including Reference to Other Corrosion Resistant Materials.

J. NFPA (National Fire Protection Association):
1. 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.3 DEFINITIONS

A. Submerged or Wetted:
1. Zone below elevation of:
a. Top face of channel walls and cover slabs.
b. Top face of basin walkways.
c. Top face of clarifier walkways.
d. Top face of digester walls, including structure piping penetrations.
e. Liquid surface or within 2 feet above top of liquid surface.
f. Top of tank wall or under tank cover.

1.4 SUBMITTALS

A. Shop Drawings:
1. Shop Fabricated Piping:
a. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
b. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
2. Pipe Wall Thickness: Identify wall thickness and rational method or standard applied to determine wall thickness for each size of each different service including exposed, submerged, buried, and concrete-encased installations for Contractor-designed piping.
3. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.
4. Thrust Blocks: Concrete quantity, bearing area on pipe, and fitting joint locations.
5. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.
6. Gasket material, temperature rating, and pressure rating for each type of pipe and each type of service.

B. Quality Control Submittals:
1. Manufacturer’s Certification of Compliance.
2. Qualifications:
a. Weld Inspection and Testing Agency: Certification and qualifications.
b. Welding Inspector:
1) Certification and qualifications.
c. Welders:
1) List of qualified welders and welding operators.

2) Current test records for qualified welder(s) and weld type(s) for factory and field welding.

3. Weld Procedures:
   a. Records in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
4. Nondestructive inspection and testing procedures.
5. Manufacturer's Certification of Compliance:
   a. Pipe and fittings.
   b. Factory applied resins and coatings.
6. Certified weld inspection and test reports.
7. Test logs.

1.5 QUALITY ASSURANCE

A. Materials in Contact with Potable Water:
   1. Certified to NSF 61 and NSF 372.

B. Weld Inspection and Testing Laboratory Qualifications:
   1. Retain approved independent testing laboratory that will provide the services of an AWS certified welding inspector qualified in accordance with AWS QC1 with prior inspection experience of welds specified herein.
   2. Perform weld examinations with qualified testing personnel who will carry out radiography, ultrasonic, magnetic particle, and other nondestructive testing methods as specified herein.
   3. Welding Inspector:
      a. Be present when shop or field welding is performed to certify that welding is in accordance with specified standards and requirements.
      b. Duties include, but are not limited to, the following:
         1) Job material verification and storage.
         2) Qualification of welders.
         3) Certify conformance with approved welding procedure specifications.
         4) Maintain records and prepare reports in a timely manner.
         5) Notify Engineer within 1 hour of discovery of unsatisfactory weld performance and within 24 hours of weld test failure.
         6) Supervision of testing personnel.

C. Welder and Welding Operator Performance:
   1. Qualify welders and welding operators by approved testing laboratory before performing any welding under this section.
   2. Perform welder qualification tests in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code.
   3. Qualification tests may be waived if evidence of prior qualification is deemed suitable by the Engineer.
   4. Qualify welders and operators in the performance of making groove welds in each different pipe material, including carbon steel pipe, in Positions 2G and 5G for each welding process to be used.
   5. Qualify welders and welding operators for stainless steel as stated herein on the type of stainless steel being welded with the welding process used.

D. Certifications:
   1. Coal-Tar Epoxy Applicator:
      a. Certified by Piping Manufacturer to be qualified to apply coal-tar epoxy coating to submerged or embedded ductile iron or cast-iron soil piping.
   2. Weld Testing Agency:

a. Certified in accordance with current American Society for Nondestructive Testing (4153 Arlingate Plaza, Columbus, OH 43228) recommended practice SNT-TC-1A, NDT Level II.

E. Quality Control Submittals:
1. Manufacturer's Certification of Compliance.
2. Laboratory Testing Equipment:
a. Certified calibrations, Manufacturer's product data, and test procedures.
3. Certified welding inspection and test results.
4. Qualifications:
a. Weld Inspection and Testing Agency:
1) Certification and qualifications.
b. Welding Inspector:
1) Certification and qualifications.
c. Welders:
1) List of qualified welders and welding operators.
2) Current test records for qualified welder(s) and weld type(s) for factory and field welding.
5. Weld Procedures:
a. Records in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
6. Nondestructive inspection and testing procedures.
7. Manufacturer's Certification of Compliance:
a. Pipe and fittings.
b. Welding electrodes and filler materials.
c. Factory applied resins and coatings.
8. Certified weld inspection and test reports.
9. Pipe coating applicator certification.

1.6 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 01 60 00 - Product Requirements.

B. Flanges:
1. Securely attach metal, hardboard, or wood protectors over entire gasket surface.

C. Threaded or Socket Welding Ends:
1. Fit with metal, wood, or plastic plugs or caps.

D. Linings and Coatings:
1. Prevent excessive drying.

E. Cold Weather Storage:
1. Locate products to prevent coating from freezing to ground.

F. Handling:
1. Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 - PRODUCTS

2.1 PIPING

A. As specified on Piping Data Sheet(s) and Piping Schedule located at the end of this section as Supplement.

B. Diameters Shown:
   1. Standardized Products: Nominal size.
   2. Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME 836.l0M.
   3. Cement-Lined Steel Pipe: Lining inside diameter.

2.2 JOINTS

A. Grooved End System:
   1. Rigid, except where joints are used to correct misalignment, to provide flexibility, or where shown, furnish flexible type.
   2. Flanges: When required, furnish with grooved type flange adapters of same manufacturer as grooved end couplings.

B. Flanged Joints:
   1. Flanges for ductile iron pipe shall conform to AWWA C115 at pressure rating meeting requirements of the connecting piping.
   2. Flanges for steel pipe shall conform to ANSI/ASME B16.5 at pressure rating meeting requirements of the connecting piping.
   3. Higher pressure rated flanges as required, to mate with equipment when equipment flange is of higher-pressure rating than required for piping.

C. Threaded Joints:
   1. NPT taper pipe threads in accordance with ANSI B 1.20. 1.

D. Thrust Tie-Rod Assemblies:
   1. NFPA 24; tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.

E. Mechanical Joint Anchor Gland Follower:
   1. Ductile iron anchor type, wedge action, with break off tightening bolts.
   2. Manufacturer and Product:
      a. EBAA Iron Inc. – Megalug (3 – 54 inch)

F. Flexible Mechanical Compression Joint Coupling:
   1. Stainless steel, ASTM A276, Type 305 bands.
   2. Manufacturers:
      a. Pipeline Products Corp.
      b. Fernco Joint Sealer Co.

G. Mechanical connections of the high-density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through flanged connections consisting of the following:
   1. A polyethylene stub end thermally butt-fused to the end of the pipe.
   2. ASTM A240, Type 304 stainless steel backing flange, 125-pound, ANSI B16.1 Standard. Insulating flanges shall be used where shown.
   3. Bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to the Manufacturer's standard. Re-torque the nuts after 4 hours.
   4. Gaskets as specified on Data Sheet.
   5. Connection to buried mechanical joint fittings and valves shall be by restrained mechanical joint follower glad designed for HDPE pipe. Provide stainless steel stiffener as required by pipe manufacturer.

2.3 COUPLINGS

A. Steel Middle Rings and Followers:
   1. Fusion bonded, epoxy-lined, and coated in accordance with Section 09 96 00 – High Performance Coatings.

B. Flexible Couplings:
   1. Manufacturers and Products:
      a. Steel Pipe:
         1) Dresser – Style 38 (1/2 inch & Larger)
         2) Smith-Blair – Style 411 (1/2 – 60 inch)
         3) Romac – 501 (2 – 24 inch)
      b. Ductile Iron Pipe:
         1) Dresser – Style 38 (14 inch & Larger)
         2) Smith-Blair – Style 411 (1/2 – 60 inch)
         3) Romac – 501 (2 – 24 inch)

C. Transition Couplings:
   1. Manufacturers and Products:
      a. Dresser – Style 62 (3 – 24 inch)
      b. Smith-Blair – Style 413 (2 – 48 inch)
      c. Romac – RC501 (3 – 24 inch)

D. Flanged Coupling Adapters:
   1. Manufacturers and Products:
      a. Steel Pipe:
         1) Smith-Blair – Series 913 (3 inch & Larger)
         2) Dresser Industries, Inc. – Style 128-W (3 – 24 inch)
         3) Romac – FC400 (12 – 96 inch)
      b. Ductile Iron Pipe:
         1) Smith-Blair – Series 912 (3 – 12 inch)
         2) Dresser Industries, Inc. – Style 128-W (3 – 24 inch)
         3) Romac – FCA501 (3 – 16 inch)

E. Dismantling Joints:
   1. Manufacturers and Products:
      a. Steel or Ductile Iron Pipe:
         1) Smith-Blair – Series 975 (3 inch & Larger)
         2) Dresser Industries, Inc. – Style 131 (4 – 24 inch)
         3) Romac – DJ400 (3 – 72 inch)

2.4 HARDWARE

A. All hardware on submerged piping or piping below the top elevation of tanks and directly exposed to water, wastewater and/or wastewater solids, including but not limited to bolts, nuts, washers, and threaded rod shall be stainless steel.

2.5 GASKET LUBRICANT

A. Lubricant shall be supplied by pipe Manufacturer and no substitute or “or-equal” will be allowed.

2.6 DOUBLE WALL CONTAINMENT PIPING SYSTEM

A. All system components shall be pre-engineered, factory fabricated, tested, and assembled such that field assembly is minimized to primarily that of straight joints.

2.7 THRUST RESTRAINT

A. Buried piping shall be restrained joint piping unless specified otherwise or when connecting to existing pipelines. When connecting to existing pipelines concrete thrust blocking shall be used as specified in Section 03 30 00 - Cast-In-Place Concrete.

B. All above grade piping shall be adequately restrained and supported.

2.8 VENT AND DRAIN VALVES

A. Pipeline 2-1/2” Diameter and Larger:
   1. Vent connections shall be 3/4-inch with V300 ball valve. Drain connection shall be 1-inch with V300 ball valve, unless shown otherwise.

B. Pipeline 2” Diameter and Smaller:
   1. Vent connections shall be 1/2-inch with V300 ball valve. Drain connection shall be 1-inch with V300 ball valve, unless shown otherwise.

C. Provide galvanized steel pipe plug in each ball valve.

2.9 FABRICATION

A. Mark each pipe length on outside:
   1. Size or diameter and class.
   2. Manufacturer’s identification and pipe serial number.
   3. Location number on laying drawing.
   4. Date of manufacture.

B. Code markings according to approved Shop Drawings.

C. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the site with flanges in place and properly faced.
   1. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the Manufacturer.

2.10 FINISHES

A. Factories prepare, prime, and finish coat in accordance with Pipe Data Sheet(s), Piping Schedule, and Section 09 96 00 – High Performance Coatings.

B. Galvanizing:
   1. Hot-dip applied, meeting requirements of ASTM A153.
   2. Electroplated zinc or cadmium plating is unacceptable.
   3. Stainless steel components may be substituted where galvanizing is specified.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Welding Electrodes:
   1. Verify proper grade and type, free of moisture and dampness, and coating is undamaged.

3.2 PREPARATION

A. Notify Engineer at least 2 weeks prior to field fabrication of pipe or fittings.

B. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

C. Damaged Coatings and Linings:
   1. Repair using original coating and lining materials in accordance with Manufacturer's instructions, except for damaged glass-lined pipe or PVDF-lined pipe that is to be promptly removed from the site.

3.3 WELDING

A. Perform in accordance with Section IX, ASME Boiler and Pressure Vessel Code and ASME B31.1 for Pressure Piping, as may be specified on Piping Data Sheets, and if recommended by piping or fitting Manufacturer.

B. Weld Identification:
   1. Mark each weld with symbol identifying welder.

C. Pipe End Preparation:
   1. Machine Shaping:
      a. Preferred.
   2. Oxygen or Arc Cutting:
      a. Smooth to touch, true, and slag removal by chipping or grinding.
   3. Beveled Ends for Butt Welding:
      a. ANSI B16.25.

D. Surfaces:
   1. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
   2. Clean stainless-steel joints with stainless steel wire brushes or stainless steel wool prior to welding.
   3. Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

E. Alignment and Spacing:
   1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
   2. Root Opening of Joint:
      a. As stated in qualified welding procedure.
   3. Minimum Spacing of Circumferential Butt Welds:
      a. Minimum four times pipe wall thickness or 1", whichever is greater.

F. Climatic Conditions:
   1. Do not perform welding if there is impingement of any rain, snow, sleet, or high wind on the weld area, or if the ambient temperature is below 32°F.
   2. Stainless Steel and Alloy Piping:
      a. If the ambient is less than 32°F, local preheating to a temperature warm to the hand is required.

G. Tack Welds:

1. Performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

H. Surface Defects:
1. Chip or grind out those affecting soundness of weld.

I. Weld Passes:
1. As required in welding procedure.

J. Weld Quality:
1. Free of cracks, incomplete penetration, weld undercutting, excessive weld reinforcement, porosity slag inclusions, and other defects in excess of limits shown in applicable piping code.

3.4 INSTALLATION - GENERAL

A. Join pipe and fittings in accordance with Manufacturer's instructions, unless otherwise shown or specified.

B. Remove foreign objects prior to assembly and installation.

C. Flanged Joints:
1. Install perpendicular to pipe centerline.
2. Bolt Holes:
a. Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
4. Plastic Flanges:
a. Install annular ring filler gasket at joints of raised-face flange.
5. Raised-Face Flanges:
a. Use flat-face flange when joining with flat-faced ductile or cast iron flange.

D. Threaded and Coupled Joints:
1. Conform to ANSI B1.20.1.
2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
3. Countersink pipe ends, ream and clean chips and burrs after threading.
4. Make connections with not more than three threads exposed.
5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

E. Soldered Joints:
1. Use only solder specified for particular service.
2. Cut pipe ends square and remove fins and burrs.
3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply non-corrosive flux to the male end only.
4. Wipe excess solder from exterior of joint before hardened.
5. Before soldering, remove stems and washers from solder joint valves.

F. Couplings:
1. General:
a. Install in accordance with Manufacturer's written instructions.
b. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.

c. Remove pipe coating if necessary to present smooth surface.

2. Application:
   a. Metallic Piping Systems:
      1) Flexible couplings, transition couplings, and flanged coupling adapters.
   b. Nonmetallic Piping Systems:
      1) Teflon bellows connector.
   c. Concrete Encased Couplings:
      1) Sleeve type coupling.
   d. Corrosive Service Piping:
      1) Elastomer bellows connector.
   e. Grit Slurry Piping:
      1) Elastomer bellows connector.

G. Pipe Connections at Concrete Structures:
   1. As specified in Section 40 05 06 - Process Piping Specialties.

H. Penetrations:
   1. Watertight Penetrations:
      a. Provide wall pipes with thrust collars, as specified in Section 40 05 06 - Process Piping Specialties.
      b. Provide taps for stud bolts in flanges to be set flush with wall face.
   2. Non-watertight Penetrations:
      a. Pipe sleeves with seep ring as specified in Section 40 05 06 - Process Piping Specialties.
      b. Pipe sleeves with modular mechanical seal may be provided where fabrication of seep ring on pipe sleeve is impractical.
   3. Existing Walls:
      a. Rotary drilled holes with modular mechanical seal as specified in Section 40 05 06 - Process Piping Specialties.
   4. Fire-Rated or Smoke-Rated Walls, Floor, or Ceilings: Insulated and encased pipe sleeves as specified in Section 40 05 06 - Process Piping Specialties.

I. PVC and CPVC Piping:
   1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
   2. Use strap wrench for tightening threaded plastic joints. Do not over tighten fittings.
   3. Do not thread Schedule 40 pipe.

J. Ductile Iron, Cement-Lined Ductile Iron, and Glass-Lined Ductile Iron Piping:
   1. Cutting Pipe:
      a. Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter.
      b. DO NOT flame cut.
   2. Dressing Cut Ends:
      a. General:
         1) As required for the type of joint to be made.
      b. Rubber Gasketed Joints:
         1) Remove sharp edges or projections.
      c. Push-On Joints:
         1) Bevel, as recommended by pipe Manufacturer.
      d. Flexible Couplings, Flanged Coupling Adapters, and Grooved End
      e. Pipe Couplings:
         1) As recommended by the coupling or adapter Manufacturer.

3.5 INSTALLATION-EXPOSED PIPING

A. Piping Runs:

1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports:
1. As specified in Section 40 05 07 – Hangers and Supports for Process Piping.

C. Group piping wherever practical at common elevations; installing to conserve building space and not interfere with use of space and other work.

D. Unions or Flanges:
1. Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

E. Install piping so that no load or movement more than that stipulated by equipment Manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

F. Piping clearance, unless otherwise shown:
1. Over Walkway and Stairs:
   a. Minimum of 7’ 6”, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
2. Between Equipment or Equipment Piping and Adjacent Piping:
   a. Minimum 3’ 0”, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
3. From Adjacent Work:
   a. Minimum 1” from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
5. Head room in front of openings, doors, and windows shall not be less than the top of the opening.
6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

3.6 INSTALLATION-BURIED PIPE

A. Joints:
1. Dissimilar Buried Pipes:
   a. Provide flexible mechanical compression joints for pressure pipe.
   b. Provide concrete closure collar for gravity and low pressure (maximum 10 psi) piping or as shown on Drawings.
2. Concrete Encased or Embedded Pipe:
   a. Do not encase joints in concrete unless specifically shown.

B. Placement:
1. Keep trench dry until pipe laying and joining are completed.
2. Pipe Base and Pipe Zone:
   a. As specified in Section 31 23 23.16 – Trench Backfill.
3. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe.
4. Measure for grade at pipe invert, not at top of pipe.

5. Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.
6. Prevent foreign material from entering pipe during placement.
7. Close and block open end of last pipe section laid when placement operations are not in progress and at close of day's work.
8. Lay pipe upgrade with bell ends pointing in the direction the pipe is laying.
9. Install closure sections and adapters for gravity piping at locations where pipe laying changes direction.
10. Deflect pipe at joints for pipelines laid on a curve using unsymmetrical closure of spigot into bell. If joint deflection of standard pipe lengths will not accommodate horizontal or vertical curves in alignment, provide:
    a. Shorter pipe lengths.
    b. Special mitered joints.
    c. Standard or special fabricated bends.
11. After joint has been made, check pipe alignment and grade.
12. Place sufficient pipe zone material to secure pipe from movement before next joint is installed.
13. Prevent uplift and floating of pipe prior to backfilling.

C. PVC and CPVC Pipe Placement:
1. Lay pipe snaking from one side of trench to other.
2. Offset:
    a. As recommended by Manufacturer for maximum temperature variation between time of solvent welding and during operation.
3. Do not lay pipe when temperature is below 40°F, or above 90°F when exposed to direct sunlight.
4. Shield ends to be joined from direct sunlight prior to and during the laying operation.

D. Tolerances:
1. Deflection from Horizontal Line, Except PVC, CPVC, or HDPE:
    a. Maximum 2".
2. Deflection from Vertical Grade:
    a. Maximum 1/4".
3. Joint Deflection:
    a. Maximum of 75% of Manufacturer's recommendation.
4. Horizontal position of pipe centerline on alignment around curves maximum variation of 1.75' from position shown.
5. Pipe Cover:
    a. Minimum 5', unless otherwise shown on Drawings.

3.7 THRUST RESTRAINT

A. Location:
1. Buried Piping:
    a. At pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist.
2. Exposed Piping:
    a. At all joints in pressure piping.

B. Thrust Ties:
1. Install as detailed.
2. Anchoring retainer glands or thrust ties with setscrews is unacceptable.

C. Mechanical Joint Valve Restraint in Proprietary Restrained Joint Piping:
1. Install pipe joint Manufacturer's adapter gland follower and pipe end retainer or thrust tie-rods and socket clamps.

D. Thrust Blocking:
   1. Place between undisturbed ground and fitting to be anchored.
   2. Quantity of Concrete:
      a. Sufficient to cover bearing area on pipe and provide required soil bearing area as shown.
   3. Place blocking so that pipe and fitting joints will be accessible for repairs.
   4. Place concrete in accordance with Section 03 30 00 – Cast-In-Place Concrete.

3.8 BRANCH CONNECTIONS

A. DO NOT install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including the first block valve in the line carrying the lower pressure, unless otherwise shown.

C. Threaded Pipe Tap Connections:
   1. Ductile Iron Piping:
      a. Connect only with service saddle or at a tapping boss of a fitting, valve body, or equipment casting.
   2. Welded Steel or Alloy Piping:
      a. Connect only with welded thread-o-let or half-coupling as specified on Piping Data Sheet.
   3. Limitations:
      a. Threaded taps in pipe barrel are unacceptable.

3.9 VENTS AND DRAINS

A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install the vents on high points, and drains on low points of pipelines, whether shown or not.

3.10 CLEANING

A. Following assembly and testing, and prior to disinfection and final acceptance, flush pipelines (except as stated below) with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

B. Blow clean of loose debris in plant process air, natural gas, and instrument air-lines with compressed air at 4,000 fpm; do not flush with water.

C. If impractical to flush large diameter pipe at 2.5 fps or blow at 4,000 fpm velocity, clean in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

D. Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.

E. Remove accumulated debris through drains 2” and larger or by removing spools and valves from piping.

3.11 DISINFECTION

A. Disinfect pipelines intended to carry potable water (W1).

B. See Section 33 13 00 – Disinfection of Water Systems.

3.12 FIELD FINISHING

A. Notify Engineer at least 3 days prior to start of any surface preparation or coating application work.

B. As specified in Section 09 96 00 – High Performance Coatings.

3.13 PIPE IDENTIFICATION

A. As specified in Section 09 96 00 – High Performance Coatings.

B. As specified in Section 22 05 53 – Mechanical Identification.

3.14 INSULATION

A. As specified in Section 40 42 00 – Process Mechanical Insulation.

3.15 HEAT TRACING

A. As specified in Section 40 41 13 – Heat Tracing.

3.16 FIELD QUALITY CONTROL

A. Pressure Leakage Testing:
   1. As specified in Section 40 05 00 – Piping Systems Testing.

B. Minimum Duties of Welding Inspector:
   1. Job material verification and storage
   2. Qualifications of welders.
   3. Certify conformance with approved welding procedures.
   4. Maintenance of records and preparation of reports in a timely manner.
   5. Notification to Engineer of unsatisfactory weld performance within 24 hours of weld test failure.

C. Required Weld Examinations:
   1. Perform Examinations in accordance with Piping Code ASME B31.1.
   2. Perform examinations for every pipe thickness and for each welding procedure, progressively, for all piping covered by this section.
   3. Examine at least one of each type and position of weld made by each welder or welder operator.
   4. For each weld found to be defective under the acceptable standards or limitations on imperfections contained in the applicable Piping Code, examine two additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required above 3. Examine, progressively, two additional welds for each tracer examination found to be unsatisfactory.

3.17 SUPPLEMENTS

A. The supplements listed below, following “END OF SECTION,” are a part of this Specification.
   1. Section 40 23 39.1 – Process Piping Schedule.
   2. Data Sheets:
      a. Section 40 23 39.13 – DS – CM Lined DIP and Fittings
      b. Section 40 23 39.33 – DS – Galvanized Steel Pipe

c. Section 40 23 39.36 – DS – SS Pipe and Fittings

END OF SECTION

SECTION 40 23 39.1
PROCESS PIPING SCHEDULE

Service	Flow Stream Identifier	Installation	Nominal Diameter	Material (Note 1)	Coating (Note 2)	Spec/Data Sheet No.	Max Operating Temp (°F)	Max Operating Pressure (psig)	Test Pressure (psig) & Method (Note 3)	Pipe Color (Note 4)	Remarks
Plant/Process Drain	PD	ALL	ALL	CLDI	EPP	40 23 39.13	Ambient	10	50, G		
Water, Potable	W1	ALL	ALL	GS	None	40 23 39.33	Ambient	100	150, HH		1

Notes:

1 CLDI – Cement Lined Ductile Iron
GS – Galvanized Steel
2 EPP – Epoxy and Polyurethane Coating System
HSE – High Solids Epoxy
CTP – Coal Tar Pitch
3 P – Pneumatic Test
G - Gravity Piping
AM – Air Method
HH – High Head
See Section 40 05 00 for Piping Systems Testing for requirements
4 See Section 09 96 00 for required painting.
For buried piping, no color shall be required; coordinate for proper coatings, as necessary.
Where no color is indicated, color to be selected by Owner.
For exposed piping not coated, provide colored banding and identification.

Remarks:

1 Provide insulation per Specification 40 42 00, Process Mechanical Insulation.

END OF SECTION

SECTION 40 23 39.13 DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
Pipe	**Buried Liquid Service**: Push-On, Mechanical, or Proprietary Restrained Joints compliant with AWWA C115/A21.15, AWWA C151/A21.51, and AWWA C150 and bear the mark of Underwriters' Laboratories (UL) approval. Use a minimum Pressure Class 250 for water and sewer lines less than or equal to 20-inch diameter. For 24-inch and larger, design for project-specific hydraulics to meet test pressure as shown in the pipe schedule. Use minimum Pressure Class 350 for pipes in casing or trenchless construction and for flanged pipe. **Exposed Pipe**: Grooved End or Flanged Joints compliant with AWWA C115/A21.15 and AWWA C151/A21.51 and have a thickness of Class 53 minimum.
Coating	**Buried Pipe:** Exterior coating used under normal conditions shall be an asphaltic coating approximately 1 mil (25 µm) thick and per AWWA C151/A21.51. **Exposed Pipe:** Shall be as indicated in the piping schedule.
Encasement	Polyethylene encasement compliant with AWWA C105/A21.5 shall be used on all underground ductile iron pipe, fittings, valves, and appurtenances. See Section 40 42 13.16 – Polyethylene Encasement for Ductile Iron and Cast Iron Pipe.
Lining	Lining shall be Cement-Mortar compliant with AWWA C104/A21.4 unless noted otherwise. Linings shall be applied at a thickness per manufacturer's recommendation. All linings for potable water service shall be NSF 61 Certified. **Ceramic Epoxy:** Protecto 401 or equal shall be used where indicated in the pipe schedule. **Glass Lining:** Compliant with ASTM B1000 – Standard Practices for Casting Preparation and Test Procedure of Porcelain Enamel-lined Pipe, Fittings, and Valves for Use in the Municipal Wastewater, Sewage, and Water Treatment Industry and shall be used where indicated in the piping schedule. Linings for fittings shall be as indicated in "Fittings" section.
Joints	**Push-On**: 250 psi minimum working pressure, compliant with AWWA C153/A21.53 and C111/A21.11. **Mechanical**: 250 psi minimum working pressure compliant with AWWA C111. **Proprietary Restrained**: 150 psi minimum working pressure. **Grooved End**: Rigid type radius cut conforming to AWWA C606, 250 psi minimum working pressure. **Flanged**: 125-pound flat face, 250-pound flat face, ductile iron, threaded conforming to AWWA C115/A21.15.
Fittings	**For all fittings:** Lining and coating shall match connecting pipe unless otherwise noted below. **Push-On**: Compliant with AWWA C153/A21.53 and C111/A21.11, gray or ductile iron, 350 psi minimum working pressure.

Fittings (Cont.)	**Mechanical Joint**: For Buried Service. Compliant with AWWA C111/A21.11 and C153/A21.53 ductile iron, 250 psi minimum working pressure. Coating/lining shall be Fusion-Bonded Epoxy meeting AWWA C116. **Proprietary Restrained Joint**: Compliant with AWWA C153/A21.53, ductile iron, 250 psi minimum working pressure. Coating/lining shall be Fusion-Bonded Epoxy meeting AWWA C116. **Proprietary Restrained River Crossing**: Clow Ball and Socket; U.S. Pipe M-Flex, or approved equal. Coating/lining shall be Fusion-Bonded Epoxy meeting AWWA C116. **Grooved End**: Compliant with AWWA C606 and C110/A21.10 for center-to-end dimensions, C110/A21.10 or AWWA C153 for wall thickness, ductile iron, 250 psi minimum working pressure. **Flange**: Compliant with AWWA C110/A21.10 and ANSI B16.1, ductile iron, faced and drilled, 125-pound flat face or 250-pound flat face. Gray cast iron will not be allowed.
Grooved End Couplings	**Grooved End Couplings:** Ductile iron housing per ASTM A536. 250 psi maximum working pressure for sizes through 18 inches, 150 psi for 20 inches and larger. **Grooved End Adapter Flanges**: Ductile iron per ASTM A536. 250-psi through 12 inches and 150-psi for 14 inches and larger. Must allow for direct connection to ANSI Class 125 flanged components.
Bolting	**Buried Mechanical and Proprietary Restrained**: 316 stainless steel T-head bolts and hardware **Exposed Grooved End Joints and 125-pound Flanges:** ASTM A307 Grade A carbon steel hex head bolts and ASTM A563 Grade A steel hex head nuts. **Exposed 250-pound Flanges**: ASTM A307 Grade B carbon steel hex head bolts and ASTM A563 Grade A carbon steel heavy hex head nuts. **Additional Requirements:** All hardware on submerged piping or piping below the top elevation of tanks and directly exposed to water, wastewater and/or wastewater solids, including but not limited to bolts, nuts, washers, and threaded rods shall be 316 stainless steel.
Gaskets	**Mechanical Joints, Water and Sewage**: Styrene-butadiene rubber (SBR) gaskets produced in accordance with ANSI/AWWA C111, Table 4 are acceptable for use in a mechanical joint mechanism. (SBR) rubber gaskets shall be rated for the same working pressure as the pipe. Locking gaskets produced in accordance with AWWA C111 are acceptable for use as a joint restraint mechanism for buried joints. Locking gaskets shall be a high-visibility color and rated for the same working pressure as the pipe. **Mechanical and Proprietary Restrained Joints, Air**: Viton, Fluorel, or Manufacturer's standard for high temperature air service, rated to 300°F minimum, conforming to ANSI/AWWA C111/A21.11 **Grooved End Joints**: Halogenated butyl conforming to ASTM D2000 and AWWA C606. Gaskets for air service shall be pressure-responsive synthetic rubber, rated to 300°F minimum, conforming to ASTM D2000.

Gaskets (Cont.)	**Flanged, Water and Sewage Services**: 1/8-inch thick, unless otherwise specified, homogenous black rubber (EPDM), hardness 60 (Shore A), rated to 212°F, conforming to ANSI B16.21 and ASTM D1330 Steam Grade or full face per ANSI/AWWA C111/A21.11. **Flanged, Air Service**: 1/8-inch thick, unless otherwise specified, Teflon, PTFE, or compressed inorganic fiber with nitrile binder, rated to 300°F minimum, conforming to ANSI B16.21 and ASTM D1330. **Additional Requirements:** Ring gaskets shall not be permitted. Blind flanges shall be gasketed covering the entire inside face with the gasket cemented to the blind flange. Gasket pressure rating shall be equal to the pressure rating of the connecting pipe or fitting. NSF61-listed gaskets are required for potable water service.
Joint Lubricant	Manufacturer's Standard.

END OF SECTION

SECTION 40 23 39.33 GALVANIZED STEEL PIPE AND MALLEABLE IRON FITTINGS		
Item	**Size**	**Description**
Pipe		Galvanized carbon steel, ASTM A106, Grade B seamless or ASTM A53 Rev A, Grade B seamless or ERW.
	2” & smaller	Schedule 80
	2-1/2” thru 6”	Schedule 40
	8”-12”	Schedule 30
	14”	Standard weight.
Joints	2” & smaller	Threaded or flanged at equipment as required.
	2-1/2” & larger	Rigid grooved end meeting the requirements of AWWA C606.
Fittings	2” & smaller	Threaded: 150- or 300-pound malleable iron, ASTM A197 or ASTM A47, dimensions in accordance with ANSI B16.3.
	2-1/2” & larger	Grooved End: Malleable iron ASTM A47 or ductile iron ASTM A536, 250 psi working pressure, grooved ends to accept couplings without field preparation. Victaulic; Gustin-Bacon.
Branch Connections	2” & smaller	Tee or reducing tee in conformance with Fittings above, 2,000-pound WOG threadolet or welding boss, galvanize after welding.
	2-1/2” & larger	Branch Same Size as Run: Grooved end tee in accordance with Fittings above. Branch One or More Sizes Smaller Than Run: grooved end reducing tee in accordance with Fittings above.
Flanges	2” & smaller	Galvanized forged carbon steel, ASTM A105, ANSI B16.5 Class 150 or Class 300 threaded, 1/16-inch raised face.
	2-1/2” & larger	Grooved end adapter flange, malleable iron ASTM A47 or ductile iron ASTM A536. Victaulic; Gustin-Bacon.
Unions	2” & smaller	Threaded malleable iron, ASTM A197 or A 47, 300-pound WOG, brass to iron seat, meeting the requirements of ANSI B16.3.
Couplings	2-1/2” & larger	Grooved End: Rigid joint malleable iron, ASTM A47 or ductile iron, ASTM A536, 250 psi working pressure. Victaulic; Gustin-Bacon.
Plugs	2” & smaller	Forged carbon steel, ASTM A181/A181M Rev A, Grade II, round head, threaded.
Bolting	All	Grooved End Couplings: Carbon steel, ASTM A183 bolts and nuts, 110,000 psi minimum tensile strength.

		Flanges: Carbon steel ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.
Gaskets	All flanges	Flanged, Water, Sewage, and Air Services: 1/16-inch thick, compressed inorganic fiber with nitrile binder, rated to 700°F and 1,000 psi. Ring gaskets shall NOT be permitted. Blind flanges shall be gasketed covering the entire inside flange with the gasket cemented to the blind flange.
	Grooved end couplings	EPDM or chlorinated butyl per ASTM D2000 for water and air to 230°F, dimensions conforming to AWWA C606.
Thread Lubricant	2” & smaller	Teflon tape or joint compound that is insoluble in water.

END OF SECTION

SECTION 40 23 39.36
STAINLESS STEEL PIPE AND FITTINGS – GENERAL SERVICE

Item	Size	Description
Pipe	2” & smaller	Schedule 40S: ASTM A312-93, Type 316 seamless, pickled, and passivated.
	2-1/2” thru 6”	Schedule 10S: ASTM A778 Rev A-90 “as-welded” grade, Type 316L.
	8” & larger”	Schedule 5S: ASTM A778 Rev A-90 “as-welded” grade, Type 316L.
Joints	2” & smaller	Threaded or flanged at equipment as required or shown.
	2-1/2” & larger	Butt-welded or flanged at valves and equipment.
Fittings	2” & smaller	Threaded Forged: 1,000 CWP, ASTM A182 Rev C-93 Grade F316L.
	2-1/2” & larger	Butt Welded: ASTM A774-94 Grade 316L conforming to MSS SP-43, “as-welded” grade, pickled and passivated; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise.
Branch Connections	2” & smaller	Tee or reducing tee in conformance with Fittings above.
	2-1/2” & larger	Butt-welding tee or reducing tee in accordance with Fittings above.
Flanges	All	Forged Stainless Steel, ASTM A182 Rev C-93, and Grade F316L, ANSI B16.5-88 Class 150 or Class 300 slip-on weld neck or raised face. Cast Carbon Steel: ASTM A216-93, Grade WCA, drilled, ANSI B16.5-88 Class 150 or Class 300 Van Stone Type with stainless steel stub ends, ASTM A240-94 Type 316L “as welded grade”, conforming to MSS-SP43, wall thickness same as pipe.
Unions	2” & smaller	Threaded Forged: ASTM A182 Rev C-93 Grade F316, 2,000 pound or 3,000 pound WOG, integral ground seats, AAR design meeting the requirements of ANSI B16.11-91, bore to match pipe.
Bolting	All	Forged Flanges: Type 316 stainless steel, ASTM A320-94 Grade B8M hex head bolts and ASTM A194-94 Grade 8M hex head nuts. Van Stone Flanges: Carbon steel ASTM A307-94 Grade B hex head bolts and ASTM A563-93 Grade A hex head nuts. Provide same on mating cast iron flange on valve or equipment with flat ring gasket.
Gaskets	All Flanges	Flanged, Water, and Wastewater Service: 1/8-inch thick, unless otherwise specified, homogenous black rubber

Gaskets (Cont.)		(EPDM), hardness 60 (Shore A), rated to 212°F., conforming to ANSI B16.21 and ASTM D1330 Steam Grade. Flanged, Air Services: 1/16-inch thick, Teflon, PTFE, or compressed inorganic fiber with nitrile binder; suitable for temperatures to 550°F and pressures to 1,000 psi. Ring gaskets shall NOT be permitted. Blind flanges shall be gasketed covering the entire inside face with the gasket cemented to the blind flange.
Thread Lubricant	2” & smaller	Teflon Tape.

END OF SECTION

SECTION 40 42 00 – PROCESS MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulation, jackets, and accessories for piping and related systems.

B. Related Sections:
   1. Section 09 96 00 – High-Performance Coatings.
   2. Section 40 23 39 – Process Piping - General.

1.2 REFERENCES

A. ASTM International:
   1. A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
   2. C168 – Standard Terminology Relating to Thermal Insulation.
   3. C177 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   4. C335 – Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation.
   5. C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   6. C533 – Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
   7. C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
   8. C547 – Standard Specification for Mineral Fiber Pipe Insulation.
   9. C552 – Standard Specification for Cellular Glass Thermal Insulation.
   10. C585 – Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing.
   11. C591 – Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
   12. C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
   13. C929 – Standard Practice for Handling, Transporting, Shipping, Storage, Receiving, and Application of Thermal Insulation materials for Use in Contact with Austenitic Stainless Steel.
   14. C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
   15. D2310 – Classification of Machine-Made “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
   16. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
   17. E96 – Standard Test Methods for Water Vapor Transmission of Materials.

1.3 DEFINITIONS

A. Buried: Piping that is installed below buildings, foundations or finish grade, either in soil or encased in concrete in soil.

B. Concealed: Piping above suspended ceilings and within walls, partitions, shafts, or service spaces and spaces NOT normally exposed to view but NOT buried.

C. Exterior: Piping that is installed outside a building or within a pipe trench or tunnel.

D. Flame Spread and Smoke Density: Burning characteristics determined in accordance with ASTM E84. No units apply to value.

E. Interior: Piping that is installed inside a building.

F. K Factor: Thermal conductivity determined in accordance with ASTM C177 or C518 and expressed in units of Btu-inch/hour-feet^2 – °F.

G. Mineral Fiber: Fibers manufactured of glass, rock, or slag processed from a molten state, with or without a binder.

H. Water Vapor Permeance: Water vapor transmission determined in accordance with ASTM E96 and expressed in units of perm-inch.

1.4 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 33 00 - Submittal Procedures.

B. Product Data:
1. Insulation Properties: Include K factor, thickness, density, operating temperature limits, tensile strength, compressive strength, moisture absorption, flame spread, and smoke developed in accordance with ASTM E84 and corrosivity to stainless steel piping in accordance with ASTM C795.
2. Jacket Properties: Include covering material, cover thickness, tensile strength, tear strength, permeability per ASTM E96, flame spread, and smoke developed in accordance with ASTM E84, closure type or devices, and accessories.
3. Insulating Blankets: Include materials, performance characteristics, method of attaching to equipment, listing of locations where insulating blankets shall be installed.

C. Manufacturer's Application Instructions:
1. Include assembly and application drawings and detailed instructions.

D. Laboratory Report:
1. Provide certified laboratory report stating that insulation is NOT manufactured using chlorinated polymers and does NOT contain chlorides, bromides, sulfates, or fire-rated materials.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store insulation materials and accessories under cover and protected from moisture.

B. Handle and store insulation for use on stainless steel in accordance with ASTM C929.

1.6 SEQUENCING AND SCHEDULING

A. Pressure test piping and complete application of coating system before applying insulation.

B. When piping is to be heat traced, install and functionally test heat tracing before installation of insulation.

C. Before beginning installation of piping insulation, verify that the Engineer has accepted piping tests, pipe coating applications, and heat tracing tests.

1.7 WARRANTY

A. Furnish one – year minimum warranty.

B. Furnish five – year manufacturer warranty.

C. See Section 01 78 36 – Warranties and Bonds for warranty requirements.

PART 2 - PRODUCTS

2.1 PIPE INSULATION, GENERAL REQUIREMENTS

A. Insulation Thicknesses:
1. Provide insulation thickness in inches in accordance with the following table. Insulation thickness shown is nominal manufacturing tolerance of 15% variation is permissible.

Required Insulation Thicknesses					
SERVICE TEMPERATURE RANGE *(As designated in insulation schedule at end of this Section.)*	**Nominal Pipe Diameters (Inches)**				
	≤1	**1.25-2**	**2.5-4**	**5-10**	**>10**
>200°F	2.0	2.5	3.0	3.5	3.5
100-200°F	1.5	1.5	1.5	2.0	2.5
40-100°F	0.5	1.0	1.0	1.5	2.0
<40°F	1.0	1.0	1.5	2.0	2.0
Heat Traced Pipes	1.0	1.0	1.0	1.5	2.0
Aeration Air Pipes	0.5	0.5	1.0	1.0	1.0

2.2 PIPE INSULATION

A. Insulation Types:
1. Provide in accordance with the insulation types listed and scheduled.

B. Insulation, Type 1:
1. Insulation Material:
   a. Closed cell elastomeric insulation
2. Minimum Temperature Range: (-40)–220°F.
3. K Factor at 75°F: NOT more than 0.27 BTU-in/hr-ft^2-°F.
4. Fire Ratings:
   a. Flame Spread: 25 or less.
   b. Smoke Density: 50 or less for insulation thicknesses up to 1.5 inches.
5. Joints: Seal with manufacturer's recommended contact adhesive to form continuous water barrier.
6. Manufacturers (ONE of the following):
   a. Armacell Engineered Systems – AP/Armaflex
   b. Or Approved Equal.

C. Insulation, Type 2:
1. Insulation Material: Preformed mineral fiberglass insulation made from glass fibers bonded with a thermosetting-resin.
   a. Conform to ASTM C547, Class 1.
   b. Provide with factory installed vapor barrier.
      1) Material: White kraft paper bound to aluminum foil meeting ASTM C1136, Type I.

2) Longitudinal Lap Seals: Pressure sensitive, self-sealing longitudinal lap strip with factory applied adhesive.
3) Circumferential Butt Seals: 4-inch-wide tape or similar properties or 4-inch wide overlap with adhesive seal.
4) Vapor Barrier Permeability: 0.02 perms or lower.
5) Vapor Barrier Flame Spread Rating: 25 or less.

2. Minimum Temperature Range: 0-850°F.
3. K Factor at 75°F: NOT more than 0.23 BTU-in/hr-ft^2-°F.
4. Average Insulation Density: 3.3 lbs/ft^3.
5. Maximum Moisture Absorption, Volume Percent: 0.2%.
6. Manufacturers (One of the following):
   a. Owens Corning.
   b. Johns Manville
   c. Knauf Insulation
   d. Other Approved Equal.

D. Insulation, Type 3:
1. Insulation Material: Rigid polyisocyanurate foam in accordance with ASTM C591, Type IV.
2. Temperature Range: (-297)–300°F.
3. K Factor at 75°F: NOT more than 0.19 BTU-in/hr-ft^2-°F.
4. Minimum Average Density: 4.0 lbs/in^2.
5. Maximum Moisture Absorption, Volume Percent: 0.7%.
6. Minimum Compressive Strength: 25 lbs/in^2.
7. Moisture Permeability: 4.00 perm-inch.
8. Manufacturers (One of the following):
   a. ITW Insulation Systems.
   b. Kingspan Insulation LLC/Dyplast.
   c. Other Approved Equal.

E. Insulation, Type 4:
1. Insulation Material: Rigid cellular glass in accordance with ASTM C553, Type II.
2. Temperature Range: (-450)–900°F.
3. K Factor at 75°F: NOT more than 0.32 BTU-in/hr-ft^2-°F.
4. Minimum Average Density: 7.5 lbs/ft^3.
5. Maximum Moisture Absorption, Volume Percent: 0.2%.
6. Minimum Compressive Strength: 87 lbs/in^2.
7. Moisture Permeability: 0.00 perm-inch.
8. Manufacturers (One of the following):
   a. Owens Corning – Foamglas, Ultra-CUF.
   b. Or Approved Equal.

F. Insulation, Type 5:
1. Insulation Material: Asbestos free, rigid calcium silicate in accordance with ASTM C533; Type 1 for process temperatures up to 1,200°F.
2. K Factor at 500°F: 0.55 for Type 1.
3. Maximum Average (Dry) Density: 14.5 pounds per cubic foot.
4. Compressive Strength: 100 lbs/in^2, to produce a 5% compression.
5. Manufacturers: (ONE of the following, and in accordance with ASTM C533 Type I):
   a. John Manville/Industrial Insulation Group, LLC – Thermo-12 Gold.
   b. Or Approved Equal.

2.3 INSULATION JACKETS

A. Jacket, Type 1:

1. Material: 28 oz/yd^2 polyvinyl chloride on polyester fabric; total thickness 0.028 inches minimum.
2. Fire Rating: 25 maximum flame spread, smoke developed 50 or less.
3. Color: As selected by the Engineer from manufacturer's standard colors.
4. Overlap: One-inch minimum at joints and fittings.
5. Joint Seal: Self-sealing lap tape.
6. Fittings: Factory made with full thickness insulation.
7. Manufacturers (ONE of the following):
    a. Accessible Products Company
    b. Or Approved Equal.

B. Jacket, Type 2:
1. Material: Ultraviolet resistant polyvinyl chloride jacketing, 20 mil minimum thickness.
2. Fire Rating: 25 maximum flame spread, smoke developed 50 or less.
3. Color: White.
4. Overlap: One-inch minimum at joints and fittings.
5. Joint Seal: PVC solvent welded or adhesive as recommended by the manufacturer.
6. Fittings: Factory made with full thickness insulation.
7. Manufacturers (ONE of the following):
    a. Johns Manville – Zeston 2000 PVC.
    b. Proto Corp. – LoSMOKE PVC.
    c. Speedline Corp. – Smoke Safe PVC Jacketing System.
    d. Knauf Covering System.
    e. Or Approved Equal.

C. Jacket, Type 3:
1. Material: Aluminum, Allow 5005; 0.016-inch (26 gauge) minimum thickness.
2. Overlap: Overlap circumferential joints 4 inches minimum; overlap longitudinal joints 1-inch minimum; longitudinal joints oriented to minimize water entry.
3. Bands: 0.5 inch wide, 0.0508 inch (16 gauge) thick aluminum, same alloy as jacket or 0.0179-inch thick Type 304 stainless steel; install on 18-inch centers, uniformly spaced and at all fitting joints.
4. Joint Seal: Apply waterproof adhesive at joints and overlaps.
5. Fittings: Custom fit of same materials.
6. Manufacturers (ONE of the following):
    a. Foster Products/Childers Products.
    b. Or Approved Equal

2.4 VAPOR BARRIERS

A. Vapor Barrier, Type 1:
1. Material: White kraft paper bound to aluminum foil and meeting requirements of ASTM C1136, Type 1.
2. Permeability: 0.02 perms or lower.
3. Maximum Flame Spread Rating: 25.
4. Edge Seal: Pressure sensitive tape lap seal.
5. Circumferential Joints: 4-inch wide tape or 4-inch overlap with adhesive seal.
6. Manufacturers (ONE of the following):
    a. Owens Corning – all service jackets with double sure adhesive lap seal.
    b. Johns Manville – Micro-Lok AP-T plus.
    c. Or Approved Equal

B. Vapor Barrier, Type 2:
1. Material: Mastic.
2. Manufacturers (ONE of the following):
    a. Foster Products, 36-10/46-10 Weatherite.

b. Foster Products/Childers Products – CP10 or CP11 Vi-Acryl.
c. Or Approved Equal

2.5 RELATED MATERIALS

A. Cover Adhesive:
1. Premium adhesive as recommended by the insulation cover supplier for heavy-duty service in corrosive, wet environments. Standard duty adhesives are NOT permitted.

2.6 REMOVABLE INSULATING BLANKETS

A. In piping systems specified to be insulated, use removable insulating blankets for valves, meters, strainers, filters, catalytic converters, engine exhaust silencers, and other in-line piping appurtenances and equipment requiring periodic servicing.

B. Size Limits:
1. Use removable insulating blankets for equipment and piping appurtenances 3-inch in nominal size and larger. Insulate equipment and piping appurtenances less than 3-inch with molded sections of insulation or by field cutting insulation to conform to the shape of the component and to fit tightly around the component.

C. Manufacturers (One of the following):
1. Owens Corning, Temp-Mat.
2. Accessible Products Co.
3. Thermal Energy Products, Inc., Energy Wrap.
4. Or Approved Equal

D. Low temperature insulating blankets rated up to 800°F:
1. Use: For service temperatures up to 800°F.
2. Insulation: Fiberglass fiber, K factor 0.27 at 75°F.
3. Cover: 17oz fabric with both sides covered with silicone impregnated glass cloth suitable for temperatures up to 800°F.
4. Dover Fasteners (Use ONE of the following systems):
a. Grommets in the blanket and stainless-steel wire
b. 1-inch-wide straps with stainless steel rectangular ring buckles and Velcro on strap tail.

E. High temperature insulating blankets rated up to 1,400°F:
1. Rated for sustained service temperatures up to 1,400°F.
2. Insulation: Ceramic fiber, K factor 0.50 at 600°F, insulation material suitable for up to 2,300°F, thickness to match adjacent piping insulation specified thickness.
3. Cover: 17oz silicone impregnated fiberglass cloth suitable for temperatures up to 1,400°F.
4. Cover Fasteners (Use ONE of the following systems):
a. Grommets in the blanket and stainless-steel wire
b. 1-inch-wide straps with stainless steel rectangular ring buckles and Velcro on strap tail.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verification of Conditions:
1. Before installing insulation, verify satisfactory completion of pressure tests of piping systems and functional tests of heat tracing equipment.

B. Examine piping surfaces and verify that surfaces are dry and free of loose scale, rust, dirt, oil, or water before applying insulation. When specified, paint or coat pipe surfaces as specified in Section 09 96 00 – High-Performance Coatings.

C. Examine insulation materials and accessories before installation. DO NOT install insulation and jackets that have been damaged or insulation that has become wet due to exposure to water.

3.2 INSTALLATION

A. Install insulation and jacket materials in accordance with manufacturer's written instructions.

B. Apply insulation in smooth, clean manner with tight and finished smooth joints. Fits insulation tightly against surfaces. Insulate each continuous run of pipe with full-length sections of insulation with a single piece cut to length to complete the run of pipe. DO NOT use cut pieces or scraps to complete the installation.

C. Butt longitudinal and circumferential insulation joints firmly together.

D. Maintain the integrity of vapor barrier jacketing. DO NOT use staples to hold vapor barrier overlaps in place.

E. Apply sealant or cement when previous applications of adhesives and cement have thoroughly dried.

F. Apply insulation to permit expansion or contraction of pipelines without damage to insulation or jacketing.

G. Fittings:
1. Insulate fittings by covering with mitered sections of insulation or utilize factory made prefabricated fitting shapes.
2. Terminate preformed pipe jackets or covering at sufficient distance from flanges to permit removal of bolts.
3. Overlap flange and flanged fitting insulation on adjacent pipe covering by at least 2 inches.

H. Valves:
1. Insulate valves 3-inch in nominal size and larger with removable insulating blankets.
2. Size blanket to extend up to packing gland only so that replacement of packing does NOT require removal of insulating blanket.

I. Provide continuous insulation through and over pipe supports and provide protection saddles at supports.

J. Extend insulation against insulation end protection shields or covers so that insulation voids DO NOT exist and provide watertight end seals and covers where insulation terminates.

K. Insulate pipeline strainers to permit removal of strainer basket without disturbing insulation on strainer body.

L. Provide continuous pipe insulation and covering through sleeves or openings in walls and floors. When buried pipe enters a building through a below grade wall or slab penetration, begin insulation system on interior side of penetration.

M. Apply pre-molded pipe insulation with extended legs when used on pipe traced with either tubing or electric cable type.

N. For Type 1 or 2 jacket installation on piping with potential reach temperatures greater than 150°F shall be thermally isolated from piping at all insulation closure locations (end caps, transitions, etc.).

O. Apply piping identification on jackets.

3.3 INSULATION SCHEDULE

Service Designation (1)	Location (2)	Insulation Type (3)	Jacket Type (3)	Service Temp. (°F)(4)	Vapor Barrier
Heat Traced Pipes (5)	Exterior	1 or 2	2	Use thickness established in Table in paragraph 2.1	Install on Type 2 insulation

Notes:

1. Refer to Process Piping Schedule in Section 40 23 39 - Process Piping - General for service designations.
2. Insulation jackets are NOT required for interior installations that are concealed. See definitions for description of concealed locations.
3. Contractor may select from options listed.
4. Unless noted otherwise, use service temperature range provided in this table to establish insulation thickness as required by Table in paragraph 2.1 A.
5. Insulate all piping systems that are specified to be heat traced.

END OF SECTION

DIVISION 44

POLLUTION CONTROL EQUIPMENT

SECTION 44 42 27.19 – MECHANICALLY CLEANED BAR SCREEN SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the Work necessary to completely furnish the mechanically cleaned bar screens and shaftless screw conveyor units including all related equipment, equipment supports, extra materials, documentation, controls, factory and field testing, training and appurtenances for a complete and fully functioning mechanical screen system.

B. This equipment shall be furnished by the Owner to a Contractor for installation. The Manufacturer shall be responsible for all necessary coordination and support during installation and start-up.

1.2 OWNER FURNISHED MATERIALS

A. Owner has pre-purchased portions of the mechanically cleaned bar screen system to be provided to the Contractor for installation. The detailed scope of supply for the Owner furnished items is provided in section 44 42 27.20 of the project documents. The Contractor shall carefully review the scope of supply to determine those items required by the Contract Documents which are not part of the proposal or specified manufacturers scope of supply. Costs for installation of Owner furnished materials shall be included in the relevant Lump Sum Bid Price items of the bid form and shall include costs for the following:
   1. All items not specifically itemized in the Owner's scope of supply but required by the Contract Documents and/or necessary to provide a complete and operational system.
   2. All times specifically itemized in the Owner's Scope of supply which are designated to be provided by others, provided by the customer, or any similar designation.
   3. All labor, materials, and all other associated costs not included in the Scope of Supply but required by the Contract Documents and required to provide a complete and operational system.

1.3 GENERAL

A. Equipment Numbers:
   1. Mechanically Clean Bar Screens: M-1-1-1, M-1-1-2
   2. Shaftless Screw Conveyors: M-1-2-1, M-1-2-2

B. Like items of equipment provided hereinafter shall be the end products of one Manufacturer to achieve standardization of appearance, operation, maintenance, spare parts and Manufacturer's services.

C. Unit Responsibility: The Work requires that the mechanically cleaned bar screens, screenings conveyance systems, local control panels, instruments, and components complete with all accessories and appurtenances be the end product of one responsible system Manufacturer or responsible system supplier. The Manufacturer is responsible to the Owner for providing the equipment systems as specified herein.

D. A copy of this Section, with any Addendum updates included, and all referenced and applicable Sections, with any Addendum updates included, shall be submitted with each paragraph check-marked to indicate Specification compliance or marked to indicate requested deviations from Specification requirements. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the Specifications are indicated, and therefore requested by the Manufacturer, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Manufacturer with the Specifications. The Submittal shall be

accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up Sections, along with justification(s) for any requested deviations to the Specification requirements, with the submittal shall be sufficient cause for rejection of the entire Submittal with no further consideration.

1.4 SUBMITTALS

A. Submit the following additional specific information:
   1. Shop Drawings:
      a. Make, model, weight, and horsepower of each component.
      b. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.
      c. Detailed structural, mechanical, and electrical drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and details of anchorage and of connections to other work, and weights of associated equipment. Electrical drawings shall include wiring and schematic diagrams of all components.
      d. Details of attachment and support in channel.
      e. Gear output torque and rake weightlifting capacity calculations.
      f. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and motor modifications.
      g. Control panel elevation drawings showing fabrication and placement of operator interface devices and associated elements.
      h. External utility requirements (quantity and connection details) such as air, water, power, drain, etc., for each component.
      i. Suggested spare parts list to maintain the equipment in service for a period of 1 year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
      j. List of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
   2. Informational Submittals:
      a. Manufacturer's Certificate of Compliance of factory applied coating systems.
      b. Detailed installation instructions with clear, step-by-step points on the correct mechanical and electrical installation procedures.
      c. Special shipping, storage and protection, and handling instructions.
      d. Written factory test report of inspection.
      e. Field functional test reports.
      f. Manufacturer's Certificate of Proper Installation.
      g. Operation and Maintenance Manual.
      h. Welder/welding operator qualifications.
      i. Welding inspector credentials.
      j. Welding inspector’s Report.
      k. Copy of Manufacturer’s warranty.

1.5 QUALITY CONTROL

A. Manufacturer shall have a demonstrated history (minimum of ten years) in design and production of equipment for use in municipal wastewater treatment applications and under the named Manufacturer submitting. Manufacturer shall provide documentation of at least 15 installations within the previous five years with five installations being of similar or larger size. All installations shall be under the named Manufacturer submitting. At a minimum, provide the following documentation for Engineer review:
   1. Facility details (location, current contact name/number)
   2. Installation details (channel width, depth, number of channels)
   3. Equipment details (product name, bar spacing, inclination, peak capacity)
   4. Installation year

B. All welding shall be performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code, or equivalent.

C. Welding inspector shall be certified in accordance with AWS QC 1.

1.6 WARRANTY

A. Provide warranty for a minimum period of 24 months at the date of startup of the equipment. The warranty shall stipulate that the equipment furnished is suitable for the purpose intended and free from defects of material and workmanship for the duration of the warranty. In the event the equipment fails to perform as specified, the Manufacturer will promptly repair or replace the defective equipment without additional cost to the Owner.

B. Spare parts identified within this specification shall not be used to address warranty repairs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Where a Manufacturer's standard equipment name and/or model number is listed, the equipment system shall be provided and modified as required to conform to the performance, functions, features, and materials of construction as specified herein.

B. Materials, equipment, components, and accessories specified in this section shall be, products of:
1. Vulcan Industries, Inc. – Model FT-66 Severe Duty Mensch Crawler Screen.

2.2 GENERAL REQUIREMENTS

A. Noise Level: When in operation, no piece of equipment shall exceed the OSHA noise level requirements for a 1-hour exposure, 105 dBA.

B. Service Factors: Service factors shall be applied in the selection and design of components where so indicated in individual sections. When not indicated there, minimum service factors shall be 1.25, except for gears and gear drives as specified herein.

C. Safety Devices: The completed work shall include all necessary permanent safety devices, such as machinery guards, emergency stops and similar items required by OSHA, and other federal, state, and local health and safety regulations.

D. Flanges and Pipe Threads: Comply with ANSI B 16.1, Class 125; or B 16.5, Class 150, unless otherwise indicated. Threaded flanges and fittings shall have standard taper pipe threads complying with ANSI/ASME B 1.20.1.

E. Bearings:
1. Conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA):
   a. Standard 9-90 Load Ratings and Fatigue Life for Ball Bearings
   b. Standard 11-90 Load Ratings and Fatigue Life for Roller Bearings

F. Gears and Gear Drives:
1. Except as otherwise indicated, gears shall be of the bevel type. The bevel gear reducer shall be a totally enclosed unit.

2. The gear reducer shall have ball or roller bearings throughout with all moving parts immersed in oil. Gear reducers which require periodic disassembly of the unit and re-greasing of bearings are not acceptable.
3. The nominal input power rating of the gear reducer shall be at least equal to the nominal horsepower of the drive motor.
4. Gear reducer shall be designed and manufactured in compliance with applicable AGMA or equivalent standards.
5. During continuous operation, the oil temperature shall not exceed 200 degrees F.

G. Manufacturer shall provide required number and size of anchor bolts for each system.

H. Stainless Steel: Stainless steel components shall be 304 stainless steel, or higher, as specified.

I. Nameplates: Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations with stainless steel screws or drive pins. Nameplates shall contain the Manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.3 SERVICE CONDITIONS

A. Material Handled: Raw sewage including, but not limited to, rocks, grit, rags, hair, paper products, plastic products and septage and grease trap waste deposited by haulers at the upstream raw sewage pump station.

B. Location: Outdoors, to be operated in a damp, wet, corrosive atmosphere.

C. Channel Conditions:
1. Channel Width: 5.5-feet.
2. Channel Depth: 7.71-feet.
3. Channel Top Elevation: 176.40
4. Channel Bottom Elevation: 168.69
5. Operating Floor Elevation: 176.40
6. Minimum Screen Discharge Height over Operating Floor: 179.90

D. Mechanical Bar Screens:
1. Number of Mechanical Bar Screens: 2
2. Design Hydraulic Conditions:
   a. Maximum Flow Rate: 37.5-mgd with less than 9.24 inches head loss at 30 percent blinding conditions and downstream liquid depth of 5.21-feet.
   b. Average Day Flow Rate: 24.0-mgd with less than 5.64 inches head loss at 30 percent blinding conditions and downstream liquid depth of 4.30-feet.
3. Bar Spacing: 3/8-inch.
4. Screenings Loading: 30 cubic feet per million gallons.
5. Bar Screen Inclination Angle: 75 degrees from horizontal.
6. Rake mechanism travel speed between 15 and 30 feet per minute and drive motor, speed reducer, and sprockets shall not descend below the high-water elevation.
7. Equipment Environment Application Rating: NEC, Class I, Division 2 NEMA 7.

E. Shaftless Screw Conveyors:
1. Number of Conveyors: 2
2. Material Conveyed: Municipal Screenings
3. Average Density: 65 lbs/ft3
4. Maximum Trough Fill Rate at Design Capacity: 100%
5. Maximum Degree Inclined: 0 (horizontal)
6. Length: See attachments

7. Discharge Configuration: Horizontal
8. Conveyor Capacity: 85 ft3/hr, min.
9. Inlet Quantity: 1
10. Outlet Quantity: 2
11. Nominal Trough Width: 14.5 in.
12. Minimum Screw Diameter: 11 in.
13. Maximum Screw Speed: 20 rpm
14. Motor Horsepower: 1.75, min.
15. Drive Location: Inlet End

2.4 SYSTEM PERFORMANCE AND FUNCTIONAL REQUIREMENTS

A. The equipment furnished shall positively clean and remove screenings including, but not limited to, rocks, grit, rags, hair, paper products, plastic products and septage and grease trap waste deposited by haulers at the upstream raw sewage pump station from the incoming wastewater by means of a bar rack, installed in a concrete channel, designed to retain debris and a traveling rake mechanism which removes and elevates the screenings to a discharge mechanism.

B. The bar rack shall be cleaned by a single rake engaging the bar rack from the upstream side at the bottom of the channel and removing the debris. The screenings shall be lifted to a dead plate containing and conveying materials over a chute for discharge into a dedicated conveyance system. The rake shall be positively cleaned with a wiper blade at the discharge point.

C. Mechanically cleaned bar screens which utilize chains, cables, threaded stems, hydraulic cylinders, or multiple rakes to remove screenings from the channel are not acceptable. No moving parts shall be located permanently below the channel water surface at the maximum design flow. The only components that are to enter the waste stream shall be the cleaning rake head and rake arm.

D. The shaftless screw conveying system shall be designed specifically for transport of screening material received from the mechanical bar screens. The screw conveyor shall be designed to convey screenings from the drive end of the unit to the discharge end. Conveyors shall be provided complete with all appurtenances and accessories as specified and as necessary to continuously convey materials automatically. Screw conveyors shall be capable of operating continuously at the specified operating conditions and also able to start and operate with a full trough. Conveyors with shafted spirals are not acceptable.

E. System Definition:
1. The system will consist of two mechanical screens, two shaftless screw conveyors, two local control stations (one mounted to each screen frame), and one main control panel to control all components of the system.
2. Each system shall include all components and accessories which are required for a properly and fully functioning system.

2.5 EQUIPMENT AND/OR MATERIALS

A. Mechanically Cleaned Bar Screens
1. Bar Rack
a. The bar rack shall consist of vertically oriented, equally spaced bars that are inclined from the horizontal with the inclination angle specified herein. The bar rack shall be made up of equally sized sections securely fastened to the frame of the screen and be readily removable in sections no more than 18-inches wide. Screens without the ability to replace bar screen sections shall not be acceptable.
b. Bar Spacing: The bar rack shall consist of parallel bars, having a clear spacing meeting the specified requirements between each bar.

c. The bottom of the bars shall be attached to a flush bottom base plate. The bar rack shall extend from the base plate to the connection point on the dead plate.
d. Each bar shall be provided with an arced gusset, constructed of rectangular bars, at the bottom of the bar rack to allow the raking mechanism to engage the bottom most portion of the bar rack prior to reaching the inclined section of the bar rack. Curve plates in lieu of the curve bars shall not be acceptable.
e. The bar rack shall be manufactured of Type 304 stainless steel with welded spacers at top, bottom, and supported as necessary at intermediate points. The bar rack shall be trapezoidal bar, 5/16-inch x 3/16-inch x 2-1/2-inches deep.

2. Dead Plate
   a. The bar screen shall be provided with a fixed dead plate extending from the upper portion of the bar rack connection to the screenings discharge point.
   b. The dead plate shall be flat without undulation such that the rake head teeth shall ride no closer than 1/16-inch from the dead plate and no further than 1/4-inch from the dead plate.
   c. The dead plate shall be securely fastened to the side frames and manufactured of Type 304 stainless steel having a minimum thickness of 1/4-inch.
3. Discharge Chute
   a. The rake assembly shall be designed to reach the specified discharge height above the floor elevation. The discharge chute shall be positioned at a 45-degree angle, minimum, from horizontal at the top of the dead plate and be equipped with provisions to prevent drainage, leakage, and side spill of the screenings.
   b. The discharge chute shall be manufactured of Type 304 stainless steel having a minimum thickness of 1/8-inch.
4. Side Frames
   a. The side frames shall be manufactured of Type 304 stainless steel having a minimum thickness of 3/8-inch. The frame shall have a minimum width of 36-inches and extend fully from the channel invert to the top of the bar screen assembly.
   b. Each side frame shall include a fixed roller track to guide and position the rake assembly. Separate roller tracks shall be provided for the drive shaft rollers and the guide shaft rollers. The fixed roller track shall be manufactured of Type 304 stainless steel.
   c. Access plates shall be provided on each side frame to allow access to the guide shaft rollers and drive shaft rollers for maintenance and replacement. The guide shaft rollers and drive shaft rollers shall be capable of being replaced without the need to remove the rake assembly from the side frames.
5. Rake Assembly
   a. A dual arm rake assembly shall be provided to remove the collected debris from the bar rack. The rake assembly shall consist of fixed upper rake arms and spring-loaded, lower rake arms that pivot to permit movement over lodged or excessively large objects during the raking cycle. Each upper and lower rake arm shall be connected through a two-pin linkage system. After an object has been overridden, the rake teeth shall reengage and continue to clean the bar rack.
   b. All structural components of the rake assembly shall be Type 304 stainless steel.
   c. The rake assembly shall have the capability of lifting a load of no less than 100 pounds per foot of the rake width, each cycle. The rake teeth shall remain fully engaged in the bar rack until the specified lifting capacity of rake width limit is reached.
   d. The rake assembly shall be driven by a pair of cogwheels that are specially machined to mesh with a fixed pin rack. A drive shaft and guide shaft, outfitted on each end with rollers, shall travel in fixed roller tracks to position the rake assembly. The guide shaft shall be located below the drive shaft for stability.
   e. Materials of construction for the shafting shall be Type 304 stainless steel.
   f. The rake head shall have teeth sized to fit between the spacings of the bar rack. The rake teeth shall fully engage the bar rack. The rake head shall be attached to two rake arms. The rake head shall be 3/8-inch thick by 10-inches deep. The rake teeth

shall attach to the rake head and shall be in multiple, replaceable sections and shall have a minimum thickness of 3/4-inch. The rake arms shall be constructed of structural rectangular tubing that is a minimum of 3-inches by 5-inches by 7-gauge thick with a nominal length of 8-feet.

6. Wiper Assembly
   a. The bar screen shall be provided with a pivoting wiper mechanism positioned at the point of discharge with a replaceable ultra-high molecular weight polyethylene wiper blade that extends the full width of the rake.
   b. During each cycle, the wiper blade shall contact the rake heads at its inner surface during upward travel and shall scrape the debris off the end of the rake head and through the discharge chute. The entire wiper mechanism including the wiper arms shall be contained inside the framework of the bar screen.
   c. The wiper mechanism, not including the wiper blade, shall be manufactured of Type 304 stainless steel.
   d. The wiper mechanism shall be repositioned by the rake assembly. Should the wiper assembly be operated in reverse, the wiper mechanism shall remain in place and be displaced by the action of the rake assembly without the need to manually lift the wiper mechanism.
   e. The grease fittings for the wiper arms shall be extended and secured to the side frames in an area that is easily accessible by plant personnel.
   f. Shock absorbers shall be provided to cushion the release of the wiper.
7. Pin Rack
   a. The bar screen shall be provided with a stationary pin rack on each side of the frame. The pin rack shall consist of separate ANSI chain links attached with threaded fasteners to facilitate easy removal without requiring removal of the rake or drive assembly.
   b. All pins, rollers and bushings shall be easily removable including those components located below the top of the channel.
   c. Each chain link shall consist of two rollers and bushings. Pin, bushing, and roller diameter shall conform to ANSI standards. Rollers and bushing shall be manufactured of carbon steel, case hardened to minimum RC50.
   d. Rollers shall be free to rotate on bushings to reduce wear between pin rack and cogwheels.
   e. Pin bolts shall be Type 304 stainless steel with a minimum diameter of 0.4375-inches.
8. Pin Rack Lubrication and Cleaning System
   a. A pin rack lubricating/cleaning system shall be mounted to the rake assembly to allow for periodic lubrication and/or cleaning of the pin racks.
   b. The system shall be comprised of an air/oil reservoir, air fill fittings, oil fill fitting, safety relief valve, manual ball valve, pressure gauge, hoses, nozzles and fittings.
   c. The system shall allow personnel to lubricate and/or clean the pin racks from the operating floor without the need for ladders or scaffolding.
   d. The system shall require manual filling of the reservoir with lubricating oil or cleanser as well as manually charging the reservoir with air. Air supply shall be provided by others.
   e. All metal components shall be manufactured of Type 304 stainless steel.
9. Drive Unit
   a. The bar screen shall be provided with an integrated drive assembly consisting of a Class 1, Division 1, Group D explosion-proof electric motor with spring-set motor brake, gear reducer, rake assembly mounting bracket and one pair of drive cogwheels.
   b. Cogwheels
      1) Cogwheels shall be pitched to match the pin rack rollers and shall be ANSI 1045 steel with teeth flame hardened to approximately RC 50.
      2) The cogwheels shall have a minimum diameter of 7.5-inches and be of the involute gear design. Standard sprockets shall not be acceptable.

3) Cogwheels shall be capable of repair and maintenance of reciprocating rake arm assembly at the top of the channel.

c. Gear Reducer

1) The gear reducer shall be of the helical worm gear type and shall be capable of elevating the wight of the drive assembly plus its maximum calculated load.
2) Gear reducers shall have ball or roller bearings throughout with all moving parts immersed in oil.
3) Worm shall be of alloy steel with teeth precision ground and polished after casehardening.
4) The worm gear shall be of all high strength alloy bronze or alloy bronze-rimmed semi-steel.
5) Shafts shall be of all high strength alloy steel ground to required tolerances.
6) At least one bearing on each shaft shall be of the combined radial and thrust type.

B. Shaftless Screw Conveyors

1. Inlet Hopper

a. The inlet hopper shall be designed to direct wet screenings material into the screw housing from the mechanical screen. The inlet zone shall be completely shrouded to contain the screenings. The inlet hopper shall be a minimum of 12-gauge thickness and constructed of 304 stainless steel. All attachment hardware shall be 304 stainless steel.

2. Screw Conveyor Housing (Troughs) and Casings

a. Trough

1) The screw housing (trough segments) shall be a U-shaped trough constructed of 10-gauge thick 304 stainless steel.
2) Provide trough segments consisting of rolled sections butt welded together to give a maximum single segment of not more than 20-feet in length. Provide trough end flanges roll formed Type 304 stainless steel bar welded to the ends of the trough segments. Provide bolt holes uniformly located on either of the trough's vertical section centerline. Apply compressible gasket material to flanged faces to give a sealed joint when trough segments are bolted tougher.
3) The entire housing shall be supported by Type 304 stainless steel legs.
4) The maximum length of any preassembled section of trough: 20-feet and no more than two separate segments bolted together in any preassembly shipped to site. Site welding is not acceptable.
5) Provide a trough stiffener channel bolted across the width of the trough made of Type 304 stainless steel. Set stiffener channel spacing to match cover edges to give a sealed face upon which the covers are bolted.

b. Trough Liner

1) Provide troughs fitted with a liner manufactured from ultra-high molecular weight polyethylene, not less than 1/2-inch thick, formed and bonded with two layers of a different color.
2) The liner shall be provided in maximum sections of 4-feet and held in place with Type 304 stainless steel clips. No fasters are acceptable.

c. Covers

1) The transport area of the screw housing shall be furnished with removable cover panels manufactured in maximum 5-foot lengths. The cover panels shall have a minimum thickness of 1/8-inch and be constructed of Type 304 stainless steel.
2) Covers shall be provided with handles and gasket seals.
3) Provide each conveyor with the appropriate warning labels to call for lock out – tag out of the electrical system before the covers are removed.
4) Provide lockable inspection hatches over drop chutes with Type 304 stainless steel mesh.

d. Supports

1) Provide separate supports at the inlet and discharge end, with intermediate supports as required. The intermediate supports shall be no less than one for every 10-feet of length of trough segment. Provide supports in Type 304 stainless steel with its flat face rolled to match the trough shape and extending around the entire trough circumference up to within 2-inches of the top face of the trough U-flange.
2) Coordinate conveyor supports with the screen channel locations so as to avoid conflicts with installation of the screening equipment. Coordinate location of support legs axially along the trough to avoid conflict with other equipment.

e. Connections
1) Provide a flanged drain outlet with each conveyor to facilitate cleaning.

3. Shaftless Screw Conveyor Flights
a. The conveyor screw shall be of the shaftless spiral design without a center shaft or hanger bearings.
b. Spiral Flights:
1) Cold-formed high strength chrome allow steel with a minimum hardness of 220 Brinnell.
2) Provide the spiral flights designed to prevent distortion and jumping in the trough.
3) Provide a second, inner spiral, concentric with the outside spiral.
4) Provide the flights design so that the torsional rating of the auger flighting exceeds the torque rating of the drive motor at 150 percent of its nameplate horsepower.
5) Spring effect of the spiral: Not to exceed 0.12 inches per foot of length at maximum load conditions.
6) Maximum outer spiral thickness: 0.75-inches for spiral diameters up to 9-inches and 1-inch for spirals diameters greater than 9-inches.
7) Provide the spiral flighting formed in sections from one continuous flat bar and concentric to within plus-or-minus 5/64-inch.
8) Section flighting formed from plate is not acceptable.
9) Provide spiral flighting with full penetration welds at all splice connections.
10) Align the flights to assure true alignment when assembled in the field.
11) Couple the spiral flights to the end shaft by a flanged, bolted connection.
12) Provide a gland packing ring to seal the drive shaft where it penetrates through the end plate, along with a sealing system.
13) Provide the connection of the spiral to the drive system through a flanged connection plate that is welded to the spiral forming a smooth and continuous transformation from the flange plate to the spiral.
14) Provide the drive shaft with a mating flange bolted to the spiral connection plate. Provide a grease lubricated labyrinth seal shaft mounted internally in the conveyor between the back plate and spiral coupling connection.

4. Discharge Chutes and Slide Gates
a. Provide troughs with discharge chutes and slide gates for conveyance of screening material to the washing compactor and discharge hopper. Provide chutes with flanged ends.
b. Provide single-ply flanged discharge chutes at locations indicated.
1) Flexible chutes: EPDM rubber hose, neoprene, or acceptable equivalent product.

5. Slide Gates:
a. Provide slide gates on the discharge chute(s) where indicated. Each slide gate shall be electro-mechanically operated.
b. Provide slide gates designed with the following performance:
1) Maximum vertical dimension of 4-inches excluding the electric motor operator.

2) With the gate in the full, open position, at least one pitch rotation of the spiral shall be exposed to the opening in the direction of transport and where layout permits 1.5 x spiral pitch opening.
3) Gate Opening: At least the full width of the conveyor trough.

c. Materials: Type 304 stainless steel with UHMW PE components, all minimum 3/16-inch thick. Provide UHMW PE with a machined groove to accept the gate blade and give a positive seal.

2.6 ELECTRICAL COMPONENTS AND ACCESSORIES

A. General: Provide all necessary electrical components and wiring for a complete, functional system.

B. Wiring: Wiring shall meet the requirements of NFPA 70.

C. Electrical Raceways: Electrical wiring shall be installed in conduit meeting the requirements of NFPA 70.

2.7 INSTRUMENTATION AND CONTROLS

A. All controls necessary for the fully automatic operation of the mechanically cleaned bar screen system shall be provided. More specifically, this includes the controls for the screenings conveyance system and for control of the existing screenings washer/compactor units. The controls shall be designed for protection against overload in to prevent equipment damage.

A. Master Control Panel

1. The complete screening system (screening/conveying/washing/compacting) shall be provided with a master PLC control panel with HMI for overall automatic control of the system. All components required for the operation, monitoring, and control of each new screen, new conveyor, and existing washer/compactor shall be supplied by the screen Manufacturer. The control panel shall include a fiber patch panel and ethernet switch configured for connection to the plant SCADA system over fiber media via Ethernet/IP communication. The control panel will be located outdoors.
2. General Requirements:
    a. Enclosure: Corrosion Resistant NEMA 4X, suitable for installation outdoors
    b. Materials: 304 Stainless Steel
    c. The control panel shall meet U.L. requirements and shall be U.L. 508A listed as a complete assembly. The control panel shall be completely pre-wired and factory tested prior to shipment.
    d. Power: 120 volts, single-phase, 60-Hz.
    e. Main Disconnect: Circuit breaker interlocked with door handle.
    f. Panel space heater with thermostat.
    g. Panel air conditioner.
    h. Provide circuits for powering the channel level transmitters.
    i. Receive analog signals from channel level transmitters.
    j. Provide control signals to/from field devices and motor starting panel.
    k. Provide intrinsically safe barriers as required.
3. Physical Interface Devices:
    a. System Control Power selector switch and indicator light.
    b. Alarm horn, alarm indicator light, and reset pushbutton.
    c. Emergency Stop Mushroom Head pushbutton.
4. Operator Interface Terminal (OIT) touchscreen for operator interface for complete screening system. OIT shall be Panelview Plus 7 minimum 10-inch screen size. At a minimum, provide the following features from the OIT:
    a. Screen Manual and Automatic Mode Selection
    b. Screen Wash Water Manual and Automatic Mode Selection

c. Screen Status and Alarm Indications
d. Screen Auto Mode: Level/Timed selection
e. Screen On Time Adjustment
f. Screen Off Time Adjustment
g. Screen Differential Level Setpoint Adjustment
h. Shaftless Screw Conveyor Manual and Automatic Mode Selection
i. Shaftless Screw Conveyor Status and Alarm Indications
j. Washer/Compactor Manual and Automatic Mode Selection
k. Washer/Compactor Spray and Flush Manual and Automatic Mode Selection
l. Washer/Compactor Status and Alarm Indications
m. System Status Indications
n. Continuous Indication of Upstream/Downstream Channel Levels
o. Channel High Level and Level Differential Alarms
p. Alarm History
q. Elapsed time meters for all motors
r. All operator setpoint adjustments

5. Programmable logic controller (PLC) for automatic control of screening system. PLC shall be Allen-Bradley CompactLogix 1769-L30ER.
6. Control Panel External Interfaces: Provide the following interfaces between the control panel and items outside the system package:
   a. Dry Contacts:
      1) Power On
      2) General Alarm/Common Alarm
      3) Screen in AUTO
      4) Conveyor in AUTO
      5) Compactor in AUTO
      6) Screen Running
      7) Conveyor Running
      8) Compactor Running
      9) Screen Fault
      10) Conveyor Fault
      11) Compactor Fault
      12) High Water Level
   b. Analog (4-20mA):
      1) Upstream Level
      2) Downstream Level

B. Motor Starting Panel
1. A single motor starting panel shall be provided containing the power components associated with the equipment, including across-the-line starters for the screen motors, conveyor motors, and washer/compactor motors. These panels should interface with the master control panel through hard-wired inputs and outputs as required for control and monitoring of the equipment.
2. General Requirements:
   a. Enclosure: Corrosion Resistant NEMA 4X, suitable for installation outdoors
   b. Materials: 304 Stainless Steel
   c. The control panel shall meet U.L. requirements and shall be U.L. 508A listed as a complete assembly. The control panel shall be completely pre-wired and factory tested prior to shipment.
   d. Power: 480 volts, three-phase, 60-Hz.
   e. Main Disconnect: Circuit breaker interlocked with door handle.
   f. Control power transformer for 120VAC supply to master control panel.

C. Local Control Stations
1. Provide a local control station for each screen, conveyor, and washer/compactor to be mounted on the side frame of the equipment. Local control stations shall be:

a. NEMA 7/4X boxes: Class 1, Division 1, Groups A, B, C, and D
b. Copper free cast aluminum body and cover
c. Stainless steel hinges
d. Copper free cast aluminum body and cover
e. Stainless steel hinges

2. Screen Local Control Station
   a. Screen HAND/OFF/AUTO Selector Switch
   b. Screen Wash HAND/OFF/AUTO Selector Switch
   c. Emergency Stop Mushroom Head Pushbutton
   d. FAULT Light
   e. RUNNING Light
3. Washer/Compactor Local Control Station
   a. W/C HAND/OFF/AUTO Selector Switch
   b. Emergency Stop Mushroom Head Pushbutton
   c. Wash Spray HAND/OFF/AUTO Selector Switch
   d. Wash Flush HAND/OFF/AUTO Selector Switch
   e. FAULT Light
   f. RUNNING Light
4. Conveyor Local Control Station
   a. Conveyor HAND/OFF/AUTO Selector Switch
   b. Emergency Stop Mushroom Head Pushbutton
   c. FAULT Light
   d. RUNNING Light

D. Control Panels External Interfaces: Provide for all required signal interfaces between the master control panel, motor starting panel, local control stations, and field devices. Manufacturer to be responsible for accommodating required interfaces between all items.

E. Field Components: Provide the following components for each screen system which are required to implement the function described herein:
1. Screens:
   a. Local control stations.
   b. Upstream and Downstream Level Transmitters to be provided for each channel. Transmitters to be Endress + Hauser FMR20 with RIA15 indicator panels, rated for Class 1 Division 2 hazardous locations. The transmitters shall be provided with sufficient cable length for field mounting next to the main control panel.
2. Compactors:
   a. Local control stations for mounting next to existing compactors.
3. Conveyors:
   a. Local control stations.
   b. Emergency pull cords.

F. Control Description
1. In the AUTO mode, each component shall be operated based on either the channel water level differential or run time.
   a. When the channel water level differential rises to an adjustable preset level the screen system shall begin operating and shall continue to operate until the differential is reduced to the preset normal level. When the channel level drops below the adjustable set point, the screen drive shall stop after an adjustable time delay.
   b. When the system is operating based on run time, timers will cycle the screen on and off. The timer ranges shall be 0 to 60 minutes.
   c. When the shaftless screw conveyor and washer/compactor is in AUTO mode, both shall run when the screen runs.
   d. After the screen stops, the shaftless screw conveyor and washer/compactor equipment shall continue running for an adjustable time delay.

2. In the ON (HAND) mode, each component will operate continuously.

G. Alarm Control
1. The following conditions shall shutdown the screen system in ON or AUTO mode, sound horn, and illuminate respective pilot light. Alarm silence pushbutton will acknowledge and silence horn; alarm reset will extinguish alarm indicator after condition has been cleared.
   a. Screen drive motor overload
   b. Screen drive motor over torque
   c. Conveyor drive motor overload
   d. Conveyor drive motor over torque
   e. Compactor drive motor overload
2. The following conditions shall sound horn and illuminate respective signal. Alarm silence pushbutton will acknowledge and silence horn; alarm reset will extinguish alarm indicator after condition has been cleared.
   a. Channel High Level

H. Other Instrumentation and Controls: Provide all items not specifically called out which are required to implement the functions described herein.

2.8 TOOLS AND SPARE PARTS

A. Tools: The work includes one complete set of special tools recommended by the Manufacturer for maintenance and repair of each separate type of equipment; tools shall be stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. Spare Parts:
1. Spare parts shall be tagged by project equipment number and identified as to part number, equipment Manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with hinged wooden cover and locking clasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.
2. Provide, at a minimum, the following spare parts for the equipment:
   a. Mechanically Cleaned Bar Screen:
      1) One complete set of drive shaft end bearings for each unit
      2) One complete set of cogwheels for each unit
      3) One complete set of pin rack rollers and bushings of sufficient length for each unit
      4) One complete set of brake discs and springs for each unit
      5) Two complete guide shaft roller bearings for each unit
      6) Two complete drive shaft roller bearings for each unit
      7) One complete set of guide rollers of each different size per unit
      8) One limit switch for each unit
      9) One level transducer for each unit
      10) One wiper blade for each unit
   b. Shaftless Screw Conveyor:
      1) One set of shaft seals.
      2) One full set of preformed liner material.

2.9 FABRICATION

A. Shop Assembly: All equipment shall be test-run, fully assembled, in the factory before shipment. Submit test results to Engineer and Owner for review prior to shipment.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordination shall include space and structural requirements, clearances, utility connections, signals, outputs and features required by the Manufacturer including safety interlocks.

3.2 ASSEMBLY AND PREPARATION FOR SHIPMENT

A. Each drive unit, including motor, shall be completely factory assembled, aligned, and securely crated for shipment. Accessory equipment which cannot be shipped assembled to the unit, such as shafts, baseplates, impellers, spare parts, and anchorage materials, shall be separately crated, clearly marked as to the contents, and shipped on the same shipment as the drives.

B. For shipment, exposed surfaces subject to rust, such as mounting flange faces, etc., shall be covered with a rust-preventive compound such as Kendall No. 5, or equal.

3.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the Manufacturer.

B. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment and handling. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weathertight and heated storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings.

3.4 FIELD QUALITY CONTROL

A. Functional Testing: Six-hour continuous flow through operation test with wastewater on the screen, washer, and compactor.

3.5 MANUFACTURER’S SERVICES

A. A Manufacturer’s representative for the equipment specified herein shall be present at the job site for the minimum person-days listed for the services hereinunder, travel time excluded:
   1. Installation, Startup, and Testing Services:
      a. 1 person-day for installation assistance, inspection, and Certificate of Proper Installation for each screen.
      b. 1 person-day for functional and performance testing.
      c. Provide Qualifications of Manufacturer's Representative.
   2. Training Services:
      a. 1 person-day of prestart classroom or jobsite training of Owner’s personnel.
      b. Training of Owner’s personnel shall be at such times and at such locations as required and approved by the Owner.

c. Training shall only be conducted after Engineer/Owner acceptance of the Operations and Maintenance Manuals. These manuals shall be provided to staff on, or before, date of training.

3. Post-Installation Inspection
   a. 2 person-days for equipment inspection 11 months following date of Certificate of Proper Installation. This effort shall include re-training of Owner's personnel, if necessary.

3.6 SUPPLEMENTS

A. The supplements listed below and follow "END OF SECTION" are part of this specification
   1. Section 44 42 27.20 – Mechanically Cleaned Bar Screen Data Sheet

END OF SECTION

SUBMITTAL REVIEW

- ☐ FURNISH AS SUBMITTED
- ☑ FURNISH AS NOTED
- ☐ FURNISH AS CORRECTED
- ☐ REVISE AND RESUBMIT
- ☐ PARTIAL RESUBMITTAL
- ☐ REJECTED
- ☐ FOR INFORMATION ONLY

GARVER

Corrections or comments made on the submittals during this review do not relieve the contractor from compliance with the requirements of the contract documents. This check is only for review of general conformance with the design concept of the project and general compliance with the requirements of the contract documents. The contractor is responsible for the quality of the work, confirming and correlating all quantities and dimensions, selecting fabrication process and techniques of construction, coordinating the work of all trade and subcontractors, and performing the work in a safe and satisfactory manner.

BY MLTabor **DATE** 7/27/2023

1. **Remove** safety cage from your scope. Garver will provide a guard rail in lieu of the safety cage. (Pg. 65)

2. Inclination angle of 80° is acceptable.

CONFIDENTIALITY NOTICE

The Shop Drawings being submitted in their entirety embody proprietary information of VULCAN INDUSTRIES, INCORPORATED. Any reproduction or transmittal to any party outside the recipient's organization (except where the recipient has been given the express right by written agreement or as dictated by the terms of the contract) is expressly prohibited. Use and sale rights regarding the same are expressly reserved. The shop drawings in their entirety are submitted under a confidential relationship for a specific purpose, and the recipient agrees by accepting the submittal not to supply or disclose any information regarding it to any outside party. All rights hereto are expressly reserved by VULCAN INDUSTRIES, INCORPORATED, Missouri Valley, Iowa.

SUBMITTAL REVIEW COMMENTS

PROJECT:	Hilliard N. Fletcher WRRF Headworks Improvements
VULCAN JOB NO:	23107
LOCATION:	Tuscaloosa, AL
ENGINEER:	Garver Associates
CONTRACTOR:	City of Tuscaloosa
SPECIFICATION SECTION (S):	44 42 27.19
Date:	7/20/2023
From:	Tony Riecken Vulcan Industries, Inc. 212 S. Kirlin St. Missouri Valley, IA 51555 712-642-2755 tony@vulcanindustries.com

Comment #	Submittal Review Comments	Reviewer
1	The SqD contactors and circuit breakers have been replaced with Eaton Freedom Series contactors as requested.	SES
2	The E&H RIA46 transmitters have been replaced with E&H RME42 transmitters as requested.	SES
3	The Idec relays & based have been replaced with Finder 55 series relays as requested.	SES
4	See response #1.	SES
5	Channel invert elevation has been updated to EL 168.40'.	THR
6	Please confirm screen angle of 80°.	THR
7	The warranty period is twenty-four (24) months from date of actual start-up.	THR
8	There was a typo on the conveyor capacity in our specification, it has been updated to show the correct capacity of 85 ft^3/hr.	THR

June 1, 2023

City of Tuscaloosa
P.O. Box 2089
Tuscaloosa, AL 35403

Re: Equipment submittal for WRRF Headworks Improvements

P.O. No: 230248
Vulcan Industries, Inc. Job No: 23107

Dear Sirs,

We are providing you with one (1) electronic copy of a submittal for approval. The submittal will be sent via email to the following address: lukelanier@principleenvironmental.com

We are providing a warranty for equipment-listed below as follows, twenty-four (24) months from date of actual start-up ~~eighteen~~. (Section 1)

Two (2) Mensch Bar Screens, Model number FT-66 to positively remove debris from the incoming wastewater flow. (Section 2)

Two (2) Shaftless screw conveyors, Model number TF-240 to transport screenings. (Section 2)

We will also be providing the Electric Motors and Gear Reducers for all of the above equipment. (Section 3)

We have included a General Arrangement Drawing, locating the equipment and anchorage details for your approval. (Section 4)

We will be providing controls for the above listed equipment. (Section 5)

Please note that Vulcan Industries, Inc. respectfully is taking exception or noting clarifications to Vulcan's Scope of supply. Please review these and comment if necessary.

1. If there is a project integrator, please provide their contact information so a line of communication can be established between the integrator and Vulcan's Automation Specialist.

2. There are cast aluminum explosion proof local control stations enclosures being provided with the equipment. If the installer wants drilled and tapped conduit provisions done at the factory, please indicate size and location in the returned submittal.

3. The local control station for the existing press will be shipped loose for field installation by the installing contractor. The local control stations for the bar screens and screw conveyors will be mounted on the equipment at the factory.

4. Motor actuator data for the screw conveyor slide gates wasn't availably at time of submittal. The data will be submitted under a separate cover.
   Conveyor slide gate information provided on p.232-247

We will require an approval of this submittal for full release of the equipment for production. Our fabrication lead time is estimated at 42 to 48 weeks after approval. The current status of the supply chain could cause this to vary depending on component availability at the time of approval. We are doing everything we can to mitigate procurement issues, limit delays and keep your project on schedule. We appreciate your business and look forward to working with you on this project, if you have any questions or concerns, please don't hesitate to contact me.

Regards,

Tony Riecken
Vulcan Industries, Inc.
212 S. Kirlin Street
Missouri Valley, IA. 51555
712-642-2755 Fax: 712-642-4256
tony@vulcanindustries.com

EQUIPMENT SUBMITTAL

Project Name:
Hilliard N. Fletcher WRRF Headworks Improvements

Location:
Tuscaloosa, AL

Equipment:
(2) Mensch Bar Screen Model No. FT-66
(2) Shaftless Screw Conveyors Model No. TF-240

Contract Specification Section:
44 42 27.19

City P.O. 230248

Contractor:
City of Tuscaloosa
P.O. Box 2089
Tuscaloosa, AL 35403
770-952-9444

Engineer:
Garver Associates

Manufacturer:
Vulcan Industries, Inc.
212 S. Kirlin St.
Missouri Valley, IA 51555
712-642-2755, FAX 712-642-4256

Manufacturer's Representative:
Principle Environmental, Inc.
1770 The Exchange, Suite 210
Atlanta, GA 30339
Phone 770-952-9444

Vulcan Job No. 23107

Prepared by: Tony Riecken
tony@vulcanindustries.com

Warranty

Equipment Specifications

Vendor Data

General Arrangement Drawings

Electrical Documentation

Section 1

Warranty

Warranty

VULCAN INDUSTRIES, warrants all equipment of its own manufacture to be free of defects caused by faulty material or workmanship and shall, of its option, exchange or repair without charge, F.O.B. its factory, such part or parts thereof that prove defective under normal use within twenty-four (24) months from date of actual start-up. **VULCAN INDUSTRIES** obligation under this warranty is limited to the above and does not apply to replacement or repairs which are required as the result of improper installation, misuse, maladjustment, abnormal operating conditions, or lack of routine maintenance. Nor does the warranty include the furnishing of service for maintenance or problems arising from the foregoing causes. No claims for labor or other expenses will be recognized. This warranty is in lieu of and to the exclusion of all other warranties expressed or implied, statutory or otherwise.

VULCAN INDUSTRIES shall not be liable for any claims, losses, labor, expenses or damages, direct or consequential, resulting directly or indirectly from the use of, or the inability to use, its products, or for other consequential loss or damage of any nature arising from any cause.

THIS WARRANTY IS THE SOLE WARRANTY OF VULCAN INDUSTRIES AND ANY OTHER WARRANTIES EXPRESS, IMPLIED IN LAW, IMPLIED IN FACT, INCLUDING WARRANTIES OR MERCHANTABILITY AND FITNESS FOR USE, ARE HEREBY SPECIFICALLY EXCLUDED.

PROJECT: TUSCALOOSA, AL

PROJECT NO. 23107

Section 2

Equipment Specifications

Tuscaloosa, AL
Job Number: 23107
MENSCH AUTOMATIC BAR SCREEN
MODEL #66

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install Two (2) fully automatic bar screens for collecting and removing debris from the incoming wastewater flow.

B. The bar screens shall be provided complete with all accessories, spare parts, mounting anchor bolts, and other appurtenances as specified and as may be required for a complete operational system.

C. It shall be the Contractor's responsibility to ensure that the mechanical bar screens and appurtenances furnished and installed shall be compatible with and have the necessary operating clearances to the structural elements and associated equipment shown on the Contract Drawings.

1.02 REFERENCES

A. American Gear Manufacturers Association (AGMA)

B. National Electrical Manufacturers Association (NEMA)

C. American Federation of Bearing Manufacturers Association (AFBMA)

D. American Society for Testing and Materials (ASTM)

E. American Welding Society (AWS)

F. Steel Structures Painting Council, American National Standards Institute (SSPC)

G. Underwriters Laboratory (UL)

1.03 QUALITY ASSURANCE

A. The materials covered by these specifications are intended to be standard equipment of proven reliability and as manufactured by a reputable Manufacturer having experience in the production of screening equipment. The equipment furnished shall be designed and constructed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Contract Drawings and operated per the Manufacturer's recommendations.

B. The Manufacturer shall have designed and manufactured a minimum of five hundred (500) reciprocating rake bar screens with pin rack and cog wheel drive systems and shall have a minimum of ten (10) years' experience in the production of such equipment.

1.04 DESIGN REQUIREMENTS

A.	Number of Units	Two (2)
B.	Average Daily Flow	24 MGD each
C.	Peak Hourly Flow	37.5 MGD each
D.	Flow Channel Width	5'-6"

E.	Flow Channel Depth	7’-8 ½”
F.	Discharge Height EL.	*179.90’
G.	Operating Floor EL.	*176.40’
H.	Channel Top EL.	*176.40’
I.	Invert EL.	*168.40’ ✓
J.	Bar Rack Spacing	3/8”
K.	Setting Inclination	80 degrees from horizontal ✓

* Reference elevations only.

1.05 STORAGE AND HANDLING OF EQUIPMENT

A. The Contractor shall store and temporarily support equipment prior to installation in strict accordance with the Manufacturer’s recommendations and instructions. Protect all exposed surfaces. Keep records of the storage parameters and the dates that storage procedures were performed. The Contractor shall be responsible for work, equipment, and materials until inspected, tested, and finally accepted.

B. Protect the equipment from being contaminated by dust, dirt, vibration and moisture.

C. Temporarily connect equipment with built in motor space heaters to a power source and keep heaters in operation. Rotate all shafts that have bearings on at least a monthly basis.

D. The unit shall be erected and lubricated in strict accordance with the instructions of the Manufacturer's field engineer.

PART 2 - PRODUCTS

2.01 GENERAL

A. The equipment furnished shall positively clean and remove debris from the incoming wastewater by means of a bar rack, installed in a concrete channel designed to retain debris. A traveling chain and raking mechanism removes and elevates the debris to a discharge wiper mechanism. The bar rack shall be cleaned by multiple rakes engaging the upstream side bar rack from the bottom of the channel and removing the debris. The debris shall be lifted above the top of the channel and discharged through the downstream side to a screw conveyor.

B. The mechanically cleaned multiple rake bar screen system shall be fully automatic and shall consist of the following components:

1. Bar Rack
2. Frame, Supports and Guides
3. Pin Racks
4. Cog Wheels
5. Dead Plate
6. Drive Machinery
7. Rake Assembly
8. Discharge Chute
9. Anchor Bolts
10. Wiper Assembly

11. Electrical Cable Assembly
12. Electrical Controls and Control Panel
13. In addition, any other components required to provide a system, which will be capable of fully performing the functions specified.

C. Designs employing the use of chains, cables, threaded stems, hydraulic cylinders or multiple rakes to remove debris from the channel shall not be acceptable. The use of two or more motors to complete a screen cleaning cycle is not acceptable. All platforms, ladders or other safety devices required, as a part of this equipment design shall be in accordance with applicable OSHA regulations.

D. The design shall be such to ensure that all Manufacturer recommended preventive maintenance to the raking mechanism can be accomplished at the operating floor level.

E. No moving parts shall be located permanently below the channel water surface at maximum design flow. Only the cleaning rake head and rake arm shall enter the wastewater flow.

F. The drive output shaft rotation shall be constant and in one direction during normal operation in order to reduce maintenance requirements.

G. All equipment shall be designed and built for 24-hour intermittent service and for moderate shock without overheating, excessive vibration, or strain.

2.02 FRAME ASSEMBLY

A. The frame shall be manufactured of 304 stainless steel plate, having a minimum thickness of 3/8-inch. The frame shall have a minimum width of 36-inches and extend fully from the bottom of the channel to the top of the bar screen assembly.

B. Each side frame shall include a fixed roller track to guide and position the rake assembly. Separate roller tracks shall be provided for the drive shaft rollers and the guide shaft rollers. The fixed roller track shall be manufactured of 304 stainless steel.

C. Two sets of access plates shall be provided on each side frame to allow personnel to remove and replace the guide shaft rollers and drive shaft rollers without the need to remove the rake assembly from the side frames.

2.03 RAKE ASSEMBLY

A. A dual arm rake assembly shall be provided to remove the collected debris from the bar rack. The rake assembly shall consist of fixed upper rake arms and spring-loaded, lower rake arms that pivot to permit movement over lodged or excessively large objects during the raking cycle. Each upper and lower rake arm shall be connected through a two-pin linkage system. After an object has been overridden, the rake teeth shall reengage and continue to clean the bar rack.

B. All structural components of the rake assembly shall be 304 stainless steel.

C. The rake assembly shall have the capability of lifting a load of no less than 100 of rake width each cycle. The rake teeth shall remain fully engaged in the bar rack until the specified lifting capacity of rake width limit is reached.

D. Single rake arms, rake assemblies that rotate at the drive shaft and rake assemblies that gradually retreat as the load increases, prior to reaching the specified capacity, are specifically excluded and shall not be allowed.

E. The rake assembly shall be driven by a pair of cogwheels that are specially machined to mesh with a fixed a pin rack. A drive shaft and guide shaft, outfitted on each end with rollers, shall travel in fixed roller tracks to position the rake assembly. The guide shaft shall be located below the drive shaft for stability. All shafting shall be of the highest quality in conformance with ASTM specifications and shall be free of any defects. Materials of construction for the shafting shall be 303 stainless steel.

F. The rake head shall have teeth sized to fit between the spacings of the bar rack. The rake teeth shall fully engage the bar rack. The rake head shall be attached to two rake arms. The rake head shall be 3/8-inches thick by 10-inches deep. The rake teeth shall attach to the rake head in multiple replaceable sections and shall have a minimum thickness of 3/4-inch. The rake arms shall be constructed of structural rectangular tubing that is a minimum of 3-inches by 5-inches by 7-gauge thick with a nominal length of 8-feet.

2.04 DRIVE ASSEMBLY

A. The bar screen shall be provided with an integrated drive assembly consisting of a Class 1, Division 1, Group D explosion-proof electric motor with spring-set motor brake, gear reducer, rake assembly mounting bracket and one pair of drive cogwheels. The travel speed of the rake assembly shall be a nominal 30-feet per minute.

B. Cogwheels shall be pitched to match the pin rack rollers and shall be AISI 1045 steel with teeth flame hardened to a minimum RC 50. The cogwheels shall have a minimum diameter of 10-inches. The cogwheels shall be of the involute gear design. Standard sprockets shall not be acceptable.

C. The electric motor shall be close-coupled to the reducer. The brakemotor shall be a minimum 3 horsepower with a service factor of 1.15. Electrical characteristics shall be 230/460 volt, 3 phase, 60 Hertz, Class F/B rise insulation, 40 degree C Ambient.

D. The gear reducer shall be of the helical worm gear type and shall be capable of elevating the weight of the drive assembly plus its maximum calculated debris load.

E. Gear reducers shall have ball or roller bearings throughout with all moving parts immersed in oil.

F. The worm gear shall be of all high strength alloy bronze or alloy bronze-rimmed semi-steel.

G. Shafts shall be of high strength alloy steel ground to required tolerances.

H. All ball or roller bearings shall be rated and manufactured by a member of the Antifriction Bearing Manufacturer's Association. At least one bearing on each shaft shall be of the combined radial and thrust type.

I. Gear reducer units shall meet the standards of the AGMA for such equipment under moderate shock, 24-hour service with a minimum service factor of 1.25.

J. The output capacity of the gear reducer shall be equal to the motor horsepower less reducer losses at the rated service factor.

2.05 MOTOR POWER CABLE & CARRIER TROUGH

A. Provide electric power to the screen drive motor through a suitably mounted electrical power cable. The power cable shall be an "SO" type cord suitable for severe duty use, consisting of an internal cord surrounded by stranded conductors. Cord will be contained in a flexible nylon cable carrier. The cable carrier shall be flexible in one direction and

consist of interconnected molded links and stainless steel mounting brackets. The cable carrier shall be designed for high-strength, durability, repetitive articulation, and a smooth, non-abrasive contact surface for the electrical cables.

B. The power cable carrier shall be installed in a 10-gauge thick, 304 stainless steel guide trough to protect and contain the power cord. The guide trough shall be C-shaped to protect the cable carrier on three sides.

2.06 BAR RACK

A. The bar screen shall be provided with a removable bar rack. The bar rack shall consist of equally spaced, parallel bars having 3/8-inch clear spacing between each bar. The bars shall be straight and inclined at 80 degrees above the horizontal plane.

B. The bottom of the bars shall be attached to a flush bottom, base plate. The bar rack shall extend from the base plate to the connection point on the dead plate.

C. Each bar shall be provided with an arced gusset, constructed of rectangular bars, at the bottom of the bar rack which allows the raking mechanism to engage the bottom most portion of the bar rack prior to reaching the inclined section of the rack. Curved plate substituted for curved bars are not acceptable.

D. Bar racks requiring a recess in the bottom of the flow channel shall not be allowed.

E. The inclined section of the bar rack shall consist of trapezoidal bars that shall be 5/16-inches thick by 3/16-inches thick by 2 1/2-inches deep. The bars shall extend to the top of the channel.

F. The bar rack shall be manufactured of 304 stainless steel.

2.07 DEAD PLATE

A. The bar screen shall be provided with a fixed dead plate extending from the upper portion of the bar rack connection to the screenings discharge point.

B. The plate shall be flat without undulation so that the rake head teeth will ride no closer than 1/16-inch from the dead plate and no further than 1/4-inch from the dead plate. It shall be securely fastened to the side frames.

C. The dead plate shall be manufactured of 304 stainless steel having a minimum thickness of 1/4-inch.

D. Designs in which the dead plate does not extend to the point of discharge shall not be acceptable.

2.08 DISCHARGE CHUTE

A. The rake assembly shall be designed to reach a predetermined discharge height above the floor elevation. A directing (discharge) chute positioned a minimum 45 degrees from horizontal and located at the top of the dead plate shall be a part of each bar screen and shall be manufactured of 304 stainless steel having a minimum thickness of 1/8-inch.

B. A full discharge chute enclosure shall be provided. The enclosure shall be manufactured of 14-gauge 304 stainless steel and shall be provided with an access door to facilitate wiper replacement.

2.09 WIPER ASSEMBLY

A. A pivoting wiper mechanism will be positioned at the point of discharge and shall have a replaceable ultra-high molecular weight polyethylene (UHMW) wiper blade.

B. During each cycle, the wiper blade shall contact the rake heads at its inner surface during upward travel and shall scrape the debris off the end of the rake head and through the discharge chute. The entire wiper mechanism including the wiper arms shall be fully contained inside the framework of the bar screen.

C. The wiper mechanism, excluding the wiper blade, shall be manufactured of 304 stainless steel. No moving parts shall extend beyond the framework or the discharge chute.

D. The design shall be such that the rake repositions the wiper mechanism. The wiper mechanism design shall allow the rake assembly to be operated in reverse, through the wiper mechanism, without the need to manually lift the wiper assembly.

E. The grease fittings for the wiper arms shall be extended and secured to the side frames in an area where they can be easily accessed by plant personnel.

F. Shock absorbers shall be provided to cushion the release of the wiper.

2.10 PIN RACK

A. The bar screen shall be provided with a stationary pin rack on each side of the frame. The pin rack shall consist of separate ANSI chain links attached with threaded fasteners to facilitate easy removal without requiring removal of the rake or drive assembly.

B. All pins, rollers and bushings shall be easily removable including those components located below the top of the channel.

C. Each chain link shall consist of two rollers and bushings. Pin, bushing and roller diameter shall conform to ANSI standards. Rollers and bushings shall be manufactured of carbon steel, case hardened to minimum RC50.

D. Pin bolts shall be type 304 stainless steel with a minimum diameter of 9/16-inches.

E. Pin rack designs that do not conform to ANSI standards shall be specifically excluded.

2.11 PIN RACK LUBRICATON AND CLEANING SYSTEM

A. A pin rack lubricating/cleaning system shall be mounted to the rake assembly to allow for periodic lubrication and/or cleaning of the pin racks.

B. The system shall comprise of an air/oil reservoir, air fill fitting, oil fill fitting, safety relief valve, manual ball valve, pressure gauge, hoses, nozzles and fittings.

C. The system shall allow personnel to lubricate and/or clean the pin racks from the operating floor without the need for ladders or scaffolding.

D. The system shall require manual filling of the reservoir with lubricating oil or cleanser as well as manually charging the reservoir with air. Air supply shall be supplied by others.

E. All metal components shall be manufactured of 304 stainless steel.

2.12 SAFETY CAGE

A. Safety cages shall be provided to enclose the three open sides (front and both sides) of the bar screen. Cages shall have hinged, (front - side) opening doors with lockable hasps. Cages shall be a minimum of seven-feet tall above the operating floor level. Structural members shall be constructed of minimum 1 1/2-inch x 1 1/2-inch x 1/4-inch type 304

stainless steel angle. Panel filler shall be minimum 3/4-inch x 9 weight, flattened expanded metal type 304 stainless steel sheet.

2.13 CONTROLS / INSTRUMENTATION

A. The control system description, Sequence of Operation, wiring diagrams and list of components can be found in submittal Section 5 or operation manual Section 7.

2.14 FASTENERS

A. All fasteners shall be 304 stainless steel unless otherwise indicated in this specification. All threaded fasteners shall be coated with a nickel based anti-seize thread lubricant prior to assembly.

2.15 ANCHOR BOLTS

A. Anchor bolts shall be provided by the Manufacturer.

B. All anchor bolts shall be 304 stainless steel unless otherwise indicated in this specification. Anchor bolts shall be ample size and strength for the purpose intended and as shown on the Contract Drawings.

2.16 LUBRICATION

A. Equipment shall ship completely lubricated, ready for commissioning.

B. The Manufacturer shall state in the operating manual the amount of and specification for any lubricant required.

2.17 PROTECTIVE COATINGS

A. Stainless steel and plastic components shall not be coated. The stainless steel structural components shall be passivated per the methods described in ASTM A380-99, after fabrication to remove embedded iron, surface rust and weld burn.

B. All other surfaces shall be solvent cleaned to remove dirt, oil and foreign materials. Cleaned surfaces shall be shop primed with one (1) coat of TNEMEC Series N69-1212 primer, or equal, to attain a minimum dry film thickness of 3-5 mils.

C. The motor and gear reducer shall be finish coated with two (2) coats TNEMEC Series 72 Endura-Shield, or equal, to attain a total minimum dry mil thickness of 5 mils.

D. Non-stainless steel controls panels shall have Manufacturer's standard paint finish.

2.18 SPARE PARTS

A. The Manufacturer shall furnish the following spare parts as the total amount of spare parts for this specification section.

1) One complete set of drive shaft end bearings for each unit

2) One complete set of cogwheels for each unit

3) One complete set of pin rack rollers and bushings of sufficient length for each unit

4) One complete set of brake discs and springs for each unit

5) Two complete guide shaft roller bearings for each unit

6) Two complete drive shaft roller bearings for each unit

7) One complete set of guide rollers of each different size per unit

8) One limit switch for each unit
9) One level transducer for each unit
10) One wiper blade for each unit
11) Two proximity limit switch, nema 7
12) Two radar sensor w/65' cable
13) Four KLDR-1 fuse
14) Two KLDR-3 fuse
15) One KLDR-6 fuse

B. All spare parts shall be properly packaged, labeled and stored where directed by the Owner or Engineer.

PART 3 - EXECUTION

3.01 TESTING

A. The screen shall be factory assembled and factory run tested. The main control shall also be factory tested. If the screen is manufactured outside of the United States, the screen shall be factory tested at the point of manufacture and factory tested a second time as a complete assembly (including the motor and control panel) in the United States prior to shipment to the jobsite.

B. The screen shall also be field tested after erection in the presence of the Owner and Engineer to confirm and verify the structural and mechanical compliance to the specification. The field acceptance test shall include demonstrating that the rake teeth properly engage the bar rack along the length of the bar rack, that the rake assembly can pivot over debris at the base of the bar rack that is 4-inches in height without jamming, and that the screen can be run continuous for 4-hours without overheating, binding, or show other signs of misalignment.

3.02 INITIAL START-UP AND TRAINING

A. The Contractor shall provide the services of a factory-employed service technician who shall adequately inspect the installation, test the equipment furnished under this Contract and instruct the Owner's operating personnel in its maintenance and operation. Factory personnel are required. Manufacturer's representatives are not deemed acceptable to provide the start-up service. The services of the technician shall be provided for two separate trips as follows:

1. One (1) trip of two (2) days of service to inspect and certify the installation prior to startup and instruct Owner's personnel in proper operation and maintenance of the equipment.
2. Start-up service and training for the bar screen can be combined with the service for the screw conveyor if the same company provides both pieces of equipment.

SHAFTLESS SCREW CONVEYOR SYSTEM
MODEL # TF-240

1.00 DESIGN REQUIREMENTS

Number of Units:	Two (2)
Conveying Capacity:	Up to 85 cubic ft./hr. (Conveyor capacity per revolution at 25% trough loading)
Net Weight:	1,800, 2,300 lb.

2.01 GENERAL

A. The screw conveyor shall be provided to convey screenings material received from a mechanical bar screen. Screenings material shall enter the inlet hopper and be transported by the rotating screw to the point of discharge. The screw conveyor shall be designed to convey screenings from the drive end of the unit to the discharge end. Designs that pull the screenings towards the drive end shall not be acceptable.

2.02 INLET HOPPER

A. The inlet hopper shall be designed to direct wet screenings material into the screw housing from the mechanical bar screen. The inlet zone will be completely shrouded to contain the screenings. The inlet hopper shall be 12-gauge thick minimum and be constructed of 304 stainless steel. All attachment hardware shall be of 304 stainless steel.

2.03 SLIDE GATES

A. Diversion slide gates for each conveyer will be provided towards the discharge end of the conveyor and will be electro-mechanically operated.

B. Slide gates will by 5-inches vertical, excluding the gate operator and full width of the conveyor.

C. All material will be 304 stainless steel with a minimum material thickness of 3/16".

2.04 SCREW HOUSING

A. The screw housing shall be a U-shaped trough constructed of 10-gauge thick 304 stainless steel. The interior of the housing shall

incorporate a nominal 1/4-inch thick UHMW replaceable liner to prevent metal-to-metal contact between the screw housing and the screw. The entire housing shall be supported by 304 stainless steel legs.

B. The transport area of the screw housing shall be furnished with removable cover panels. The cover panels shall have a minimum thickness of 20-gauge and be constructed of 304 stainless steel.

2.05 SHAFTLESS SCREW

A. The conveyor screw shall be of the shaftless spiral design and shall be connected to the drive unit and a sealing system shall be provided to prevent water from entering the drive unit.

B. The spiral shall be formed from continuous solid bar stock with a minimum nominal thickness of 3/4-inches and nominal outside diameter of 9 1/2-inches. A 2-inch minimum diameter drive shaft shall be attached to the screw and shall be direct coupled to the gear reducer.

C. The screw shall be constructed of high strength carbon steel and have a minimum Brinell hardness of 200.

2.06 DRIVE ASSEMBLY

A. The shaftless screw conveyors shall be complete with an integrated drive assembly consisting of a Class 1, Division 1, Group D, explosion-proof electric motors close-coupled to a parallel shaft helical bevel double reduction gear reducer.

B. The motors will be 2.0 and 3.0 horsepower, 230/460 volt, 3 phase, 60 Hertz with a service factor of 1.15. The motor(s) shall be rated at 40°C ambient with Class F insulation and shall have a Class B temperature rise at full load. The nominal motor speed shall be 1800 rpm.

C. The gear reducers will be one parallel shaft and one right angle helical gear reducers. Gear reducer specifications shall be as shown in section 3.

D. Gear reducers shall have ball or roller bearings throughout with all moving parts immersed in oil. Gears shall be of alloy steel with threads precision ground and polished after casehardening. Shafts shall be of high strength alloy steel ground to required tolerances. All ball or roller bearings shall be rated and manufactured by a member of

the Antifriction Bearing Manufacturer's Association. At least one bearing on each shaft shall be of the combined radial and thrust type.

2.07 CONTROLS & ELECTRICAL SAFETY EQUIPMENT

A. Controls shall be supplied as shown in section 5.

B. A safety cable with emergency stop switch shall be provided along the sides of the washing press unit and shall enable immediate emergency interruption of all power to the drive mechanism when pulled. The safety cable shall be braided stainless steel with a red pvc flexible coating. The stop switch shall be rated and wired as shown in section 5.

2.08 FASTENERS

A. All fasteners and anchor bolts shall be 304 stainless steel unless otherwise indicated in this specification. Anchor bolts shall be provided for mounting the shaftless screw conveyor. All threaded fasteners shall be coated with a nickel based anti-seize thread lubricant prior to assembly.

2.09 LUBRICATION

A. The manufacturer shall state in the operating manual the amount of and specification for any lubricant required.

2.10 PROTECTIVE COATINGS

A. Stainless steel and plastic components shall not be painted. The stainless steel structural components and enclosure panels shall be bead blasted and passivated as required after fabrication to remove embedded iron, surface rust and weld burn. All other surfaces shall be blast cleaned to an SSPC-SP6 finish, removing all dirt, rust, scale and foreign materials.

B. Cleaned surfaces shall be shop primed with one (1) coat of TNEMEC 69-1212 primer, or equal, to attain a minimum dry film thickness of 2.5 mils. The motor and gearbox shall have one coat, 5 mils DFT, Tnemec series 69 primer and one coat, 5 mils DFT, Tnemec series 74 topcoat. The top coat shall be red in color and semi-gloss in finish.

2.11 SPARE PARTS

A. The Manufacturer shall furnish the following spare parts for each press.

1. One (1) complete set of trough liners for each conveyor

All spare parts shall be properly packed in a white wooden box, labeled and stored where directed by the Owner or Engineer.

3.01 TESTING

A. The shaftless screw conveyor shall be factory assembled and factory run tested in the United States prior to shipment. The main control panel shall also be factory tested.

B. The screw conveyor shall also be field tested after erection in the presence of the Owner and Engineer to confirm and verify the structural and mechanical compliance to the specification. The field acceptance test shall include demonstrating that the screw conveyor operates without vibration, jamming or overheating and perform its specified function satisfactorily.

3.02 INITIAL START-UP AND TRAINING

A. The Contractor shall provide the services of a factory-employed service technician who shall adequately inspect the installation, test the equipment furnished under this Contract and instruct the Owner’s operating personnel in its maintenance and operation. Manufacturer’s sales representatives are not considered acceptable service technicians. The services of the technician shall be provided as follows:

B. One (1) trip and two (2) days of service to inspect and certify the installation prior to startup and provide Owner's personnel in proper operation and maintenance of the equipment. Start-up service will be combined with the start-up service for the bar screen.

Section 3

Vendor Data

Drive System Components:
Mensch Climber Screen

Electric Motor:

Manufacturer:	Baldor
Spec. No.	A18-A000-1248
Service:	Indoor/Outdoor
H.P.:	3
RPM:	1770
Volts/Phase/Hertz:	230/460/3/60
Frame:	182TC
NEMA Classification:	Class1 Div.1 Group C&D
Insulation:	F with B rise
Service Factor:	1.15
Full Load Efficiency:	89.5
Full Load Power Factor:	73.0
Thermal Protection:	N/C Thermostats (T3C)
Space Heaters:	120 VAC, 27 watt Motor & Brake
Breakdown Torque (%):	374
Locked Rotor Torque (%):	315
Brake Torque:	15 Ft. Lb.

Gear Reducer:

Manufacturer:	Eurodrive
Type:	Helical Worm
Model No:	SA97AMS182
Reduction:	196.52 : 1
Output Torque:	14,500 in. lb.
Service Factor @ 3 HP input:	2.1
Output RPM @ 1770 input RPM:	9
AGMA Service Factor:	II

BALDOR • RELIANCE

Customer information packet

A18-A000-0248

3HP, 1770RPM, 3PH, 60HZ, 182TC, TEFC, F1
DXP SUPER CENTER-BRANCH

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5/17/2023 11:21:05 AM

Specifications

Frame	182TC
Frame Material	Iron
Frequency	60.00 Hz
Motor Letter Type	Three Phase
Phase	3
XP Class and Group	CLI GP C,D; CLII GP F,G
XP Division	Division I
Agency Approvals	CCSA US
	CSA
	UL
Auxillary Box	No Auxillary Box
Base Indicator	Rigid
Bearing Grease Type	Polyrex EM (-20F +300F)
Design Code	B
Drip Cover	No Drip Cover
Duty Rating	CONT
Efficiency @ 100% Load	87.5 %
Feedback Device	NO FEEDBACK
Heater Indicator	Heater Included, 120 V
Insulation Class	F
Inverter Code	Not Inverter
IP Rating	NONE
KVA Code	K
Lifting Lugs	Standard Lifting Lugs
Motor Standards	NEMA
Mounting Arrangement	F1
Number of Poles	4
Product Family	General Industrial
Pulley End Bearing Type	Ball
Pulley Face Code	C-Face
Service Factor	1.15
Shaft Diameter	1.125 IN

Part detail

Revision	A
Type	AC
Mech. spec.	
Base	
Status	PRD/A
Elec. spec.	W03127A A 001
Layout	613053-561
Eff. date	03-31-2022
CD Diagram	416820-001
Poles	04
Leads	
Proprietary	True
Created date	05-01-2017

Shaft Ground Indicator	No Shaft Grounding
Shaft Rotation	Reversible
Shaft Slinger Indicator	No Slinger
Starting Method	Direct on line
Thermal Device - Bearing	None
Thermal Device - Winding	Normally Closed Thermostat
XP Temp Code	T3C

Nameplate

000692000FX

000613007RC			
CLASS I GROUP	C D X	**NO.**	
CLASS II GROUP	F G X		
OPERATING TEMP CODE	T3C		

000692000MB
EQUIPPED WITH 120V/27W SPACE HEATER

000613007LB

CAT NO		**SPEC NO.**	A18-A000-0248								
HP	3	**AMPS**	8.60/4.30	**VOLTS**	230/460	**DESIGN**	B				
FRAME SIZE	X182TC	**RPM**	1770	**HZ**	60	**AMB**	40	**SF**	1.15		
D.E. BRG.	30BC02J30X	**PH**	3	**DUTY**	CONT	**INSUL**	F				
O.D.E. BRG.	25BC02J30X	**TYPE**	P	**ENCL**	TEFC	**CODE**	K				
		POWER FACTOR	73.0			**NEMA-NOM-EFF**	89.5				
		MAX CORR KVAR	01.5			**GUARANTEED EFFICIENCY**	87.5				
		NEMA NOM/CSA QUOTED EFF @				**100% LOAD**					
SER.NO.		**MOTOR WEIGHT**				**LBS.**					
	CL 1, ZONE 1, GR IIA IIB, T3										

Parts list

Part number	Description	Quantity
SA338018	SA A18-A000-0248	1.000 ea
RA326325	RA A18-A000-0248	1.000 ea
001575000A	WIRING DIAGRAM	1.000 ea
424476003WB	WIRING DIAGRAM MEDIUMA	1.000 ea
000692000JF	CAUTION LABEL TO PREVENT IGNITION	1.000 ea
000901001AA	LABEL WARNING	1.000 ea
000692000FX	UL LISTED LOGO LABEL 2.53 X 0.75 X .018	1.000 ea
000613007RC	C UL US NAMEPLATE FOR HAZARDOUS LOC	1.000 ea
000692000MB	BALDOR RELIANCE MOTOR DATA NAMEPLATE	1.000 ea
000613007LB	NP MEDIUM AC ENERGY VERIFIED LOGOS	1.000 ea
415072001A	CLAMP	1.000 ea
415072001A	CLAMP	1.000 ea
034180006DA	KEY 1/4X1/4X3/4 L	1.000 ea
702664001A	FAN 180	1.000 ea
702664001A	FAN 180	1.000 ea
423709008A	P.N. 1-1/2X1-3/4 180-210	1.000 ea
805818003B	BRKT 180 801718001WCA	1.000 ea
078565027B	F/C 78565-2WB	1.000 ea
615460002A	GRILL, PLATED 180	1.000 ea
004824015A	GREASE POLYREX EM	0.100 lb
032018018AK	HHCS 1/4-20X2-1/4L PLTD.	4.000 ea
032018012AK	HHCS 1/4-20X1-1/2 PLTD.	2.000 ea
415096002A	CPLG 1/8 HEX TYPE	1.000 ea
603285001A	SLING - 180	1.000 ea
049374010N	SCREW	4.000 ea
400638001B	WSHR	1.000 ea
418150003A	GREASE FITTING CAP	1.000 ea
034017012AB	LCKW 1/4 STD. PLATED 034017012AF	4.000 ea
035000001A	ALFTG 1/8" 1610-BL	1.000 ea
034017012AB	LCKW 1/4 STD. PLATED 034017012AF	4.000 ea
032018006AK	HHCS 1/4-20X3/4L PLATED	2.000 ea

034017012AB	LCKW 1/4 STD. PLATED 034017012AF	2.000 ea
034530006AB	P/NIP 1/8X3/4 PLATED-see 7AB	1.000 ea
032620012GD	HSSS 6-32X3/8" 304 S.S.	2.000 ea
074182000B	C/B 180-210XP WA074182000	1.000 ea
064235000A	C/B Cvr 180-210 - 064235000WCA	1.000 ea
034692001AB	HCSPP 1/8" PLATED	1.000 ea
034000012AB	WSHR 1/4 STD. PLATED	2.000 ea
034690001AL	1/8 SQ.HD.PIPE PLUG	1.000 ea
418150003A	GREASE FITTING CAP	1.000 ea
801719011D	BRKT,ODE, 180	1.000 ea
032018014AK	HHCS 1/4-20X1-3/4 PLTD.	2.000 ea
603285001B	SLING - 180	1.000 ea
406055001B	GRFTG	1.000 ea
034020012AB	HI-COLLAR LCKW 1/4 PLATE	4.000 ea
034017012AB	LCKW 1/4 STD. PLATED 034017012AF	2.000 ea
035000001A	ALFTG 1/8" 1610-BL	1.000 ea
032130010AA	HSHCS,DE BRKT	4.000 ea
032620012GD	HSSS 6-32X3/8" 304 S.S.	2.000 ea
423709010A	LEAD SPACER 1.560X.25	1.000 ea
032018010BK	HHCS 5/16-18X1-1/4 PLTD.	4.000 ea
004824001HL	EPOXY RESIN HYSOL 3149	1.000 ea
034017013AB	LCKW 5/16 STD. PLATED	4.000 ea
421910001A	GWIRE	1.000 ea
032018004AM	HHCS 1/4-20X1/2PLTD GREN	1.000 ea
034036012AB	CKW EXTERNAL TOOTH 1/4"	1.000 ea
004824007CCV	C2 PAINT SYSTEM DARK CHARCOAL GREY EPOXY	0.100 ea
613437001A	BRAKE STEARNS M/N 1-065-361-09 XP	1.000 ea
034180020CA	KEY 3/16X3/16X2-1/2 L	1.000 ea
001507000A	TAG-BRAKE (USE BEC392)	1.000 ea
033775004EA	DRSCR #6-1/4 304 S.S.	8.000 ea
032130008CA	3/8-16 X 1.00 HSHCS	4.000 ea
034180014DA	KEY 1/4X1/4X1-3/4 L	1.000 ea

613053-561

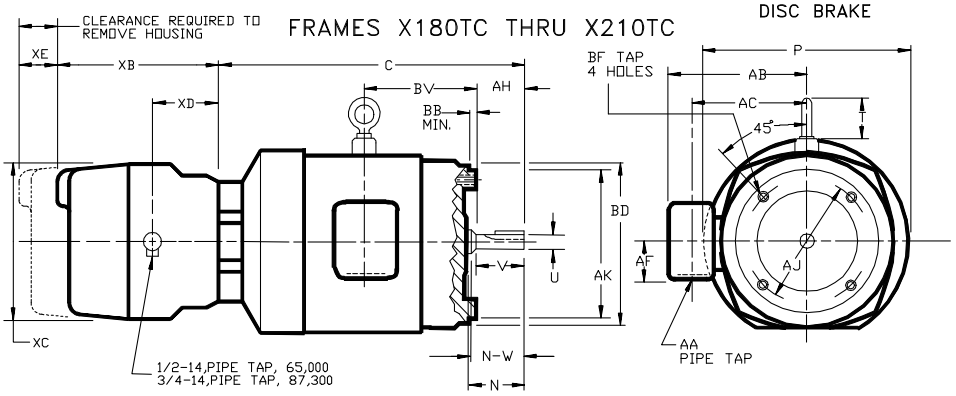
DUTY MASTER ALTERNATING CURRENT MOTORS

SQUIRREL-CAGE INDUCTION
X/T CONSTRUCTION

ENCLOSURE: TOTALLY ENCLOSED
UNDERWRITERS LISTED MOTOR
MOUNTING: FOOTLESS, NEMA "C" FACE

COOLING: FAN COOLED
ACCESSORIES: INTEGRALLY MOUNTED STEARNS DISC BRAKE

FRAMES X180TC THRU X210TC



DIMENSIONS ARE IN INCHES

FRAME	P	X/P TERMINAL BOX AA	AB	AC	AF	AJ	AK(3)	BB	BD	BF	MIN. TAP DEPTH	T
X180TC	9.50	1	9.38	6.94	2.50	7.25	8.500	.25	9.00	1/2-13	.75	2.00
X210TC	11.00	1	10.25	7.81	2.50	7.25	8.500	.25	9.00	1/2-13	.75	2.00
(1)												

FRAME	C	AH	BV	BACK END SHAFT EXT. N	N-W	U(2)	V	B.E. KEY LGTH.	SQ.	(4) WT.
X180TC	19.38	2.62	7.12	2.81	2.75	1.1250	2.50	1.75	.250	128
X210TC	22.75	3.12	8.44	3.44	3.38	1.3750	3.12	2.38	.312	193
(1)										

(1) SPECIAL DIMENSIONS ON THIS LINE

(2) "U" AND "FU" MAY VARY +.0000, -.0005

(3) "AK" MAY VARY +.000, -.003

FACE RUNOUT AND ECCENTRICITY — .004 MAX. T.I.R.

(4) MOTOR WEIGHTS MAY VARY BY 15% FOR NON-STANDARD RATINGS.

(5) FOR UNDERWRITERS CLASSIFICATION SEE MOTOR DATA PLATE

(6) FOR CLASS I,GROUP C & D AND CLASS II, GROUP E, F & G LOCATIONS.

(7) FOR CLASS I, GROUP C & D AND CLASS II, GROUP F & G LOCATIONS.

(8) 87,300 - 01
CLASS 1 GROUP C & D (NO LONGER AVAILABLE)
87,300 - 02 WITH SLINGER
CLASS 1 GROUP C & D
CLASS II GROUP E, F & G

(9) 65,000 SERIES - 180TC FRAMES - NO ADAPTER USED.
210TC FRAMES - ADD .88 TO "C" DIM. TO ACCOMMODATE ADAPTER.

87,300 SERIES - 180TC FRAMES ADD .75 TO "C" DIM. TO ACCOMMODATE ADAPTER.
210TC NO ADAPTER USED.

TERMINAL BOX LOCATED ON OPPOSITE SIDE WHEN F-2, W-1, W-4, W-5, W-7 OR C-1 MOUNTING IS SPECIFIED.

MAXIMUM PERMISSIBLE SHAFT RUNOUT WHEN MEASURED AT END OF STANDARD SHAFT EXTENSION IS .002 T.I.R.

IF MOUNTING CLEARANCE DETAILS ARE REQUIRED, CONSULT FACTORY.

EXPLOSION PROOF BRAKE SERIES 65,000 (6)						
TORQUE LB.FT.	BRAKE MODEL NUMBER	WT. LB.	XB	XC	XD	XE
3	1-065-321	38	6.62	7.88	1.81	3.62
6	1-065-331	40	6.94	7.88	2.12	3.62
10	1-065-351	42	7.25	7.88	2.44	3.62
15	1-065-361	42	7.25	7.88	2.44	3.62
(1)						

EXPLOSION PROOF BRAKE SERIES 87,300 (7)						
TORQUE LB.FT.	BRAKE MODEL NUMBER	WT. LB.	XB	XC	XD	XE
10	1-087-311	62	9.34	10.88	2.97	4.50
15	1-087-321	63	9.34	10.88	2.97	4.50
25	1-087-331	63	9.34	10.88	2.97	4.50
35	1-087-341	63	9.34	10.88	2.97	4.50
50	1-087-351	64	9.34	10.88	2.97	4.50
(1)						

EXPLOSION PROOF BRAKE SERIES 87,300-01 & 02 (8)						
TORQUE LB.FT.	BRAKE MODEL NUMBER	WT. LB.	XB	XC	XD	XE
10	1-087-314	82	10.34	10.88	3.97	4.50
15	1-087-324	83	10.34	10.88	3.97	4.50
25	1-087-334	83	10.34	10.88	3.97	4.50
35	1-087-344	83	10.34	10.88	3.97	4.50
50	1-087-354	84	10.34	10.88	3.97	4.50
(1)						

CUSTOMER IS RESPONSIBLE FOR DETERMINING THAT BALDOR'S PRODUCT WILL PERFORM SUITABLY IN THE INTENDED APPLICATION.

BALDOR - RELIANCE®

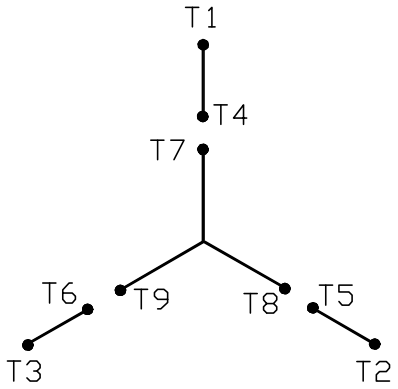
DIM SHT,X180TC THRU X210TC,TEFC,C-FACE
SH 1 of 1

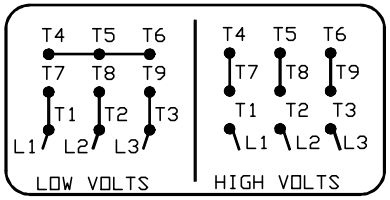
REV. DESC: 87,300-01,CLASS 1 GROUP C&D NO LONGER AVAILABLE		TDR: 000001081850	
REV. LTR: A	VERSION: 01		
FILE: \RGS\00025\092	REVISED: 08:24:28 08/17/2018	BY: RGSWT	
MTL: -			

613053-561

416820–001

A-C MOTOR
CONNECTION DIAGRAM
STANDARD 9 LEAD Y CONNECTED





(N. P. 1575-A)

416820–001

REV. DESC: FONT CHANGE FOR PDF SEARCHABLE		
REV. LTR: A	VERSION: 01	TDR: 000001009382
FILE: \MGA\00000\659	REVISED: 10:33:07 12/21/2016	BY: MGHMTT
MTL: –		

BALDOR

CONN DIAG – STANDARD 9 LEAD, Y CONNECTED

SH 1 of 1

S..AD..

SA..AD..

General Information

Introduction

The SEW-Eurodrive Helical-Worm Gear Units are designed for continuous duty under difficult operating conditions. Only materials of the highest quality are used in the manufacture of the units. These units have the following standard construction features:

Gearcase and flanges of high strength gray cast iron SAE Class 30.

Double seals on output shafts with additional inner seal made of Viton®.

Captured keys on input and output shafts.

Foot mounted, flange mounted, flange mounted with hollowshaft, or shaft mounted.

Efficiency

The efficiency of the gear units is mostly determined by the gearing and bearing friction, and ranges up to approximately 92%. However, due to the sliding friction of the worm gearing, the actual efficiency depends upon the gear ratio of the worm stage and the input speed.

The helical-worm gear units have an input helical gear stage which reduces the ratio of the worm gear stage and as a result improves the overall efficiency as compared to a gear unit with a worm gear only.

The rated efficiencies are achieved if the gear unit has been correctly run in, has achieved its nominal operating temperature, has the proper lubrication, and is operating within its torque rating.

Backdriving

With respect to torque driving back from the output shaft, the backdriving efficiency 2 $\frac{1}{}$ is far less favorable than the forward efficiency and may need to be taken into account.

The low backdriving efficiency may provide some braking effect in certain instances but since the actual efficiency is dependent on many factors including ambient temperature and worm speed, we request you submit full details to our engineering department if this braking effect is required.

Since the SEW-Eurodrive Helical-Worm gear units have fairly high efficiency, they can not be considered as self-locking, and should not be used if the self-locking effect is required.

Input Power, Output Torque, and Speed

The details on power, torque, and speed given in the selection tables always refer to the mounting position B3 or similar mounting position with standard features, standard ambient conditions, and standard lubricants. Depending upon ratio, increased output power ratings may be achieved through the use of special lubricants. Please consult your SEW-Eurodrive representative.

The output speeds have been rounded up or down. The actual output speed may vary slightly due to the motor frame size, the loading, or the supply voltage.

Design Variations

In addition to the versions shown in the accompanying pages, the Helical-Worm Gear Units are also available with the combination of double shaft, double flange or flange opposite shaft mount.

Additional features available for the Helical-Worm Gear units are:

Adapters for IEC or NEMA C-Face motors.

Motor mounting platforms and scoops.

Adapters for torque limiting couplings.

Corrosion protection.

Torque arm attachment.

Shrink disc shaft mounting.

Please contact your SEW-Eurodrive representative for additional information.

Abbreviations

The following abbreviations are used in the selection tables:

f_B	Service Factor
F_{Ra}	Permissible output overhung load (lb) at the midpoint of the output shaft extension
F_{Re}	Permissible input overhung load (lb) at the midpoint of the input shaft extension
i	Gear unit ratio
i_w	Worm gear stage ratio
	Efficiency
n_a	Output speed in rpm
n_e	Input speed in rpm
P_a	Rated output power (Hp)
P_e	Calculated power input into the gear unit (Hp) P_e is calculated from $T_{a\,max}$ by taking into account the gear units' efficiency under standard operating conditions. For calculated P_e less than .2Hp, a dash (—) is shown in the respective selection tables since the actual values are subject to large variations.
P_n	Motor rated power (HP)
T_a	Output torque (lb-in.) with reference to the driving motor
$T_{a\,max}$	Maximum permissible output torque (lb-in.) at $f_B = 1.0$

Dimension Page Notes

The dimension sheets are valid for standard units with various basic features. In particular, accessories such as platforms, scoops, etc. will alter the basic dimensions. Please refer to the respective accessory dimension pages for additional dimensions.

Certified dimension sheets are available from your SEW-Eurodrive Assembly Center.

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Service Factoring

Unit Selection

In order to select the most suitable gear unit it is essential that a thorough knowledge of the characteristics of the driven machine are known. The gear units are normally designed for constant torque load and only a few starts/stops. If these conditions do not exist, it is necessary to determine a service factor, $f_{B\ TOTAL}$, where $f_{B\ TOTAL} = f_B \times f_{B1} \times f_{B2}$

- f_B Is determined by the start/stop frequency, Load Class, and the daily operating time.
- f_{B1} Is determined by the ambient temperature.
- f_{B2} Is determined by the cyclic duration factor.

f_B, f_{B1}, f_{B2} service factors are shown in the diagrams that follow.
For gearmotors, the appropriate service factor taken from the diagram is then compared with the service factor given with each speed/power combination listed in the gearmotor selection tables. To ensure a long, trouble free service life it is essential that the unit selected has a service factor equal to, or greater than, that determined from the diagram.

Load Classification

I = Uniform load. Permissible inertia acceleration factor 0.2

II = Moderate shock load. Permissible inertia acceleration factor 3.0

III= Heavy shock load. Permissible inertia acceleration factor 10

For inertia acceleration factor > 10, please contact your nearest SEW-Eurodrive representative.

Inertia acceleration factor = $\frac{J_L}{J_m}$

Where: J_L = Reflected Load Inertia
J_m = Motor Inertia

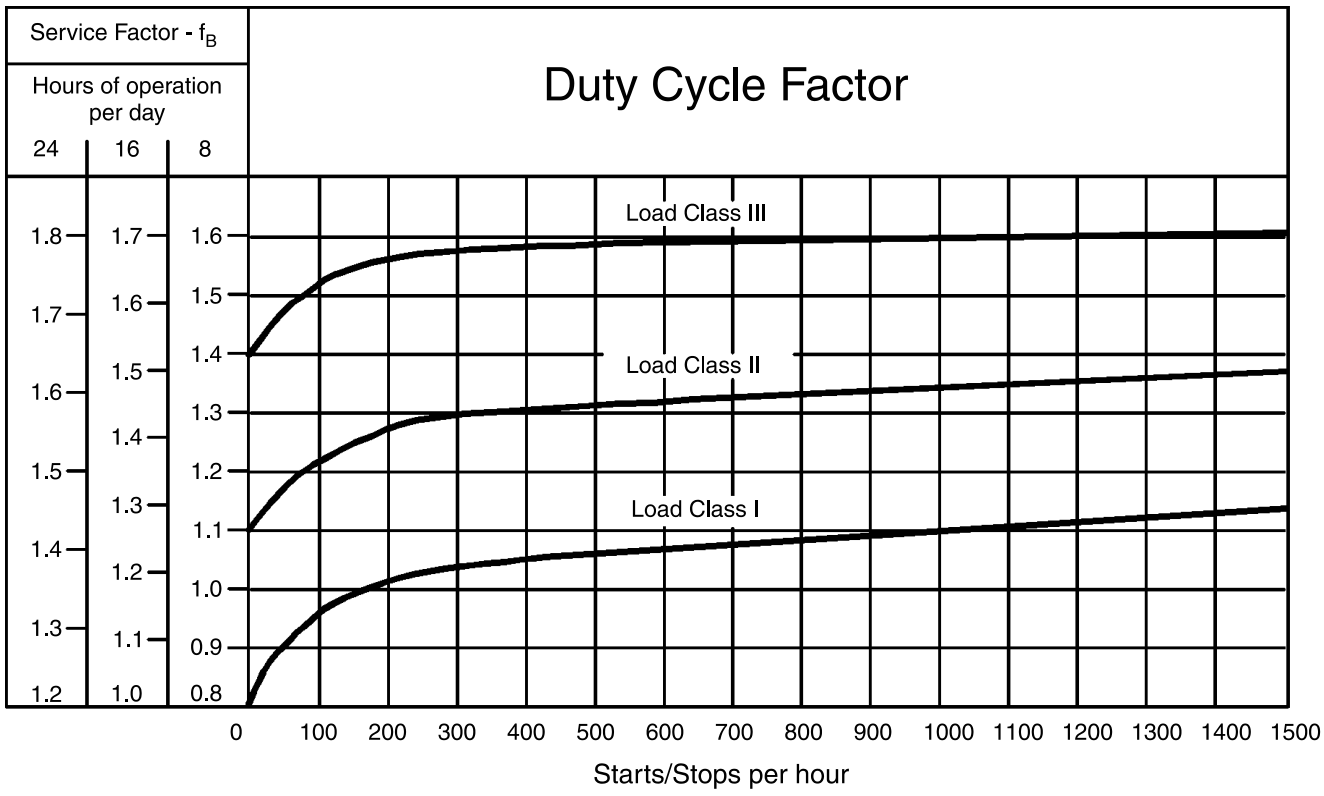
All external load inertias, J, must be reflected back to the input side of the gear unit.

Example: $J_L \quad J \quad \frac{1}{(Gear\ Ratio)^2}$

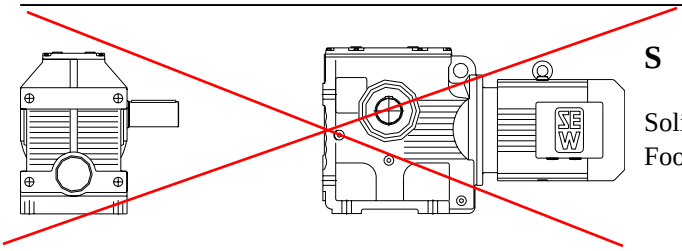
Included in the number of starts and stops per hour must be all regenerative brake actions and the speed changes from high to low speed as experienced with multi-speed motors.
Example: Load Class I with 200 starts and stops per hour and operating time of 24 hours per day gives $f_B = 1.36$.

AGMA

For Service Factors using AGMA criteria, please refer to the guidelines on page 4.

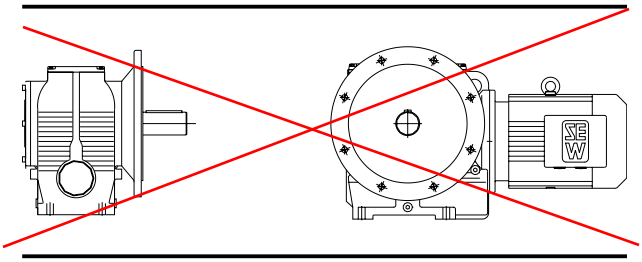


Mounting Options



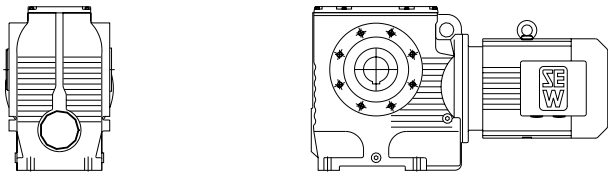
S

Solid shaft
Foot mount



SF

Solid shaft
Flange mount (D & B5 style flange with through holes)



SA

Hollowshaft with key
Shaft mount

Technical Data
Helical-Worm Speed Reducer Ratings
S/SF/SA/SAF 97 (6.61" C.D.) With Mineral Oil

		Input speed n_e [1]																							
		3400 rpm				3200 rpm				2800 rpm				2200 rpm				1700 rpm				1400 rpm			
		n_a	T_a	P_e	η	n_a	T_a	P_e	η	n_a	T_a	P_e	η	n_a	T_a	P_e	η	n_a	T_a	P_e	η	n_a	T_a	P_e	η
i	i_w	rpm	lb-in	HP	%	rpm	lb-in	HP	%	rpm	lb-in	HP	%	rpm	lb-in	HP	%	rpm	lb-in	HP	%	rpm	lb-in	HP	%
286.40	40/1	12	31150	7.71	76	11	31770	7.45	76	9.8	32745	6.65	75	7.7	34690	5.59	74	5.9	35400	4.52	73	4.9	35400	3.86	72
262.22	40/1	13	30535	8.25	76	12	31150	7.85	76	11	32125	7.18	75	8.4	33985	5.99	75	6.5	35400	4.92	73	5.3	35400	4.12	72
231.67	40/1	15	29295	8.91	76	14	29915	8.51	76	12	31150	7.85	76	9.5	33365	6.65	75	7.3	35045	5.45	74	6	35400	4.66	73
196.52	40/1	17	27610	9.84	77	16	28410	9.58	76	14	29650	8.78	76	11	31685	7.32	76	8.7	33985	6.25	75	7.1	35400	5.32	74
180.95	40/1	19	26815	10.37	77	18	27610	9.98	77	15	28765	9.18	76	12	31065	7.85	76	9.4	33365	6.52	75	7.7	34690	5.72	74
161.74	40/1	21	25755	11.04	77	20	26285	10.64	77	17	27610	9.84	77	14	30180	8.51	76	11	32305	7.05	76	8.7	33985	6.25	75
145.60	40/1	23	24425	11.70	77	22	25225	11.31	77	19	26550	10.51	77	15	28940	9.04	77	12	31420	7.58	76	9.6	33010	6.65	75
131.85	40/1	26	23540	12.50	77	24	24250	12.10	77	21	25490	11.04	77	17	28055	9.58	77	13	30445	8.11	76	11	32305	7.18	76
116.92	40/1	29	20530	12.37	76	27	22570	12.64	77	24	24250	11.84	77	19	26725	10.24	77	15	29560	8.78	77	12	31065	7.71	76
105.71	40/1	32	17525	11.84	75	30	19560	12.24	76	26	23275	12.64	77	21	25930	11.04	77	16	28410	9.31	77	13	30445	8.25	76
89.60	40/1	38	11330	9.71	70	36	14780	11.31	74	31	19560	12.50	77	25	24160	12.10	77	19	26725	10.37	77	16	28675	9.18	77
78.26	40/1	43	8140	8.51	65	41	9205	8.91	67	36	15665	11.70	75	28	22480	12.77	78	22	25400	11.17	78	18	27260	9.98	77
65.45	40/1	52	5975	7.85	63	49	6860	8.25	64	43	9115	9.04	68	34	18760	12.90	77	26	23455	12.24	78	21	25665	11.04	78
80.85	37/3	42	27880	20.62	89	40	27880	19.42	89	35	27880	17.02	89	27	29205	14.10	89	21	28940	10.91	88	17	28585	8.91	88
71.43	37/3	48	27345	22.88	90	45	27880	21.95	89	39	27880	19.29	89	31	29205	15.96	89	24	29205	12.37	88	20	29205	10.24	88
60.59	37/3	56	25755	25.27	90	53	26285	24.34	90	46	27610	22.48	90	36	29205	18.75	89	28	29205	14.50	89	23	29205	11.97	88
55.79	37/3	61	24955	26.60	90	57	25490	25.27	90	50	26815	23.67	90	39	28940	20.08	89	30	29205	15.69	89	25	29205	13.03	88
49.87	37/3	68	23985	29.26	90	64	24425	27.93	90	56	25755	25.27	90	44	28055	21.68	90	34	29205	17.56	89	28	29205	14.50	89
44.89	37/3	76	21505	27.93	90	71	23275	29.26	90	62	24690	26.60	90	49	26995	23.28	90	38	29205	19.42	89	31	29205	16.09	89
40.65	37/3	84	19205	27.93	90	79	20800	29.26	90	69	23720	27.93	90	54	26110	25.27	90	42	28585	21.01	90	34	29205	17.69	89
36.05	37/3	94	16195	26.60	89	89	17875	27.93	89	78	21240	29.26	90	61	24870	26.60	90	47	27525	22.74	90	39	29205	19.95	89
32.60	37/3	104	13805	25.27	89	98	15575	26.60	89	86	19030	29.26	90	67	23895	27.93	90	52	26375	24.07	90	43	28320	21.28	90
27.63	37/3	123	8940	20.22	86	116	11680	24.21	88	101	15400	27.93	89	80	21150	29.26	90	62	24870	26.60	90	51	26640	23.67	90
24.13	37/3	141	6415	17.16	83	133	7255	18.09	84	116	12300	25.27	88	91	18230	29.26	90	70	23630	29.26	90	58	25400	25.27	90
26.39	35/6	129	15490	33.25	93	121	15490	31.92	93	106	15490	27.93	93	83	22570	31.92	93	64	23010	25.27	93	53	23010	20.75	92
23.59	35/6	144	15490	37.24	93	136	15490	35.91	93	119	15490	30.59	93	93	21685	34.58	93	72	23010	27.93	93	59	23010	23.28	93
21.23	35/6	160	15490	42.56	93	151	15490	39.90	93	132	15490	34.58	93	104	21065	37.24	93	80	22745	30.59	93	66	23010	25.27	93
19.23	35/6	177	13720	41.23	93	166	14870	41.23	93	146	15490	38.57	93	114	20180	38.57	93	88	22125	33.25	93	73	23010	27.93	93
17.05	35/6	199	11680	39.90	93	188	12835	41.23	93	164	15310	42.56	93	129	19205	41.23	93	100	21240	35.91	93	82	22745	31.92	93
15.42	35/6	220	9825	37.24	92	208	11150	39.90	93	182	13630	41.23	93	143	18055	43.89	93	110	20355	37.24	93	91	21860	33.25	93
13.07	35/6	260	6415	29.26	90	245	8320	34.58	92	214	10975	39.90	93	168	15220	42.56	93	130	19205	42.56	93	107	20620	37.24	93
11.41	35/6	298	4560	24.34	88	280	5175	25.27	89	245	8850	37.24	92	193	13100	42.56	93	149	17700	43.89	93	123	19560	39.90	93
9.55	35/6	356	3320	21.55	87	335	3850	23.28	87	293	5135	26.60	89	230	10620	41.23	93	178	14780	43.89	93	147	18055	43.89	94
8.26	35/6	412	2565	19.55	85	387	2965	21.01	86	339	4025	24.47	88	266	8675	39.90	93	206	12745	43.89	93	169	15665	45.22	94

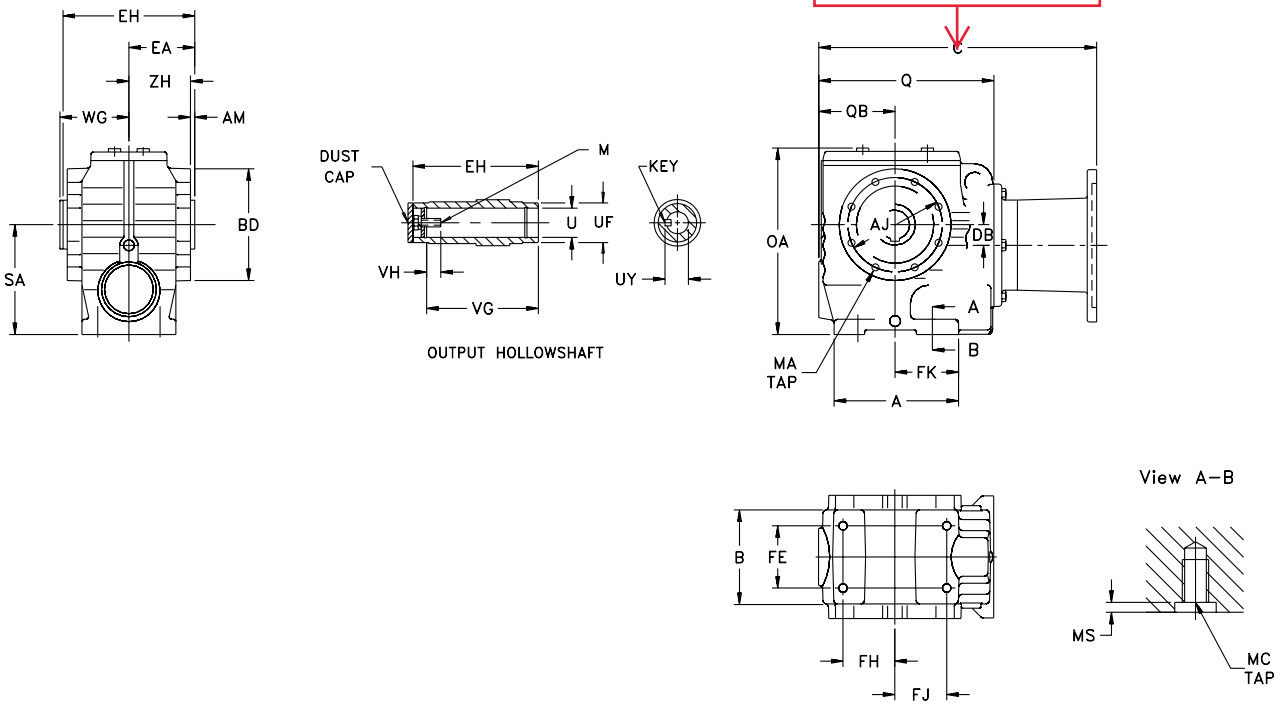
[1] To obtain the output torque capacity and efficiency for input speeds other than those indicated in the above charts, it is possible to interpolate between the chart values given. The corresponding input horsepower required can be calculated by substituting the interpolated values in the formula below:

$$P_e \quad \frac{T_a \quad n_e}{63025 \quad i} Hp$$

Ratings within the outlined area indicate thermal limit rating exceeded, $P_{e\,max}$ = 30.00HP

n_e Input speed for gear unit in rpm
i Overall ratio for gear unit
i_w Ratio for worm gear stage
n_a Output speed for gear unit in rpm
T_a Maximum output torque in lb-in for gear unit
P_e Maximum input power in Hp for gear unit
η Overall eficiency of helical worm gear combination at the indicated input speed when running at normal operating temperature

SEE NEXT PAGE



Gearcase

Model	A	AJ	AM	B	BD	DB	EA	FE	FH	FJ	FK	MA	MC	MS	OA
SA87	10.24	7.09	0.20	7.64	8.46	1.48	4.92	4.65	4.53	4.33	4.92	M16 x 1.02	M16 x 1.26	0.24	14.49
	260	180	5	194	215	37.5	125	118	115	110	125	M16 x 26	M16 x 32	6	368
SA97	11.85	8.66	0.20	9.29	10.24	2.05	5.71	6.30	5.31	4.45	5.51	M16 x 1.02	M20 x 1.42	0.24	17.91
	301	220	5	236	260	52	145	160	135	113	140	M16 x 26	M20 x 36	6	455

Gearcase

Model	Q	QB	SA	WG	ZH
SA87	13.39	5.91	8.86	5.04	4.72
	340	150	225	128	120
SA97	16.54	7.09	11.02	5.87	5.51
	420	180	280	149	140

Output Shaft Inch Series/*Optional Metric Series*

For solid shaft design, see page 544.

EH	UF	U	UY	VG	VH	Key	M
9.84	3.74	$2.375^{+.001}_{0}$	2.65	8.66	1.37	5/8 5/8 3 1/4	3/4 10 2
250	*95*	*70* $^{+.030}_{-0}$	*74.9*	*220*	*34*	*20 x 12 x 110*	*M20 x 50*
11.42	4.72	$2.750^{+.001}_{-0}$	3.03	10.23	1.24	5/8 5/8 3 1/4	3/4 10 2
290	*120*	*90* $^{+.035}_{-0}$	*95.4*	*255*	*41*	*25 x 14 x 140*	*M24 x 60*

Motor Compatibility - NEMA

Model		NEMA LP 143TC 145TC	182TC 184TC	213TC 215TC	254TC 256TC	284TC 286TC
SA87	C	18.07	20.67	20.67	23.78	—
		459	525	525	604	—
SA97	C	—	23.62	23.62	26.73	28.78
		—	600	600	679	731

Motor Compatibility - IEC

Model		IEC LP 80	90	100	112	132ML	132S/M	160	180
SA87	C	17.20	17.80	19.65	19.65	23.19	20.67	24.37	—
		437	452	499	499	589	525	619	—
SA97	C	—	—	22.60	22.60	26.14	23.62	27.32	28.74
		—	—	574	574	664	600	694	730

Dimensions are $\frac{\text{inch}}{mm}$

Dimension C is to motor mounting surface

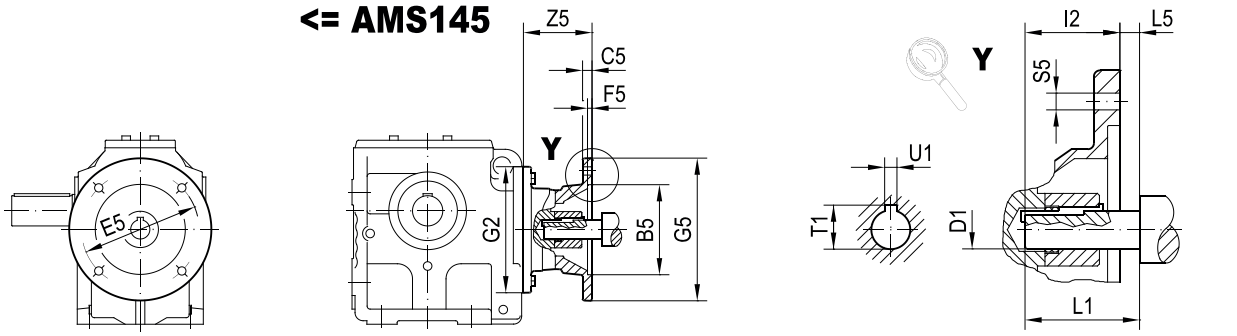
For the selected LP adapter size the pinion bore must be available in the desired gear ratio for the reducer. Please see the compatibility tables beginning on page 496.

Refer to page 556 for standard NEMA C-Face dimensions.

See page 543 for available output shaft sizes.

02 154 00 20

<= AMS145



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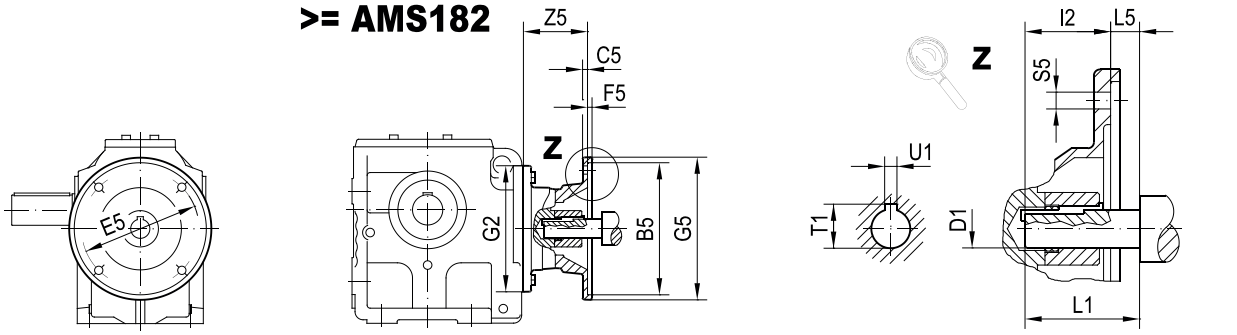

		B5	C5	E5	F5	G2	G5	I2	L5	S5	Z5	D1	L1	T1	U1
S..97 S..97p	**AMS182**	215.9	10	184	5	300	228	66.6	3.3	15	95.0	28.575	69.9	31.7	6.35
	AMS184	215.9	10	184	5	300	228	66.6	3.3	15	95.0	28.575	69.9	31.7	6.35
	AMS213/215	215.9	11	184	5	300	228	79.2	6.6	15	120.0	34.925	85.9	38.7	7.94
	AMS254/256	215.9	12	184	5	300	228	95.3	6.4	15	180.0	41.275	101.6	45.8	9.53
	AMS284/286	266.7	15	228.6	5	300	286	111.3	6.1	15	185.0	47.625	117.3	53.4	12.7
	AMS324/326	317.5	17	279.4	5	300	356	127.0	6.4	17.5	250.0	53.975	133.4	60.0	12.7
	AMS364/365	317.5	17	279.4	5	300	356	142.7	6.6	17.5	250.0	60.325	149.4	67.6	15.88

26878585/EN – 11/2021

Drive System Components:
TF Shaftless Screw Conveyor

Electric Motor:

Manufacturer:	Baldor
H.P.:	2.0
Serial No.:	N/A
RPM:	1725
Volts/Phase/Hertz:	208-230/460/3/60
Classification:	Class 1, Div. 1, Grp. C & D
Spec No.:	05F831W649G1
Frame Size:	145TC
Enclosure:	XPFC
Shaft End Bearing:	6205-J/C3
Opp. End Bearing:	6203-J/C3
Full Load Amps (460 V.)	2.7
Service Factor:	1.15

Gear Reducer:

Manufacturer:	Siemens
Model No:	KAZ89-K5-140
Serial No.	N/A
Reduction:	:1
Mount:	M1

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BALDOR • RELIANCE

Product Information Packet

DXP INDUSTRIES

05F831W649G1

2HP,1725 65C RISERPM,3PH,60HZ,145TC,0532

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Part Detail

Revision:	-	**Status:**	PRD/A	**Change #:**		**Proprietary:**	No
Type:	AC	**Prod. Type:**	0532M	**Elec. Spec:**	05WGW649	**CD Diagram:**	
Enclosure:	XPFC	**Mfg Plant:**		**Mech. Spec:**	05F831	**Layout:**	
Frame:	145TC	**Mounting:**	F1	**Poles:**	04	**Created Date:**	06-20-2012
Base:	RG	**Rotation:**	R	**Insulation:**	F	**Eff. Date:**	07-12-2012
Leads:	9#18	**Literature:**		**Elec. Diagram:**		**Replaced By:**	

Nameplate NP0977XP

NO.		**TEMP CODE**	T3C				
SPEC.	05F831W649G1	**DE BRG**	6205				
CAT.NO.		**ODE BRG**	6203				
HP	2	**GREASE**	POLYREX EM				
VOLTS	208-230/460	**MOTOR WEIGHT**	80 LBS				
AMPS	5.7-5.4/2.7	**NEMA-NOM-EFF**	86.5				
RPM	1725 65C RISE	**FL PF**	82				
CYCLE	60	**PH**	3	**CL**	F	**FRAME**	145TC
SER.F.	1.15	**DES**	B	**CODE**	J	**CC**	010A
SER.							
RATING	50C AMB-CONT						
USABLE AT 208V							

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Parts List

Part Number	Description	Quantity
SA247364	SA 05F831W649G1	1.000 EA
RA234238	RA 05F831W649G1	1.000 EA
HW3201A05	3/8-16 EYEBOLT	1.000 EA
HW4002A18	1"HEX STEEL PIPE NIPPLE FOR 305XP MTRS	1.000 EA
HW3021F12	SPRING PIN, .156 X 1.25	1.000 EA
35CB1005A01	CONDUIT BOX,MACH - GROUP "C" MTRS	1.000 EA
35EP1715A02	FR ENDPLATE,TEFC,35M,X-PROOF MTR,GROUP"C	1.000 EA
84XN3118J20	5/16-18 X 1 1/4" SOC HD CAP SCREW	4.000 EA
HW5100A03SP	WAVY WASHER (W1543-017)	1.000 EA
35EP1704A11	PU ENDPLATE, MACH GROUP "C"	1.000 EA
84XN3118J20	5/16-18 X 1 1/4" SOC HD CAP SCREW	4.000 EA
51XN1032A20	10-32 X 1 1/4 HX WS SL SR	2.000 EA
HW4001A01	1/4 HX SOC PIPE PLG (F/S) ALLOY STEEL W/	2.000 EA
60XN1032A07	10-32 X 1/2 TRUSS HEAD, TORX SERRATED ZN	2.000 EA
51XB1214A16	12-14X1.00 HXWSSLD SERTYB	1.000 EA
35FH1000A18	FAN COVER FOR DRIP COVER	1.000 EA
10XN2520A18	1/4-20 X 1-1/8 HEX CAP SCREW.	3.000 EA
35FH4500A11	DRIPCOVER(W/ AUTOPHERETIC PRIMER)	1.000 EA
HA2001A13	35-10103 SPACER WELKER	3.000 EA
51XN1032A20	10-32 X 1 1/4 HX WS SL SR	3.000 EA
35CB1501A01	CONDUIT BOX LID, MACH. - GROUP "C"MTRS	1.000 EA
RM1020A41	O-RING, -150 BUNA-N, .103 CS X 2.862 ID	1.000 EA
HW2501D13SP	KEY, 3/16 SQ X 1.375	1.000 EA
HA7000A01	KEY RETAINER 7/8" DIA SHAFT	1.000 EA

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Parts List (continued)

Part Number	Description	Quantity
85XU0407S04	4X1/4 U DRIVE PIN STAINLESS	6.000 EA
LB1115	LABEL,LIFTING DEVICE	1.000 EA
LB1359	LABEL, UL/CSA "XP"	1.000 EA
MJ1000A75	GREASE, POLYREX EM EXXON	0.050 LB
35FN3002A05SP	EXFN, PLASTIC, 6.376 OD, .638 ID	1.000 EA
MG1025Z20	ACTIVATOR WILKOFAST 060.32	0.010 GA
MG1025G29	PAINT 789.205 DARK GRAY METALLIC (USE W/	0.017 GA
LB1119	WARNING LABEL	1.000 EA
LB1172A01	CUSTOM MTR CARTON LABEL LASER PRINTER	1.000 EA
LC0145B01	CONNECTION LABEL	1.000 EA
NP0977XP	BR XP UL CSA CC CL-I GP-C&D	1.000 EA
36PA1001	PACKAGING GROUP	1.000 EA

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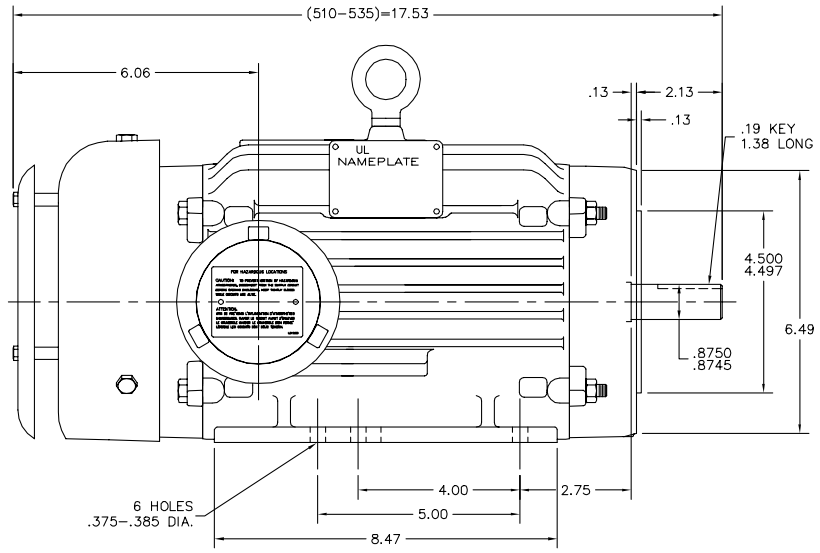
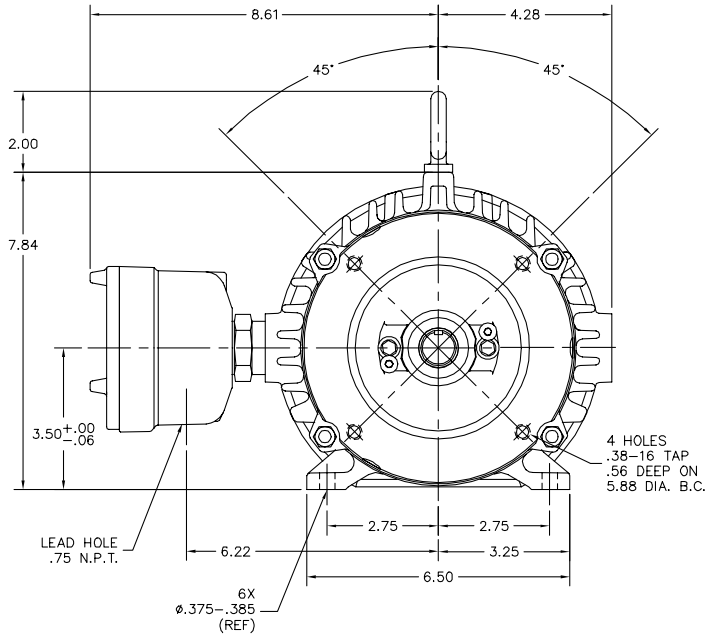
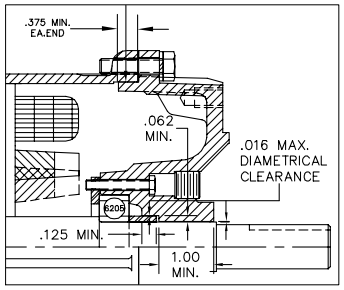






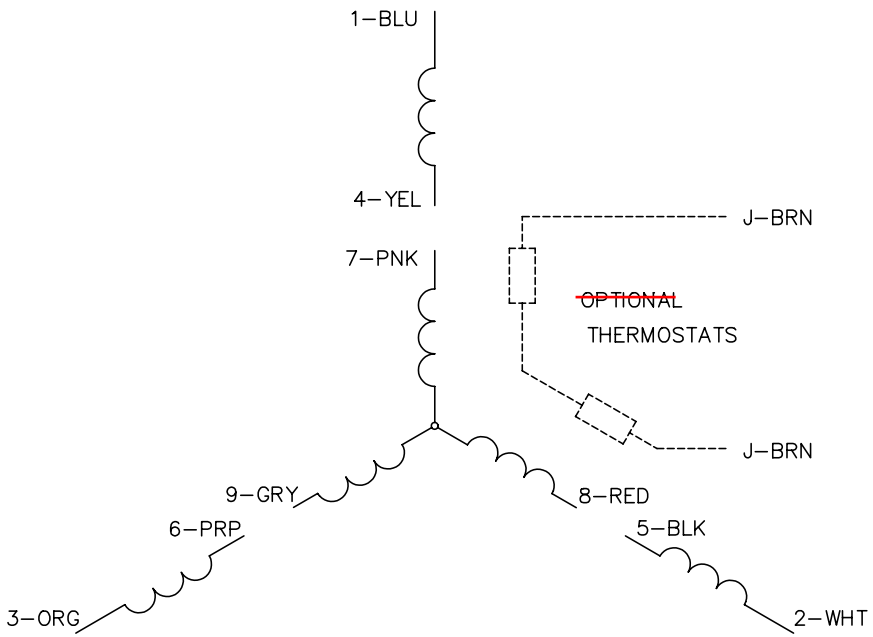
CUSTOMER IS RESPONSIBLE FOR DETERMINING THAT BALDOR'S PRODUCT WILL PERFORM SUITABLY IN THE INTENDED APPLICATION.

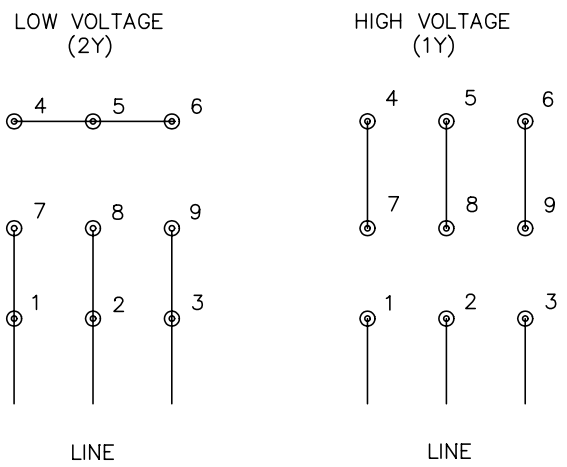
REV. DESC: NEW			BALDOR
REV. LTR: –	VERSION: 00	TDR: 000000752108	HOR 143–5TC XPFC X35M CLI GP C&D W/DRIP COVER
FILE: \AAA\00192\650	REVISED: 01:43:59 06/20/2012	BY: ENALEM0	SH 1 of 1
MTL: –			

05LYF831

BALDOR A MEMBER OF THE ABB GROUP

CD0005





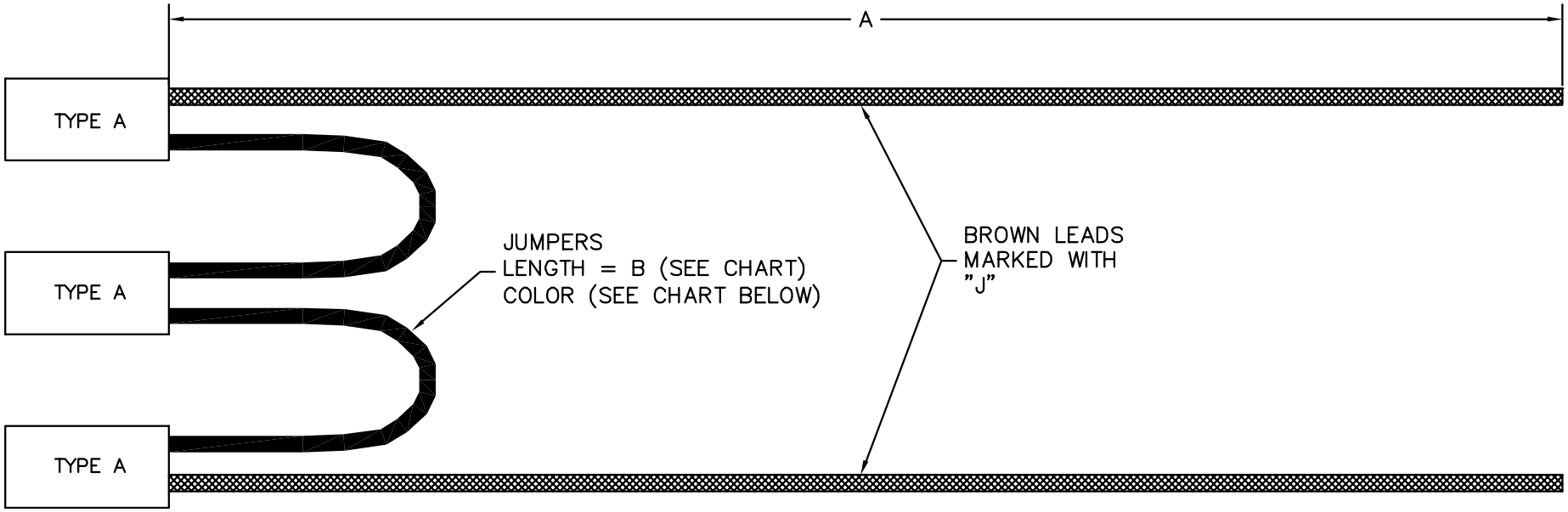
NOTES:

1. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
2. ~~OPTIONAL~~ THERMOSTATS ARE PROVIDED WHEN SPECIFIED.
3. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY BE A MULTIPLE OF THOSE SHOWN ABOVE.
4. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

CD0005

REV. DESC: REVISE TO SHOW OPTIONAL COLORS			BALDOR ELECTRIC Co.
REV. LTR: E	BY: JLP	REVISED: 01/19/99 10:15	TDR: 0171435
CD0005		FILE: AAA00005140	MDL: –
		MTL: –	3PH, DV, 9 LEADS

BALDOR A MEMBER OF THE ABB GROUP



PART# SUFFIX	TEMPERATURE	JUMPER LEAD COLOR	SLEEVE MATERIAL	TI PART#	A	B	BALDOR MODEL
A01	135°C	YELLOW	.006" MYLAR	7AM034A5	28.00"	5.00"	35, 36, 37, 305, 306, 307
A02	150°C	BLACK	.006" MYLAR	7AM037A5	28.00"	5.00"	35, 36, 37, 305, 306, 307
A03	110°C	WHITE	.006" MYLAR	7AM029A5	28.00"	5.00"	35, 36, 37, 305, 306, 307

NOTES:

1. THERMOSATS: TI 7AMxxx DEVICES, NUMBER, AND TEMPERATURE SPECIFIED BY ASSEMBLY
2. ALL LEADS TO BE 18 GAGE, 150°C, 600V, XLPE
3. THERMOSTATS TO BE MARKED WITH TI PART NUMBER AND OPENING TEMPERATURE.
4. ALL LEADS TO BE UL RECOGNIZED
5. ALL LEADS TO BE CSA CERTIFIED, OR UL RECOGNIZED FOR CANADA

REV. DESC: REVISED NOTES TO MATCH UL REQUIREMENTS			BALDOR • DODGE • RELIANCE
REV. LTR: B	VERSION: 02	TDR: 000000465431	
FILE: \AAA\00106\872		REVISED: 10:58:16 05/19/2008	3 THERMOSTAT ASSEMBLY DRAWING
MTL: –		BY: ENBRAM0	SH 1 of 1

TP5050

BALDOR
A MEMBER OF THE ABB GROUP

AC Induction Motor Performance Data

Record # 40516

Typical performance - not guaranteed values

Winding: 05WGW649	**Type:** 0532M	**Enclosure:** XPFC

Nameplate Data				General Characteristics at 460 V, 60 Hz: High Volt Connection	
Rated Output (HP)	2			Full Load Torque	6 LB-FT
Volts	208-230/460			Start Configuration	DOL
Full Load Amps	5.7-5.4/2.7			Break Down Torque	21 LB-FT
R.P.M.	1725			Pull-Up Torque	14.9 LB-FT
Hz	60	Phase	3	Locked-rotor Torque	17 LB-FT
NEMA Design Code	B	KVA Code	J	Starting Current	20.8 Amps
Service Factor	1.15			No-load Current	1.15 Amps
NEMA Nom. Eff.	86.5	P.F.	82	Line-line Res. @ 25°C.	8.18 Ohms
Rating - Duty	50C AMB-CONT			Temp. Rise @ Rated Load	37°C
S.F. Amps				Temp. Rise @ S.F. Load	46°C

Load Characteristics at 460 Volts, 60 Hz

% of Rated Load	25	50	75	100	125	150	S.F.
Power Factor	44	67	77	82	83	84	83
Efficiency	82.3	87.3	88.2	87.5	86	84	86.6
Speed	1783	1768	1751	1733	1712	1689	1720
Line Amperes	1.32	1.62	2.07	2.59	3.19	3.86	2.95

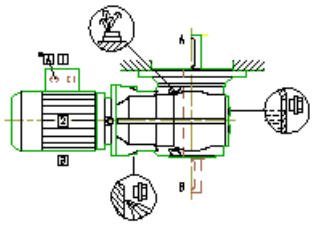
SIEMENS

Industry

Data sheet for SIMOGEAR Gearboxes KAZ89-K5-180

Design according to catalog: MD50.1 (SIMOGEAR geared motors), Edition 2015

Ordering Data



Client-Order-No:
Order-No:
Consignment-No:
Quotation-No:

Item-No: **100**

Customer's designation:
Project: **16 / 750-003 Whitewater, WI**

Gear unit - Basic data

	Geared motor	KAZ89-K5-180
	Gear unit type	Bevel gear unit
	Installation size	89
	Transmission ratio	109.04
	Number of teeth	57575.0/528.0
	Service factor	1,23
	Nominal torque	1600 Nm
	Output torque	1300 Nm
	Output speed	16 1/min
	Specification	CE (Europe / other countries)
	Weight without oil	64.00 kg
	oil volume	6,1 l
	Adapter	K5 Short adapter for NEMA motor
	Adapter Size	180
	Permissible input torque	33 Nm

Gearbox options

Mounting type and position		
D16	Mounting position	M6
	Output side	A
E57	Special installation position	Rotation of M6 to M4 by 85°
	Mounting type	Housing flange
	Output shaft	hollow shaft
	Output shaft dimensions	H50
	Hollow shaft cover	Sealing cap
Output shaft bearing		
	Output shaft bearing	Standard bearing
Lubrication and Sealing		
K06	Gear oil	Mineral oil CLP VG220
	Output shaft sealing	Standard sealing
Ventilation and oil control		
	Gearbox breather	Pressure breather valve
	Oil level control	Oil level plug
	Oil drain	Oil drain plug
Other gearbox options		
	Housing material	Cast iron

Motor data (For your information only.)

Y00'*AND(a)1760*'	Input speed	1760 1/min
Y00'*ANL(a)2.20*'	Motor power	2.2 kW

Adapter options

Coupling

Backstop

Additional Options

General options

Environment

	application	Standard
	place of installation	Indoor installation

SIEMENS

Industry

	Environment	Normal
Surface treatments		
L03	Surface treatments	Coating for low environmental stress C2
L50	Color:	Color RAL 5015 sky blue
Conservation		
Rating plate		
K41	Second rating plate	Second rating plate. supplied loose

Documentation	
Operation Instructions	BA 2030, BA 2039
Delivery time	

Notes

Drive System Components:
TF Shaftless Screw Conveyor

Electric Motor:

Manufacturer:	Baldor
H.P.:	3.0
Serial No.:	N/A
RPM:	1760
Volts/Phase/Hertz:	230/460/3/60
Classification:	Class 1, Div. 1, Grp. C & D
Spec No.:	06F793W356G1
Frame Size:	182TC
Enclosure:	XPFC
Shaft End Bearing:	6206
Opp. End Bearing:	6205
Full Load Amps (460 V.)	4.0
Service Factor:	1.15

Gear Reducer:

Manufacturer:	Siemens
Model No:	FDAZ89-K5-180
Serial No.	N/A
Reduction:	106.52:1
Mount:	M1

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BALDOR • RELIANCE

Product Information Packet

DXP INDUSTRIES

06F793W356G1

3HP,1760 65C RISERPM,3PH,60HZ,182TC,0628

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Part Detail

Revision:	-	**Status:**	PRD/A	**Change #:**		**Proprietary:**	No
Type:	AC	**Prod. Type:**	0628M	**Elec. Spec:**	06WGW356	**CD Diagram:**	
Enclosure:	XPFC	**Mfg Plant:**		**Mech. Spec:**	06F793	**Layout:**	
Frame:	182TC	**Mounting:**	F1	**Poles:**	04	**Created Date:**	06-19-2012
Base:	RG	**Rotation:**	R	**Insulation:**	F	**Eff. Date:**	07-12-2012
Leads:	9#16	**Literature:**		**Elec. Diagram:**		**Replaced By:**	

Nameplate NP0977XP

NO.		**TEMP CODE**	T3C				
SPEC.	06F793W356G1	**DE BRG**	6206				
CAT.NO.		**ODE BRG**	6205				
HP	3	**GREASE**	POLYREX EM				
VOLTS	230/460	**MOTOR WEIGHT**	141 LBS				
AMPS	8/4	**NEMA-NOM-EFF**	89.5				
RPM	1760 65C RISE	**FL PF**	80				
CYCLE	60	**PH**	3	**CL**	F	**FRAME**	182TC
SER.F.	1.15	**DES**	B	**CODE**	H	**CC**	010A
SER.							
RATING	50C AMB-CONT						
USABLE AT 208V	8.4						

BALDOR A MEMBER OF THE ABB GROUP

Parts List

Part Number	Description	Quantity
SA247367	SA 06F793W356G1	1.000 EA
RA234241	RA 06F793W356G1	1.000 EA
HW3201A05	3/8-16 EYEBOLT	1.000 EA
07CB1000A02	CONDUIT BOX, MODEL 306,EXP. PROOF	1.000 EA
84XN2520J12	1/4-20 X 3/4 SOC.HD CAP SCR	4.000 EA
HW1001A25	LOCKWASHER 1/4, ZINC PLT .493 OD, .255 I	4.000 EA
WD1000B17	KPA-8C BURNDY TERMINAL	1.000 EA
11XW1032G06	10-32 X .38, TAPTITE II, HEX WSHR SLTD U	1.000 EA
06EP1709A11	FREP XPFC DRN,GP C(8.50 DIA. B.C.)	1.000 EA
HW4506A02	BREATHER/DRAIN-EXP PROOF-.125-27 NPTF AI	1.000 EA
HW3022E05	.125 DIA X .500 ROLLED SPRING PIN	1.000 EA
10XN3118K20	5/16-18 X 1 1/4 GRADE 5 STEEL ZC PLATED	4.000 EA
HW1001A31	LOCKWASHER 5/16, ZINC PLT.591 OD, .319 I	4.000 EA
HW5100A05	WVY WSHR F/205 & 304 BRGS	1.000 EA
06EP1707A10	PUEP 182-4TC 206 BRG 306M GRP-C DRAIN(HW	1.000 EA
HW4506A02	BREATHER/DRAIN-EXP PROOF-.125-27 NPTF AI	1.000 EA
HW3022E05	.125 DIA X .500 ROLLED SPRING PIN	1.000 EA
51XN1032A20	10-32 X 1 1/4 HX WS SL SR	2.000 EA
HW4001A01	1/4 HX SOC PIPE PLG (F/S) ALLOY STEEL W/	2.000 EA
60XN1032A07	10-32 X 1/2 TRUSS HEAD, TORX SERRATED ZN	2.000 EA
10XN3118K20	5/16-18 X 1 1/4 GRADE 5 STEEL ZC PLATED	4.000 EA
HW1001A31	LOCKWASHER 5/16, ZINC PLT.591 OD, .319 I	4.000 EA
51XB1214A16	12-14X1.00 HXWSSLD SERTYB	1.000 EA
06FH1003A07	FAN HOUSING 306 X-PROOF FOR DRIP COVER	1.000 EA

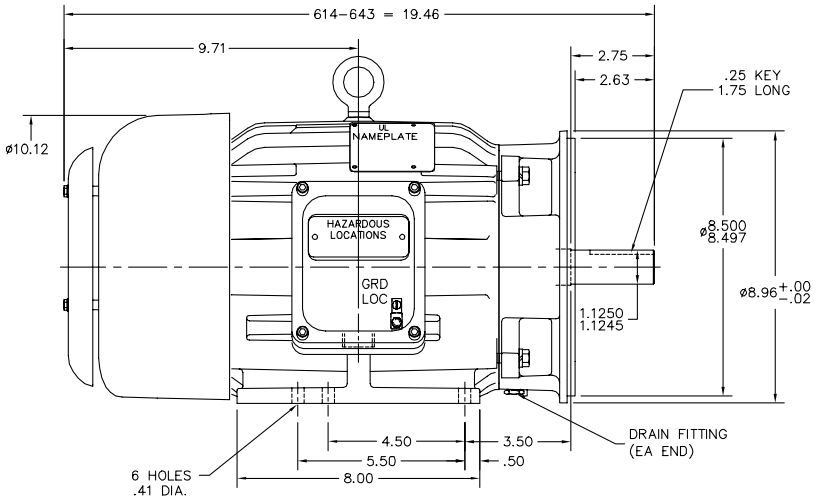
BALDOR A MEMBER OF THE ABB GROUP

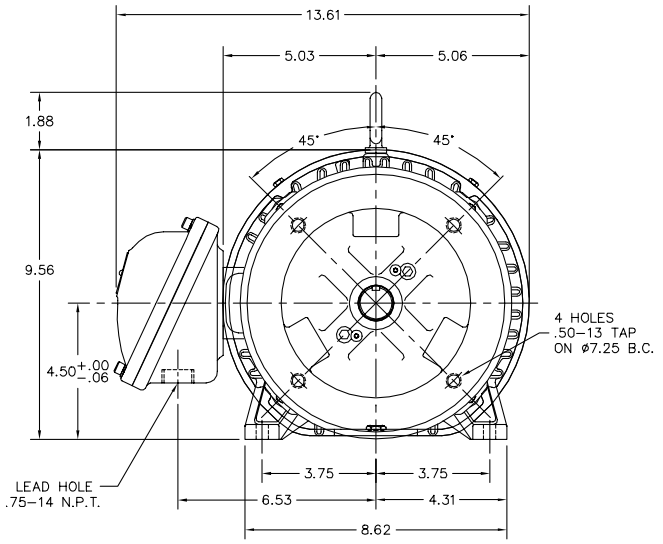
Parts List (continued)

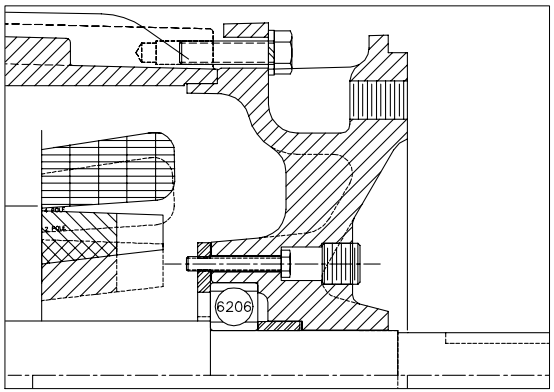
Part Number	Description	Quantity
51XN1032A14	10-32 X 0.875 HX WS SL SR	4.000 EA
36FH4500A09	SPECIAL DRIP COVER, W/AUTOPHERETIC PRIME	1.000 EA
HA2001A09	SPACER, .218 ID X .937 LG	3.000 EA
51XN1032A22	10-32 X 1 3/8 HX WS SL SR	3.000 EA
07CB1502A01	CONDUIT BOX LID MACH (DUCTILE IRON)	1.000 EA
84XN2520J16	1/4-20 X 1 SOC HD CAP SCREW	4.000 EA
HW1001A25	LOCKWASHER 1/4, ZINC PLT .493 OD, .255 I	4.000 EA
HW2501E16	KEY, 1/4 SQ X 1.750	1.000 EA
HA7000A02	KEY RETAINER RING, 1 1/8 DIA, 1 3/8 DIA	1.000 EA
LB1081	LABEL CSA XPROOF	1.000 EA
LB1115	LABEL,LIFTING DEVICE	1.000 EA
85XU0407S04	4X1/4 U DRIVE PIN STAINLESS	6.000 EA
MJ1000A75	GREASE, POLYREX EM EXXON	0.050 LB
36FN3000A01SP	EXFN, PLASTIC, 7.00 OD, .912 ID	1.000 EA
MG1025G29	PAINT 789.205 DARK GRAY METALLIC (USE W/	0.028 GA
MG1025Z20	ACTIVATOR WILKOFAST 060.32	0.010 GA
LB1119	WARNING LABEL	1.000 EA
LB1172A01	CUSTOM MTR CARTON LABEL LASER PRINTER	1.000 EA
LC0145B01	CONNECTION LABEL	1.000 EA
NP0977XP	BR XP UL CSA CC CL-I GP-C&D	1.000 EA
G0PA1000	PACKAGING GROUP	1.000 EA

BALDOR A MEMBER OF THE ABB GROUP

06LYF793







CUSTOMER IS RESPONSIBLE FOR DETERMINING THAT BALDOR'S PRODUCT WILL PERFORM SUITABLY IN THE INTENDED APPLICATION.

REV. DESC: ADD DRIP COVER TO DESCR.		
REV. LTR: B	VERSION: 02	TDR: 000000730570
FILE: \AAA\00111\636	REVISED: 02:54:52 02/01/2012	BY: ENSTEKO
MTL: –		

BALDOR

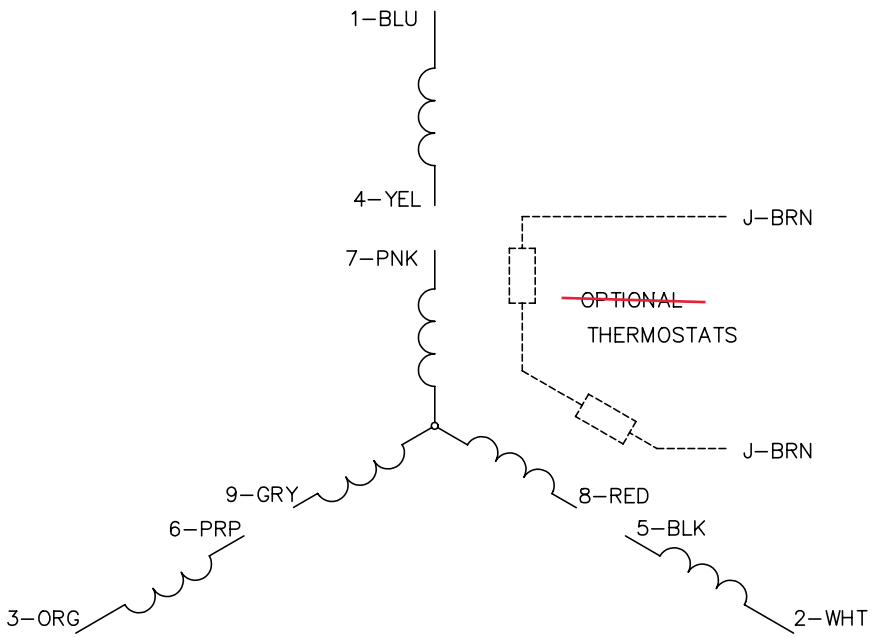
HORZ 182–4TC XPFC M CL I–GP C&D DRAINS, DRIP COVER

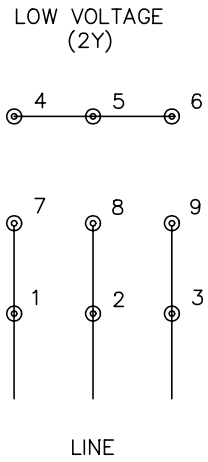
SH 1 of 1

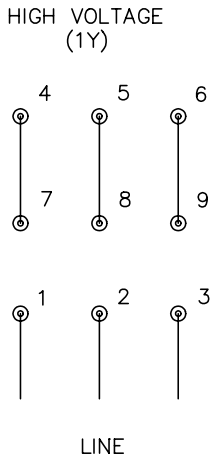
06LYF793

BALDOR A MEMBER OF THE ABB GROUP

CD0005







NOTES:

1. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
2. ~~OPTIONAL~~ THERMOSTATS ARE PROVIDED WHEN SPECIFIED.
3. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY BE A MULTIPLE OF THOSE SHOWN ABOVE.
4. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

CD0005

REV. DESC: REVISE TO SHOW OPTIONAL COLORS			BALDOR ELECTRIC Co.
REV. LTR: E	BY: JLP	REVISED: 01/19/99 10:15	TDR: 0171435
CD0005		FILE: AAA00005140	MDL: –
		MTL: –	3PH, DV, 9 LEADS

BALDOR A MEMBER OF THE ABB GROUP

BALDOR
A MEMBER OF THE ABB GROUP

AC Induction Motor Performance Data

Record # 40513

Typical performance - not guaranteed values

Winding: 06WGW356	**Type:** 0628M	**Enclosure:** XPFC

Nameplate Data				General Characteristics at 460 V, 60 Hz: High Volt Connection	
Rated Output (HP)	3			Full Load Torque	8.93 LB-FT
Volts	230/460			Start Configuration	DOL
Full Load Amps	8/4			Break Down Torque	32 LB-FT
R.P.M.	1760			Pull-Up Torque	19.5 LB-FT
Hz	60	Phase	3	Locked-rotor Torque	21.5 LB-FT
NEMA Design Code	B	KVA Code	H	Starting Current	31.7 Amps
Service Factor	1.15			No-load Current	1.89 Amps
NEMA Nom. Eff.	89.5	P.F.	80	Line-line Res. @ 25°C.	3.77 Ohms
Rating - Duty	50C AMB-CONT			Temp. Rise @ Rated Load	29°C
S.F. Amps				Temp. Rise @ S.F. Load	34°C

Load Characteristics at 460 Volts, 60 Hz

% of Rated Load	25	50	75	100	125	150	S.F.
Power Factor	40	62	73	79	82	84	81
Efficiency	82.8	88.4	89.8	89.7	89	87.5	89.3
Speed	1788	1779	1770	1759	1748	1735	1752
Line Amperes	2.09	2.57	3.21	3.94	4.82	5.75	4.47

SIEMENS

Datenblatt für SIMOGEAR Getriebe mit Adapter

Datasheet for SIMOGEAR gearbox with adapter

31.009

Artikelnummer: **2KJ3406-5CA05-0HF1-Z**

Article No.: **D01+K06+K41+L03+L50**

Kunden-Auftrags-Nr. / Client order no. :

Siemens-Auftrags-Nr. / Order no. :

Angebots-Nr. / Offer no. :

Item-Nr. / Item no. :

Komm.-Nr. / Consignment no. :

Projekt / Project :

Zulässige Betriebsdaten
Permissible operating data

Maximal kurzzeitig zulässige Eintriebsdrehzahl n1max Maximum briefly permissible input speed n1max	4.500 1/min 4,500 rpm
Referenzeintriebsdrehzahl n1 Reference input speed n1	1.450 1/min 1,450 rpm
Maximal zulässiges Eintriebsdrehmoment der Getriebe/Adapter Kombination für den Dauerbetrieb T1N Maximum permissible input torque of the gear unit/adapter combination for continuous operation T1N	17,4 Nm 17.4 Nm
Maximal zulässiges Abtriebsdrehmoment der Getriebe/Adapter Kombination für den Dauerbetrieb T2N Maximum permissible output torque of the gear unit/adapter combination for continuous operation T2N	1.850,0 Nm 1,850.0 Nm

Getriebe
Gearbox

Typbezeichnung Type designation	SIMOGEAR FDAZ89-K5-(180) SIMOGEAR FDAZ89-K5-(180)
Getriebe Gearbox	Flachgetriebe FDAZ89 Parallel shaft gearbox FDAZ89
Befestigungsart Getriebe Mounting type gearbox	Gehäuseflanschausführung Housing flange
Abtriebswelle Output shaft	H50 mm (Hohlwelle) H50 mm (Hollow shaft)
Einbaulage Mounting position	(D01) M1 (D01) M1
Übersetzung Transmission ratio	106,52 (19920 / 187) 106.52 (19920 / 187)
Nennmoment Nominal torque	1.850,0 Nm 1,850.0 Nm
Getriebeöl Gear oil	(K06) Mineralöl CLP VG220 (K06) Mineral oil CLP VG220
Ölmenge Oil charge	5,6 l 5.6 l
Umgebungstemperatur Environment temperature	-15 ... +40°C -15 ... +40 °C
Gewicht ohne Öl Weight without oil	76,4 kg 76.4 kg
Gehäusewerkstoff Erstgetriebe Housing material first gearbox	Grauguss Cast iron

Getriebeoptionen
Gearbox options

Hohlwellenabdeckung Hollow shaft cover	Verschlusskappe Sealing cap
Abtriebswellenlagerung Output shaft bearing	Standardlagerung Standard bearing
Abtriebswellenabdichtung Output shaft sealing	Standardabdichtung Standard sealing
Getriebeentlüftung Gearbox breather	Druckentlüftungsventil Pressure breather valve
Ölstandskontrolle Oil level control	Ölstandsschraube Oil level screw
Ölablass Oil drain	Ölablassschraube Oil drain plug

Adapter
Adapter

Adapter Adapter	K5 Kurzadapter für NEMA-Motoren K5 Short adapter for NEMA motors
Lochkreis Hole circle	7.25" 7.25"
Zentrierung Centering	8.5" 8.5"
Motorwelle Motor shaft	1.126" x 2.75" 1.126" x 2.75"
Zulässiges Eintriebsdrehmoment Adapter für den Dauerbetrieb Permissible input torque of adapter for continuous operation	44,0 Nm 44.0 Nm

Adapteroptionen
Adapter options

-

Allgemeine Optionen
General options

Oberflächenbehandlung Surface treatments	Lackiert Painted
Beschichtung Coating	(L03) Beschichtung für geringe Umweltbelastung C2 (L03) Coating for low environmental stress C2
RAL Farbton RAL Color	(L50) 5015 Himmelblau (L50) 5015 sky blue
Lackierung am Flansch Coating on flange	- -
Zweites Leistungsschild Second rating plate	(K41) Zweites Leistungsschild beigelegt (K41) Second rating plate supplied loose
Verpackung Packing	Standardverpackung Standard packing

Weitere Informationen
Further information

Allgemeine Produktinformationen General product information	SIMOGEAR
Konfigurator Configurator	2KJ.....
Betriebsanleitung Operating instructions	
Getriebe Gearbox	BA 2030
Adapter Adapter	BA 2039

SIEMENS

Datenblatt für SIMOGEAR Getriebe mit Adapter

Datasheet for SIMOGEAR gearbox with adapter

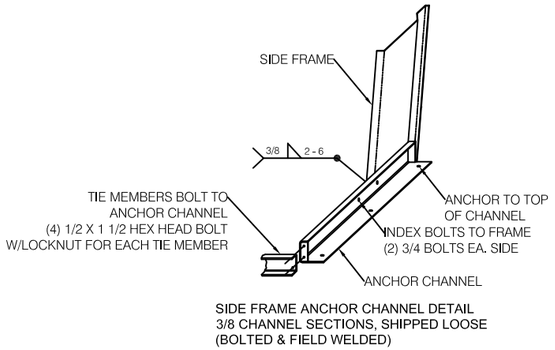
Artikelnummer: **2KJ3406-5CA05-0HF1-Z**

Article No.: **D01+K06+K41+L03+L50**

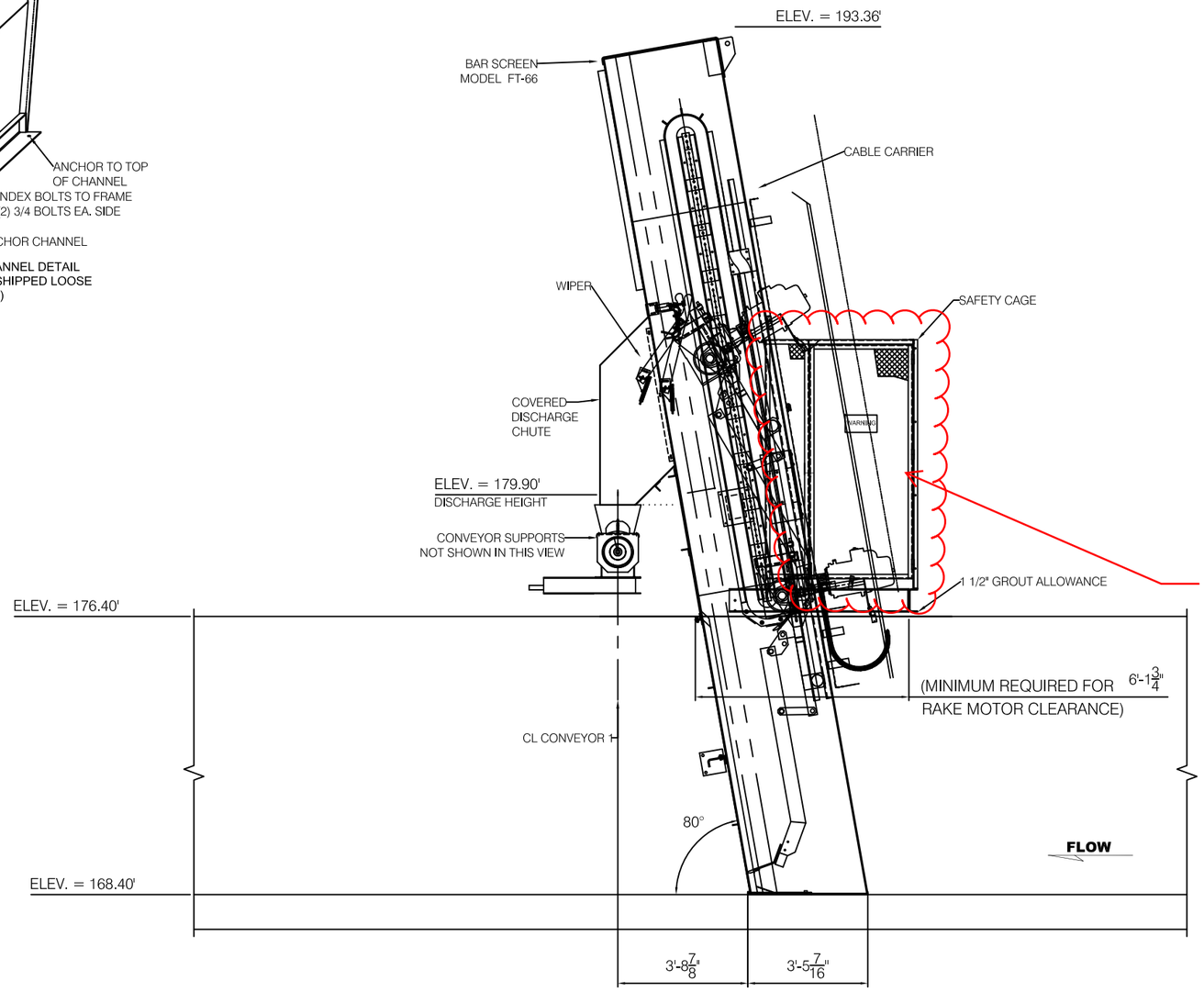
Katalog Catalog	MD 50.11 Getriebe mit Adapter

Section 4

General Arrangement Drawings



SIDE FRAME ANCHOR CHANNEL DETAIL
3/8 CHANNEL SECTIONS, SHIPPED LOOSE
(BOLTED & FIELD WELDED)



A-A SCREEN SIDE ELEVATION
Scale: 1/4"=1'-0"

NOTES:

ANCHORAGE SUPPLIED BY VULCAN INDUSTRIES, INC.
INSTALLATION IS BY CONTRACTOR.

SEE LISTED ANCHORS SUPPLIED BY VULCAN

ALL INTERCONNECTING WIRING, CONDUIT,
OFF LOADING, PLACEMENT OF EQUIPMENT ETC...IS BY OTHERS.

APPROXIMATE SHIPPING WEIGHTS:

BAR SCREENS: 8,500 LB EACH

SCREW CONVEYOR 1: 1,600 LB

SCREW CONVEYOR 2: 2,000 LB

ALL DIMENSIONS AND ELEVATIONS ARE REFERENCED FROM THE CONTRACT DRAWINGS.

ALL DIMENSIONS ON THIS DRAWING SHOULD BE VERIFIED IN THE FIELD BY CONTRACTOR AND OR THE ENGINEER.

Remove safety cage from your scope. Garver will provide guard rail in lieu of safety cage.

23107-Tuscaloosa, AL	ANCHOR LIST		
Vulcan Equipment	Anchor Quantity	Anchor	Anchor type
Bar Screen No. 1	10	5/8" x 8" All Thread	Epoxy HIT-200A
Bar Screen No. 2	10	5/8" x 8" All Thread	Epoxy HIT-200A
Screw Conveyor No. 1	6	1/2" x 5 1/2"	Wedge
Screw Conveyor No. 2	8	1/2" x 5 1/2"	Wedge

REV	DATE	BY	DESCRIPTION	
001	7/20/2023	THR	CHANGED INVERT ELEVATION TO 168.40'	

Vulcan THE PROVEN SCREEN CHOICE
212 SOUTH KIRLIN STREET
MISSOURI VALLEY, IA. 51555
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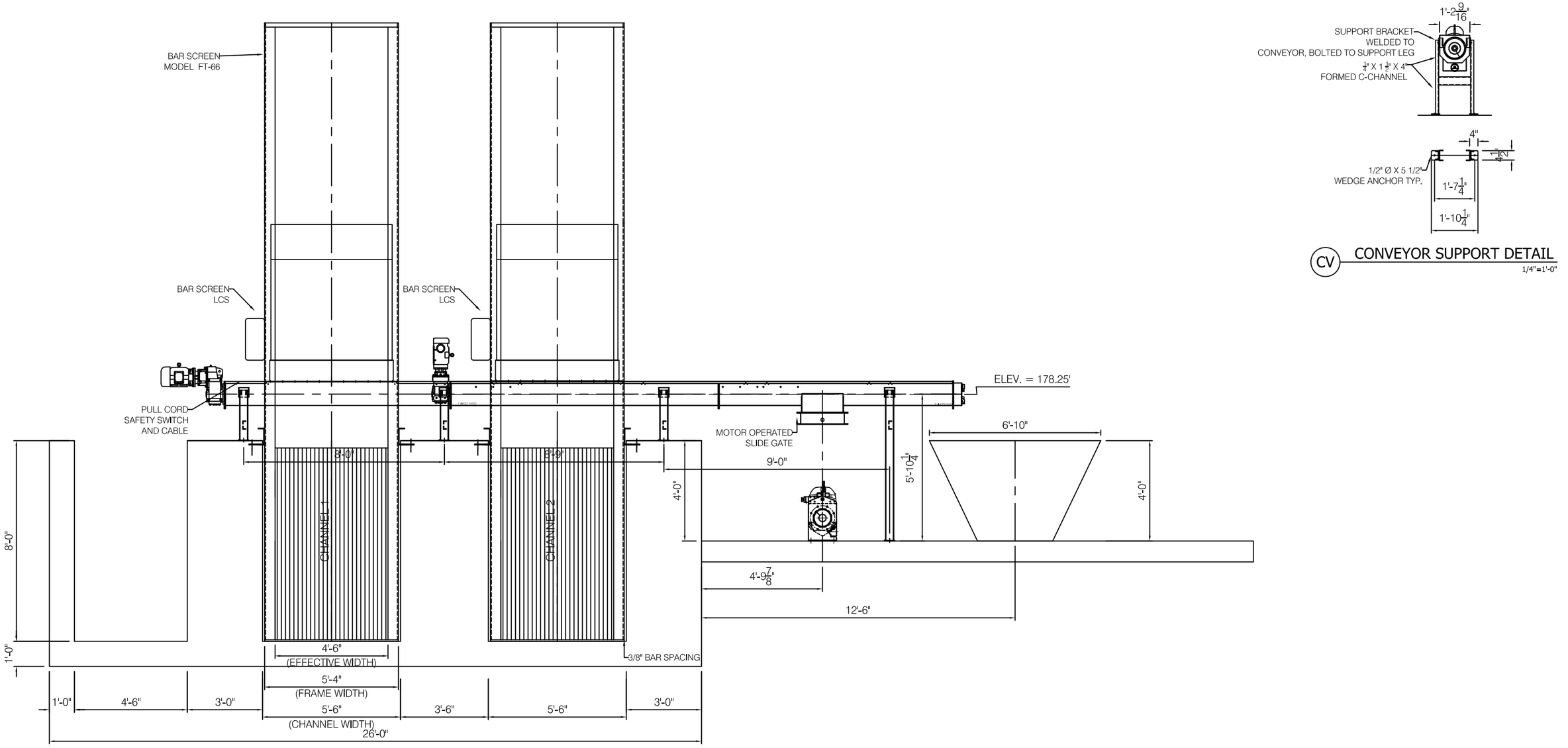
SCALE: 1/4"=1'-0"		DRAWN BY:	THR
DATE: 4/12/2023	SHEET NUMBER: OF	REVIEWED BY:	THR
TITLE: ELEVATION VIEW		PROJECT NUMBER:	23107
PROJECT: TUSCALOOSA, AL		DRAWING NUMBER:	23107-GA1



D DOWN STREAM VIEW

Scale: 1/4"=1'-0"

CV CONVEYOR SUPPORT DETAIL

1/4"=1'-0"

REV	DATE	BY	DESCRIPTION	
001	7/20/2023	THR	CHANGED INVERT ELEVATION TO 168.40'	

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SCALE: 1/4"=1'-0"		DRAWN BY: THR
DATE: 4/12/2023	SHEET NUMBER: OF	REVIEWED BY: THR
TITLE: DOWN STREAM VIEW		PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL		DRAWING NUMBER: 23107-GA2

REV	DATE	BY	DESCRIPTION
001	7/20/2023	THR	CHANGED INVERT ELEVATION TO 168.40'

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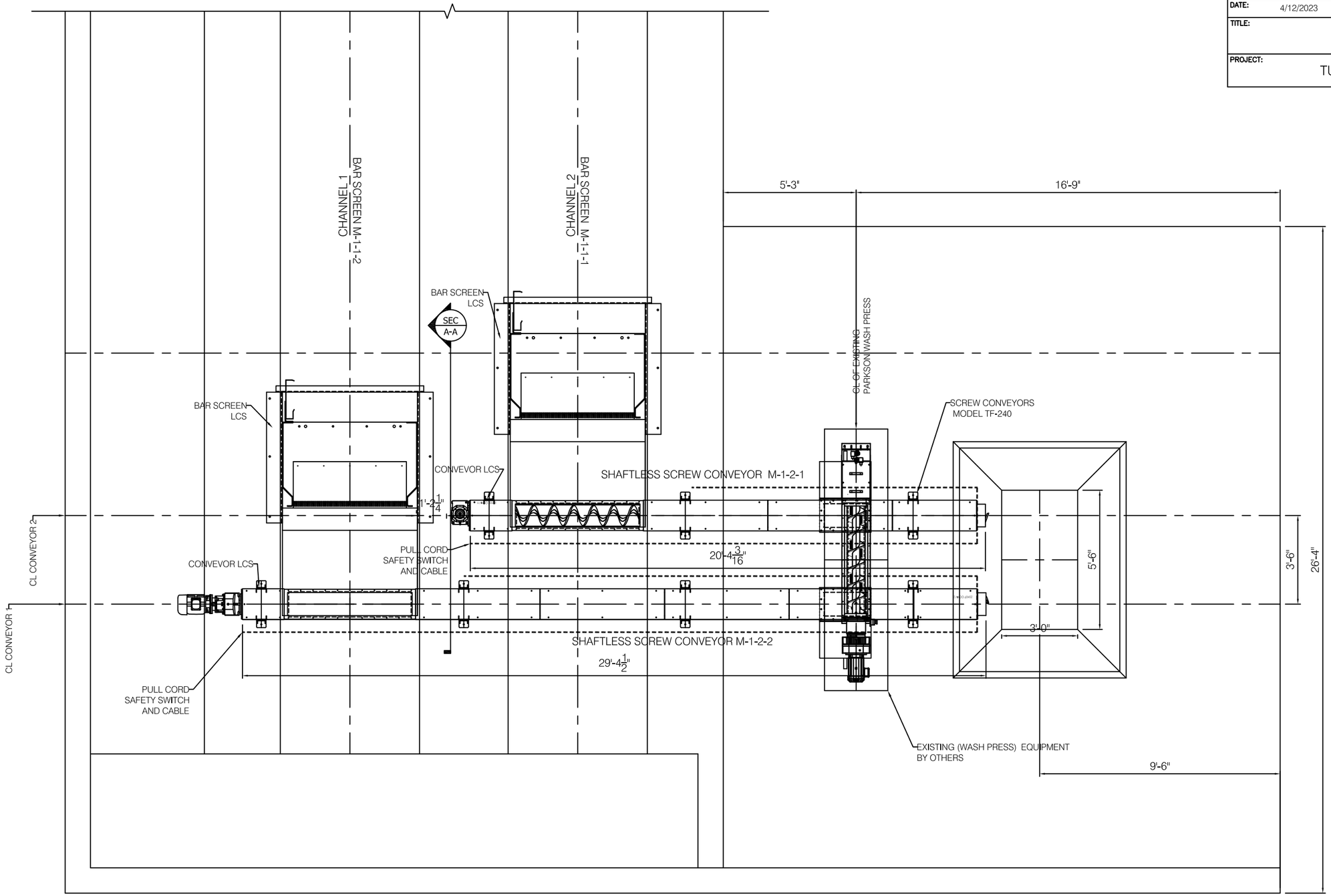
SCALE: 1/4" = 1'-0"		DRAWN BY: THR
DATE: 4/12/2023	SHEET NUMBER: OF	REVIEWED BY: THR
TITLE: PLAN VIEW		PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL		DRAWING NUMBER: 23107-GA3



Section 5

Electrical Documentation

Bar Screen
Sequence of Operation

Typical for two bar screens

1. After the Mensch Screen has been properly installed/adjusted, motor rotation checked and all control panel devices (timer(s), overload(s), current sensing relay, etc.) have been set, automatic operation may proceed. Make sure the Emergency Stop buttons are pulled out, place the Hand/Off/Auto switch in the “Auto” position and all personnel are clear of the equipment.

2. Open the control panel door and place the circuit breakers in the “On” positon. Close the control panel door and place the control panel disconnect in the “On” positon. Then place the control power selector switch to the "On" position. The white control power indicator light should be on at this time.

3. The Bar Screen will be started by a repeat cycle timer within the PLC or by the differential level system. When the PLC based repeat cycle timer “off” time times out the repeat cycle timer “on” time will be initiated. The motor starter coil, run indicator and run relay will be energized. If the time set in the repeat cycle timers “on” time is set for a short time period, the bar screen will make one cycle and park at the end travel limit switch (LS-1). The differential level system may also start the bar screen. When the preset/adjustable differential level set point is reached the screen will be started in the forward direction. The bar screen will continue to run as long as a differential level condition is present. If a high high differential level condition is detected above high high set point the bar screen will be started and will continue to run until this condition is no longer present. The high high differential level condition will also cause the Press to run continuously in Storm Mode until the high high condition is no longer present. The end travel limit switch forms the holding circuit for the bar screen. The bar screen will park at this limit switch when a run signal is no longer present.

4. The bar screen is protected from overtorque by the current sensing relay (CSR1(3). Should the bar screen encounter an obstacle the drive motor current will increase. Once this increase equals the preset of CSR1(3), the CSR1(3) contact in will close turning on the Overcurrent relay, the Screen Fault pilot light and the alarm horn will sound. To silence the alarm horn, press the Alarm Silence push button. The drive will be stopped and an alarm condition will be generated. Turn the Hand/Off/Auto selector switch to the "Off" position. Then push the Screen Common Reset push button to reset. The jam must be cleared and the controls again set for automatic operation.

5. The rake is protected from over-rotation by the action of the rake arm activating the overrotate limit switch (LS-2). When (LS-2) closes, CR6(17) is energized and the overrotate pilot light is illuminated and the alarm horn will sound. To silence the alarm horn, press the Alarm Silence push button. The CR6(17) contact in line 58(92) forms the holding circuit. The CR6(17) contact in line 49(83) opens stopping the drive. To reset the overrotate condition, place the Hand/Off/Auto selector switch to the "Hand" position and use the Forward/Off/Reverse selector switch at the local control station to reverse the rake to the end travel limit switch. The jam must be cleared and the controls again set for automatic operation. To reset the condition, push the Screen Common Reset push button.

6. If the motor circuit should encounter a phase loss, short circuit or high amp draw condition the solid-state motor overload will trip. The drive motor will stop and the motor overload contact in line 160 will close giving an input to the PLC. The Screen Fault pilot light will be illuminated and the alarm horn will sound. To silence the alarm horn, press the Alarm Silence push button. The cause of the motor overload condition must be corrected before normal operation can continue. To reset the condition, push the Screen Common Reset push button.

7. Dry contacts are available for remote indication of the following: power on, in Auto, screen running, general fault/common alarm, high water level and screen fault.

8. An Ethernet switch has been provided in the control panel to allow connection between the PLC and the OIT. This switch could also be used enable communication between the control panel and plant SCADA system if IP addresses were entered into the PLC program.

Bar Screen
Device Functions

Selector Switches

Control Power	This switch allows the operator to turn the 120VAC control circuit supply “Off” and “On”.

Push Buttons

Screen Common Reset	This push button resets an overtorque condition, overrotate condition, high motor temp condition and motor overload condition. The Hand/Off/Auto selector switch should be placed in the “Off” position before pressing the Screen Common Reset push button.

Pilot Lights

Control Power	This pilot light will be lit when control power is available at the control panel.
Running	This pilot light will be lit when the Bar Screen is running in the forward or reverse direction.
Fault	This pilot light will be lit after one of the following conditions occurs; overcurrent, motor overload, overrotate or fail to start.

Protective Devices

Current Sensing Relay	This relay monitors the current draw of the drive motor. When the current exceeds the preset of this relay the machine will stop. The cause of the increased current draw must be corrected before automatic operation may continue. Press the Screen Common Reset push button to reset.

Automatic Control Devices

Repeat Cycle Timer	The preset/adjustable “OFF” time of the PLC based repeat cycle determines how often the screen will run. The preset/adjustable “ON” time of the PLC based repeat cycle timer determines how long the screen will run after the “OFF” time has timed out.
Differential Level Detector	The differential level detector consists of two transducers, one mounted upstream from the bar screen and one mounted downstream from the bar screen. The transducers are wired to the main control panel. When the differential level reaches the preset/adjustable set point the bar screen will run continuously until the differential level is no longer present. The differential level system is an override to the repeat cycle timer. If a high high differential level condition is detected, the bar screen will run continuously until the condition is no longer present.

Machine Mounted Device Functions

End Travel Limit Switch	This switch is mounted on the side frame of the screen near top of the bar screen. It provides the holding circuit for the control circuit after the bar screen has started. The rake will park at this switch after one cycle unless a run signal is present.
Overrotate Limit Switch	This switch is mounted to the rake carriage. If the rake would encounter an object too large to pass over, the articulation of the rake will close this switch and stop the bar screen. The rake must then be reversed in “Hand” mode and the object removed. Press the Screen Common Reset push button to reset.

Bar Screen
Device Functions

Local Control Station Device Functions

Emergency Stop	This maintained push button will stop the operation of the Mensch Screen when pushed.
Hand/Off/Auto	When this switch is in the “Hand” position, the Forward/Off/Reverse selector switch is enabled. When in the “Auto” position, the PLC based repeat cycle timer has control with the differential level system as an override.
Forward/Off/Reverse	This switch is enabled when the Hand/Off/Auto switch is in the “Hand” position. Placing this switch in the “Forward” position will start the rake in the forward direction. Hold this switch in the “Reverse” position and the rake will run in the reverse direction. This switch is spring return from the reverse position.
Running	This pilot light will be lit when the Bar Screen is running in the forward or reverse direction.
Fault	This pilot light will be lit after one of the following conditions occurs; overcurrent, motor overload, overrotate or fail to start.

Screw Conveyor
Sequence of Operation

Typical of two Screw Conveyors

1. After the Screw Conveyor has been properly installed/adjusted and all control panel devices (timer(s), overload(s), current sensing relay, etc.) have been set, and the cable-operated Emergency Stop switch is set and the Hand/Off/Auto selector switch is in the “Auto” position then automatic operation may proceed.

2. Then go to the control panel, make sure all the selector switches are in the "Off" position. Open the control panel door and place the circuit breaker in the “On” position. Close and secure the control panel door. Then turn on the control panel main disconnect and turn the Control Power selector switch to the "On" position. The white Control Power indicator light should be on at this time.

3. The Screw Conveyor will be signaled to start when the bar screen has been called to run and us running. When the bar screen starts a PLC based off delay timer will be initiated. The motor starter coil, running indicator and running relay will be energized and the conveyor will start. The conveyor will continue to run the bar screen stops then the off-delay timer will begin to time down. When the off-delay timer has timed out the conveyor will stop.

4. The conveyor is protected from overcurrent by the current sensing relay (CSR2(4). Should the Screw Conveyor encounter an obstacle the drive motor current increases. Once this increase equals the preset of CSR2(4), the CSR2(4) contact will close energizing the overcurrent relay (CR11(21). The drive motor will be stopped and the alarm horn will be energized. To silence the alarm horn press the Alarm Silence push button. Turn the Hand/Off/Auto selector switch to the "Off" position. Then press the Conveyor Common Reset push button to reset. Use the Forward/Off/Reverse selector switch to reverse the Screw Conveyor. The cause of the overcurrent condition must be corrected and the controls again set for automatic operation.

5. Dry contacts are available for remote indication of the following: in Auto, Fault and Running.

6. An Ethernet switch has been provided in the control panel to allow connection between the PLC and the OIT. This switch could also be used enable communication between the control panel and plant SCADA system if IP addresses were entered into the PLC program.

Screw Conveyor Device Functions

Selector Switches

Control Power	This switch allows the operator to turn the 120VAC control circuit supply “Off” and “On”.

Push Buttons

Screw Conveyor Common Reset	This push button resets the Press current sensing relay after an overcurrent condition and a motor overload condition. The Hand/Off/Auto selector switch should be placed in the “Off” position before pressing the Press Common Reset push button.

Pilot Lights

Control Power	This pilot light will be lit when control power is available at the control panel.
Running	This pilot light will be lit when the conveyor is running the automatic mode within the PLC or when run in manual mode.
Fault	This pilot light will be lit after one of the following conditions occurs; overcurrent, motor overload or fail to start.

Protective Devices

Current Sensing Relay	This relay monitors the current draw of the drive motor. When the current exceeds the preset of this relay the conveyor will stop. The cause of the increased current draw must be corrected before automatic operation may continue. Push the Screw Conveyor Common Reset push button to reset.

Automatic Control Devices

Screw Conveyor Running	The conveyor will begin operation when a Screen Running signal has been received by the PLC.
Off Delay Timer	This timer is located in the PLC and is operator accessible by the operator interface on the control panel. This timer controls how long the conveyor runs after the bar screen stops.

Local Control Station Device Functions

Emergency Stop	This maintained push button will stop the operation of the Press when pushed.
Hand/Off/Auto	When this switch is in the “Hand” position, the Press will run continuously in the forward direction. When in the “Auto” position, the automatic circuit within the PLC in the control panel has control.
Cable-operated Emergency Stop	This maintained cable-operated switch will stop the operation of the Screw Conveyor when tripped.

Screw Conveyor
Device Functions

Running	This pilot light will be lit when the Press is running the automatic sequence programmed within the PLC or when run in manual mode.
Fault	This pilot light will be lit after one of the following conditions occurs; overcurrent, motor overload or fail to start.

Existing Press
Sequence of Operation

1. After the Press has been properly installed/adjusted, motor rotation checked and all control panel devices (timer(s), overload(s), current sensing relay, etc.) have been set, automatic operation may proceed. Pull out the Emergency Stop push button, place the Hand/Off/Auto selector switch for the Press and for the solenoid valves in the “Auto” position. Make sure all personnel are clear of the equipment.

2. Open the control panel door and place the circuit breakers in the “On” positon. Close the control panel door and place the control panel disconnect in the “On” positon. Then place the control power selector switch to the "On" position. The white control power indicator light should be on at this time.

3. The Press will be called to run when the screw conveyor has been started. The Press will run in the forward direction throughout its operation and the wash spray solenoid valve will be energized. When the Press stops then the wash flush solenoid valve will be energized for an operator adjustable amount of time.

4. The Press is protected from overcurrent by the current sensing relay (CSR5) in line 138. Should the Press encounter an obstacle the drive motor current increases. Once this increase equals the preset of CSR5, the CSR5 contact in line 137 will close energizing the press overcurrent relay CR27 and the Press Fault indicator. The drive motor will stop, the solenoid valves will be de-energized and the alarm horn will be energized. To silence the alarm horn, press the Alarm Silence push button. Turn the Press Hand/Off/Auto selector switch to the "Off" position. Then push the Press Common Reset push button to reset. Once lockout procedures are met, the jam may be cleared and the controls again set for automatic operation.

5. If the motor circuit should encounter a phase loss, short circuit or high amp draw condition the solid-state motor overload will trip. The drive motor will stop and the motor overload contact in line 158 will close giving an input to the PLC and energizing the Press Fault Indicator. The cause of the motor overload condition must be corrected before normal operation can continue. To reset the condition, press the Press Common Reset push button.

6. Dry contacts are available for remote indication of the following: in Auto, Fault and Running.

7. An Ethernet switch has been provided in the control panel to allow connection between the PLC and the OIT. This switch could also be used enable communication between the control panel and plant SCADA system if IP addresses were entered into the PLC program.

Existing Press Device Functions

Selector Switches

Control Power — This switch allows the operator to turn the 120VAC control circuit supply “Off” and “On”.

Push Buttons

Press Common Reset — This push button resets the Press current sensing relay after an overtorque condition and a motor overload condition. The Hand/Off/Auto selector switch should be placed in the “Off” position before pressing the Press Common Reset push button.

Pilot Lights

Control Power — This pilot light will be lit when control power is available at the control panel.

Running — This pilot light will be lit when the Press is running the automatic sequence programmed within the PLC or when run in manual mode.

Fault — This pilot light will be lit after one of the following conditions occurs; overcurrent, motor overload or fail to start.

Protective Devices

Current Sensing Relay — This relay monitors the current draw of the drive motor. When the current exceeds the preset of this relay the Press will stop. The cause of the increased current draw must be corrected before automatic operation may continue. Push the Press Common Reset push button to reset.

Automatic Control Devices

Screw Conveyor Running — The Press will begin operation when a Screw Running signal has been received by the PLC.

Local Control Station Device Functions

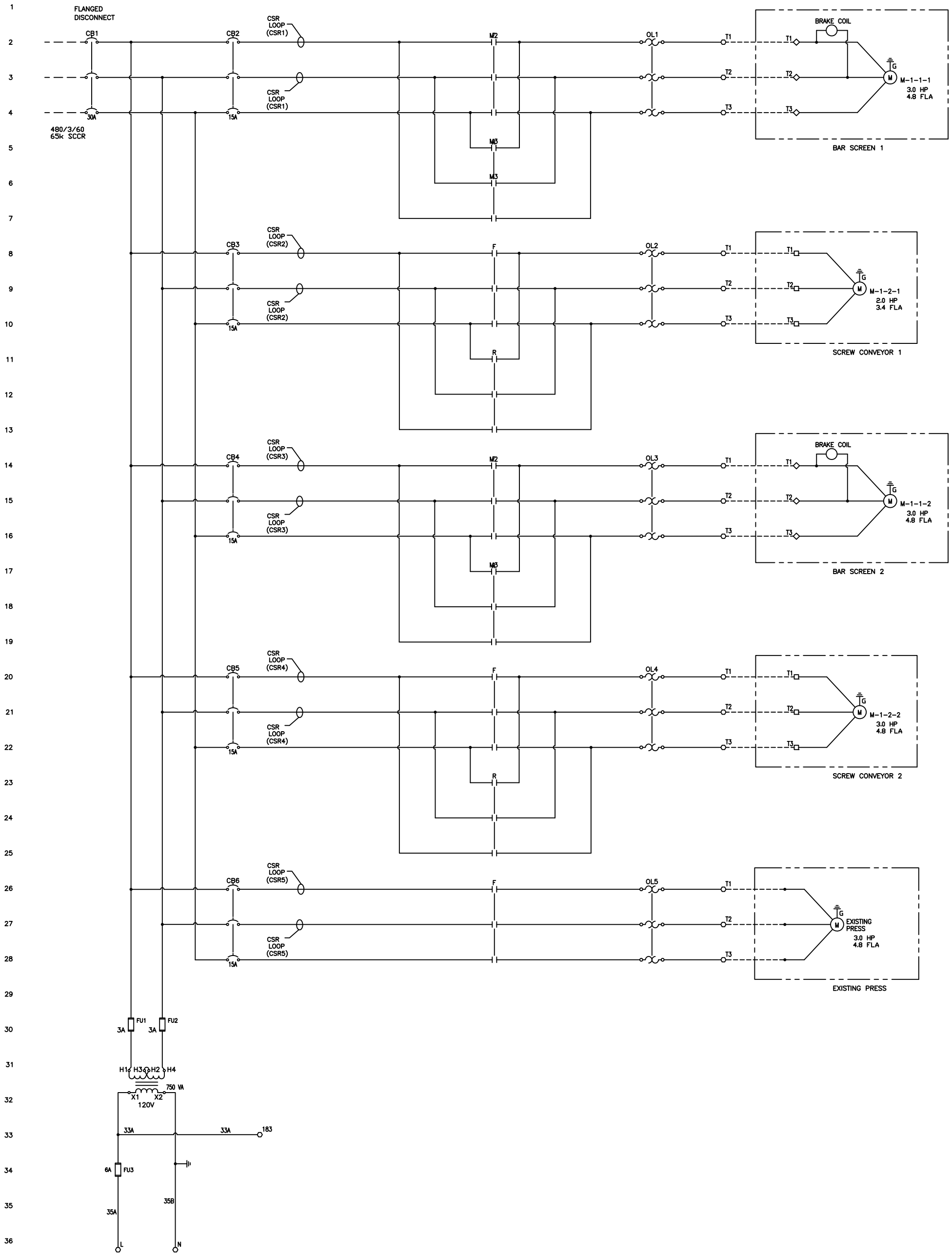
Emergency Stop — This maintained push button will stop the operation of the Press when pushed.

Press Hand/Off/Auto — When this switch is in the “Hand” position, the Press will run continuously in the forward direction. When in the “Auto” position, the automatic circuit within the PLC in the control panel has control.

Wash Spray Hand/Off/Auto — When this switch is in the “Hand” position, the wash spray solenoid valve will be energized continuously. When in the “Auto” position, the automatic circuit within the PLC in the control panel has control of the wash spray solenoid valve.

Wash Flush Hand/Off/Auto — When this switch is in the “Hand” position, the wash flush solenoid valve will be energized continuously. When in the “Auto” position, the automatic circuit within the PLC in the control panel has control of the wash flush solenoid valve.

Running	This pilot light will be lit when the Press is running the automatic sequence programmed within the PLC or when run in manual mode.
Fault	This pilot light will be lit after one of the following conditions occurs; overcurrent, motor overload or fail to start.



CAUTION!

THIS CONTROL PANEL IS DESIGNED TO BE MOUNTED IN A NON–EXPLOSIVE ENVIRONMENT. INSTALL PROPER CONDUIT RUNS AND SEALING FITTINGS BETWEEN EXPLOSIVE AND NON–EXPLOSIVE ENVIRONMENTS PER NATIONAL ELECTRIC CODES.

——— CONTROL WIRING

– – – – – – – – – FIELD WIRING

- ○ MASTER CONTROL PANEL TERMINAL
- □ SCREW CONVEYOR LOCAL/J–BOX TERMINAL
- ◇ BAR SCREEN LCS/J–BOX TERMINAL
- ⬡ STARTING PANEL TERMINAL

VULCAN INDUSTRIES, INC. IS NOT RESPONSIBLE FOR INTERCONNECTING CONDUIT OR WIRING BETWEEN THE EQUIPMENT AND THE CONTROL PANEL OR BETWEEN THE CONTROL PANEL AND PLANT TERMINATION POINTS.

1. CONTROL PANELS NEMA 4X 304SS.
2. LOCAL CONTROL STATIONS NEMA 7.
3. SCREEN LIMIT SWITCHES NEMA 7/6P.

DENOTES LOCATED IN STARTING PANEL

DENOTES DOOR MOUNTED

DENOTES FIELD MOUNTED

REV		
2		
1	7/17/2023	SES

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SCALE: NONE		DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 1 OF 8	REVIEWED BY: SES
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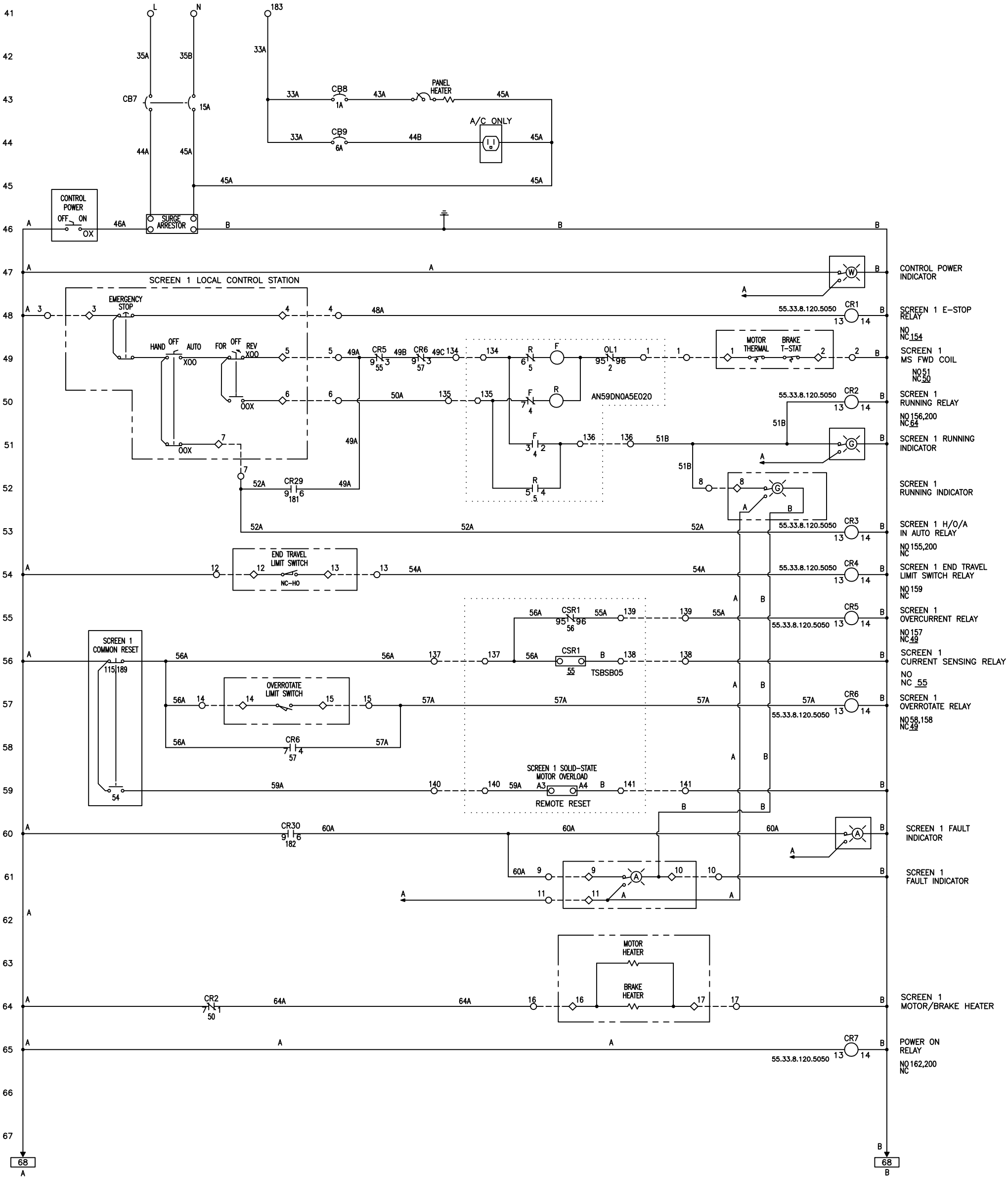
PROJECT: TUSCALOOSA, AL		DRAWING NUMBER: ED-7734-A



DENOTES LOCATED IN STARTING PANEL

DENOTES DOOR MOUNTED

DENOTES FIELD MOUNTED

CAUTION!

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———— CONTROL WIRING

– – – – – – – – – FIELD WIRING

○ MASTER CONTROL PANEL TERMINAL
□ SCREW CONVEYOR LOCAL/J–BOX TERMINAL
◇ BAR SCREEN LCS/J–BOX TERMINAL
⬡ STARTING PANEL TERMINAL

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1. CONTROL PANELS NEMA 4X 304SS.
2. LOCAL CONTROL STATIONS NEMA 7.
3. SCREEN LIMIT SWITCHES NEMA 7/6P.

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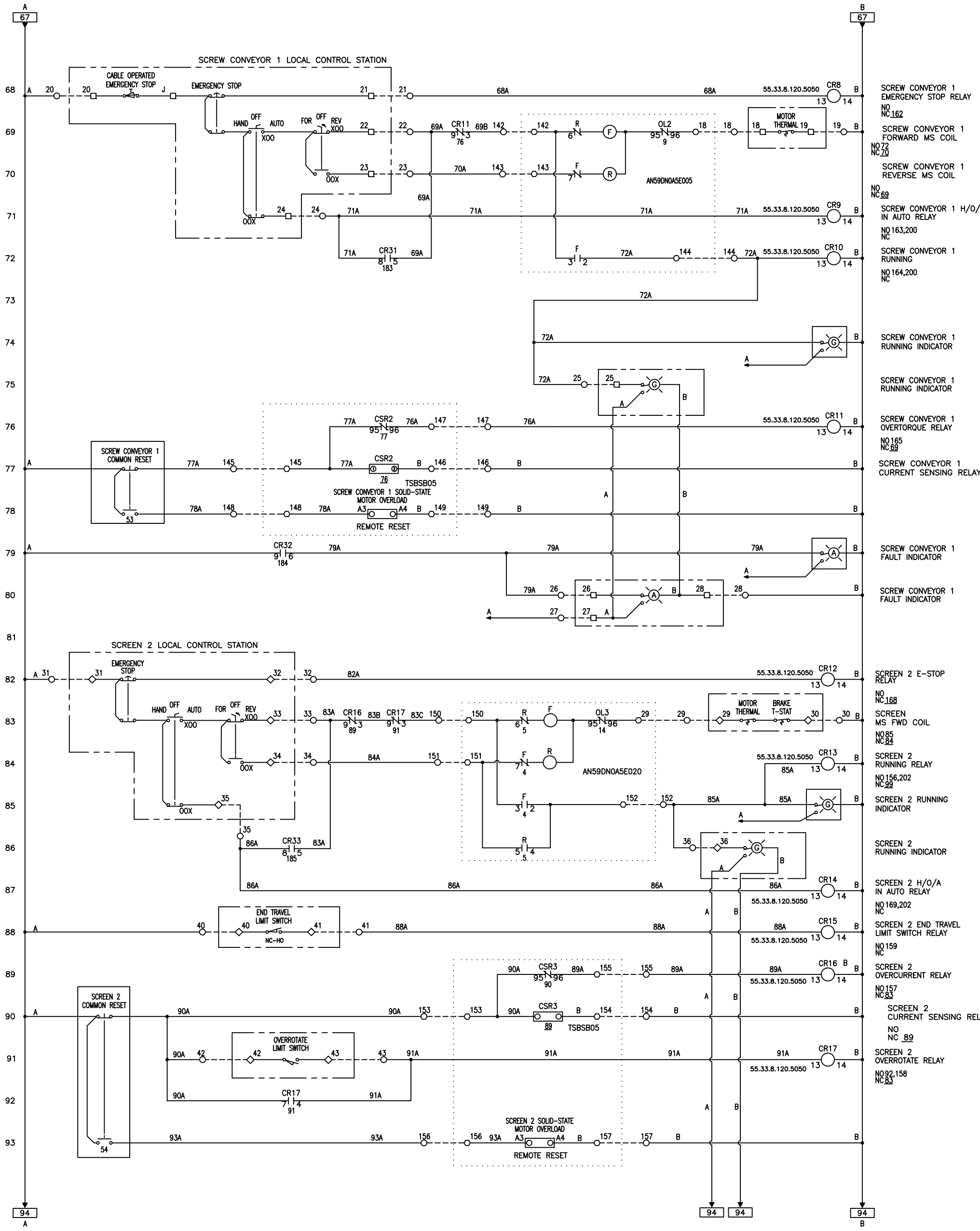
SCALE: NONE			DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 2 OF 8		REVIEWED BY: SES
TITLE: ELECTRICAL SCHEMATIC			PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL			DRAWING NUMBER: ED-7734-B



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——— CONTROL WIRING

– – – – – – – – – FIELD WIRING

- ○ MASTER CONTROL PANEL TERMINAL
- □ SCREW CONVEYOR LOCAL/J-BOX TERMINAL
- ◇ BAR SCREEN LCS/J-BOX TERMINAL
- ⬡ STARTING PANEL TERMINAL

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1. CONTROL PANELS NEMA 4X 304SS.
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3. SCREEN LIMIT SWITCHES NEMA 7/6P.

REV		
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DATE: 5/22/2023	SHEET NUMBER: 3 OF 8		REVIEWED BY: SES
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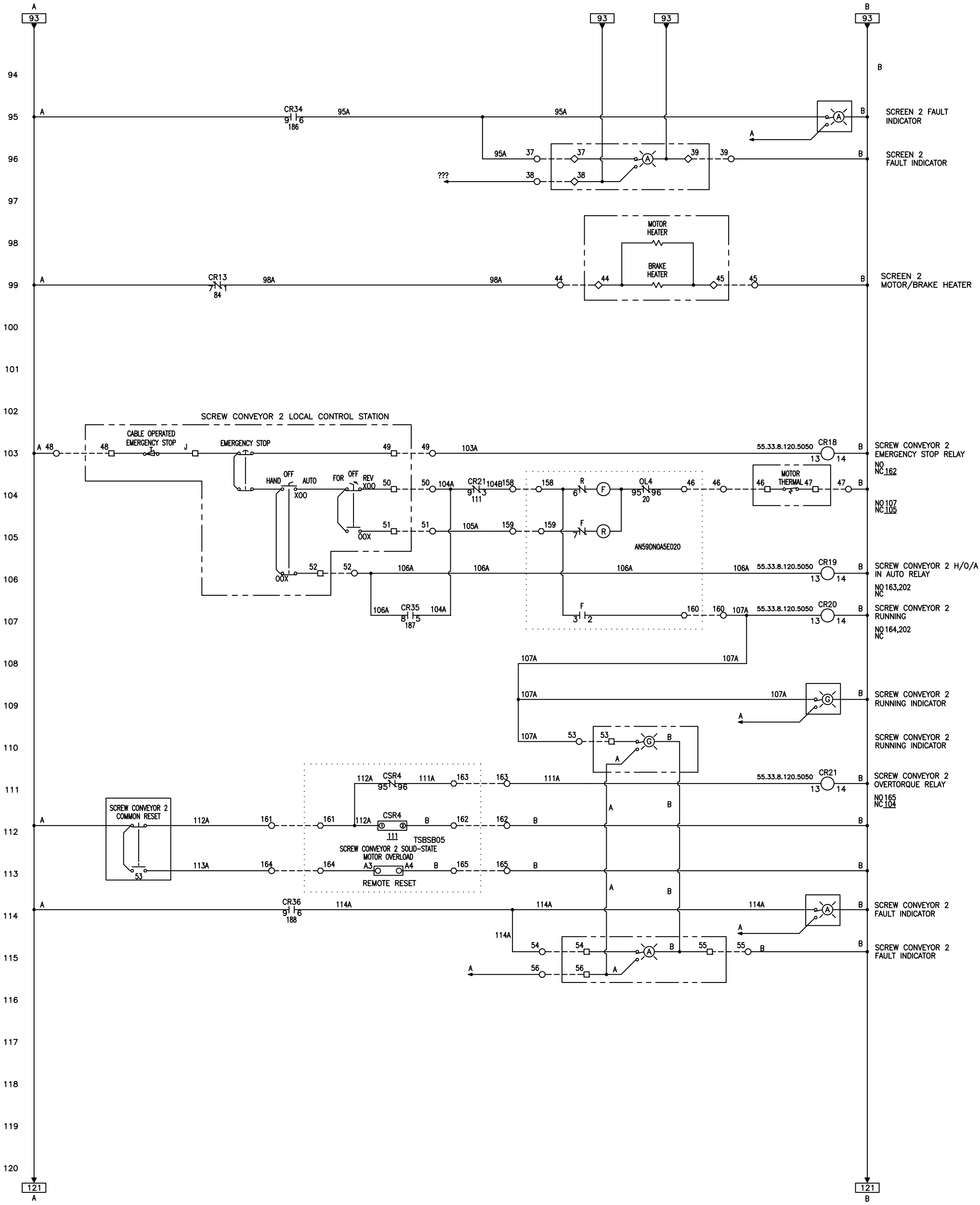
PROJECT: TUSCALOOSA, AL			DRAWING NUMBER: ED-7734-C



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———— CONTROL WIRING

– – – – – – – – – FIELD WIRING

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1. CONTROL PANELS NEMA 4X 304SS.
2. LOCAL CONTROL STATIONS NEMA 7.
3. SCREEN LIMIT SWITCHES NEMA 7/6P.

DENOTES LOCATED IN STARTING PANEL

DENOTES DOOR MOUNTED

DENOTES FIELD MOUNTED

REV		
2		
1	7/17/2023	SES

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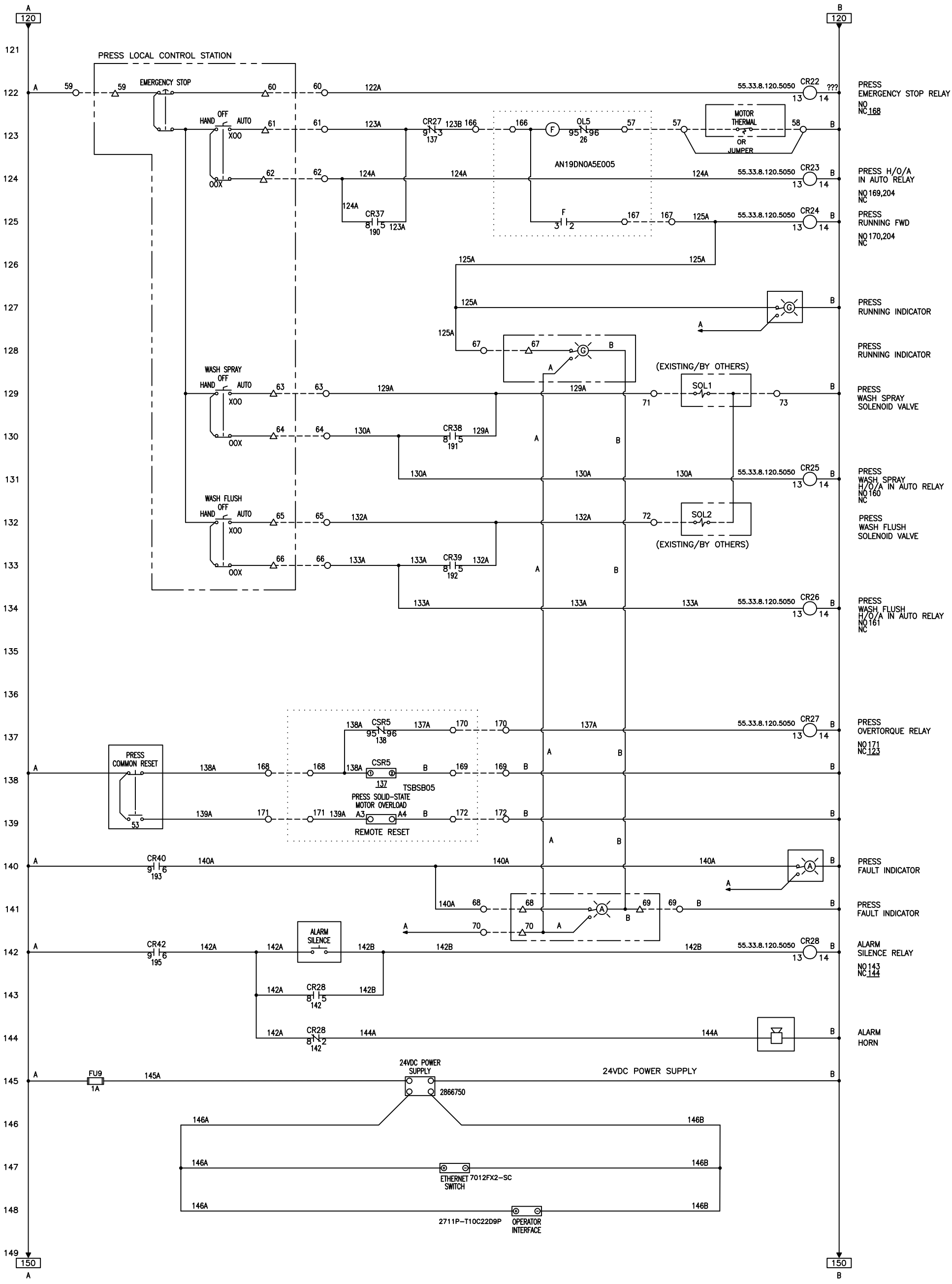
PROJECT: TUSCALOOSA, AL			DRAWING NUMBER: ED-7734-D



DENOTES LOCATED IN STARTING PANEL

DENOTES DOOR MOUNTED

DENOTES FIELD MOUNTED

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CONTROL WIRING

FIELD WIRING

- MASTER CONTROL PANEL TERMINAL
- SCREW CONVEYOR LOCAL/J-BOX TERMINAL
- BAR SCREEN LCS/J-BOX TERMINAL
- STARTING PANEL TERMINAL

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2. LOCAL CONTROL STATIONS NEMA 7.
3. SCREEN LIMIT SWITCHES NEMA 7/6P.

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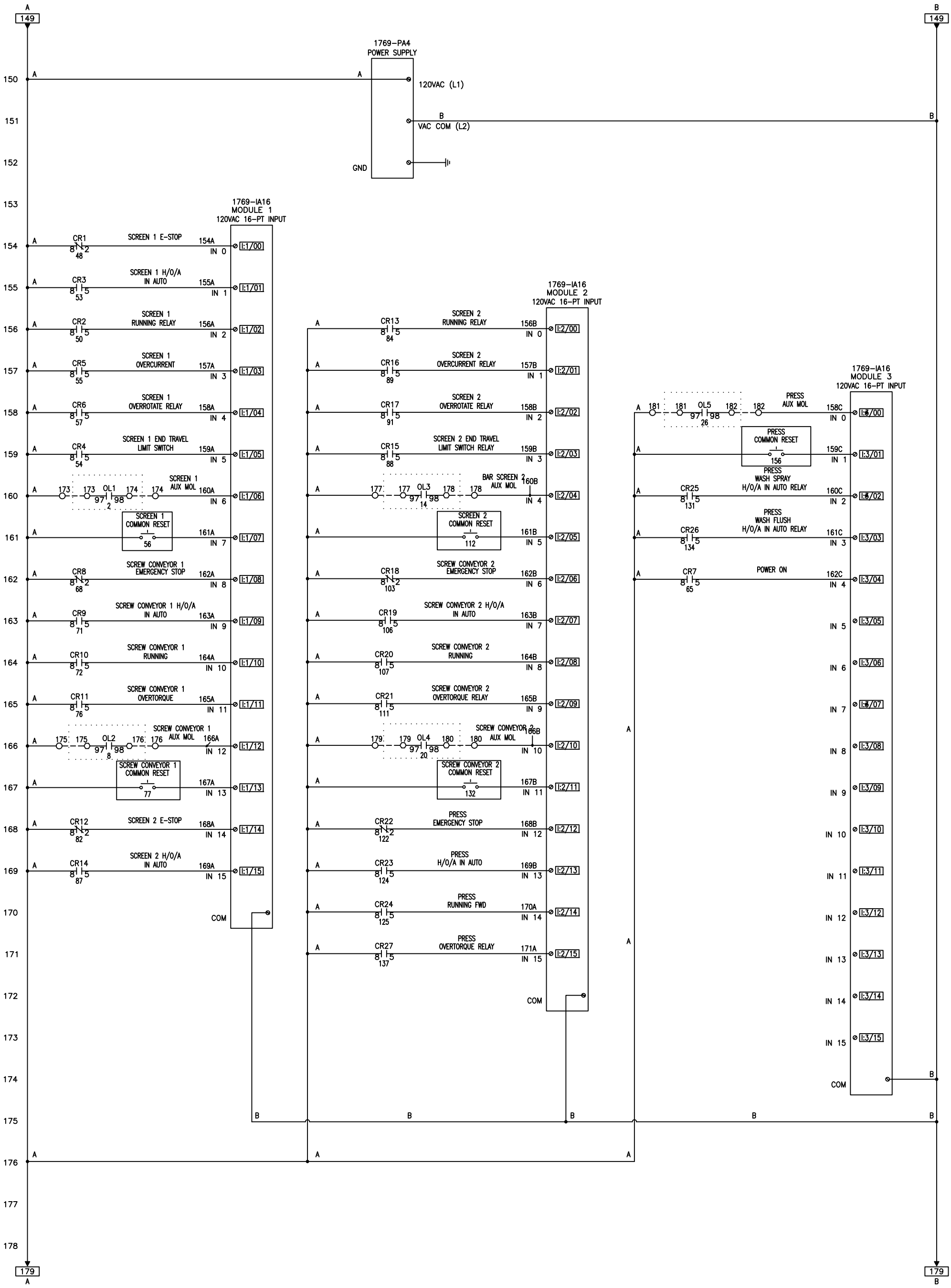
TITLE: ELECTRICAL SCHEMATIC			PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL			DRAWING NUMBER: ED-7734-E



DENOTES LOCATED IN STARTING PANEL

DENOTES DOOR MOUNTED

DENOTES FIELD MOUNTED

CAUTION!

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——— CONTROL WIRING

– – – – – – – – – FIELD WIRING

○ MASTER CONTROL PANEL TERMINAL
□ SCREW CONVEYOR LOCAL/J–BOX TERMINAL
◇ BAR SCREEN LCS/J–BOX TERMINAL
⬡ STARTING PANEL TERMINAL

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2. LOCAL CONTROL STATIONS NEMA 7.
3. SCREEN LIMIT SWITCHES NEMA 7/6P.

REV		
2		
1	7/17/2023	SES

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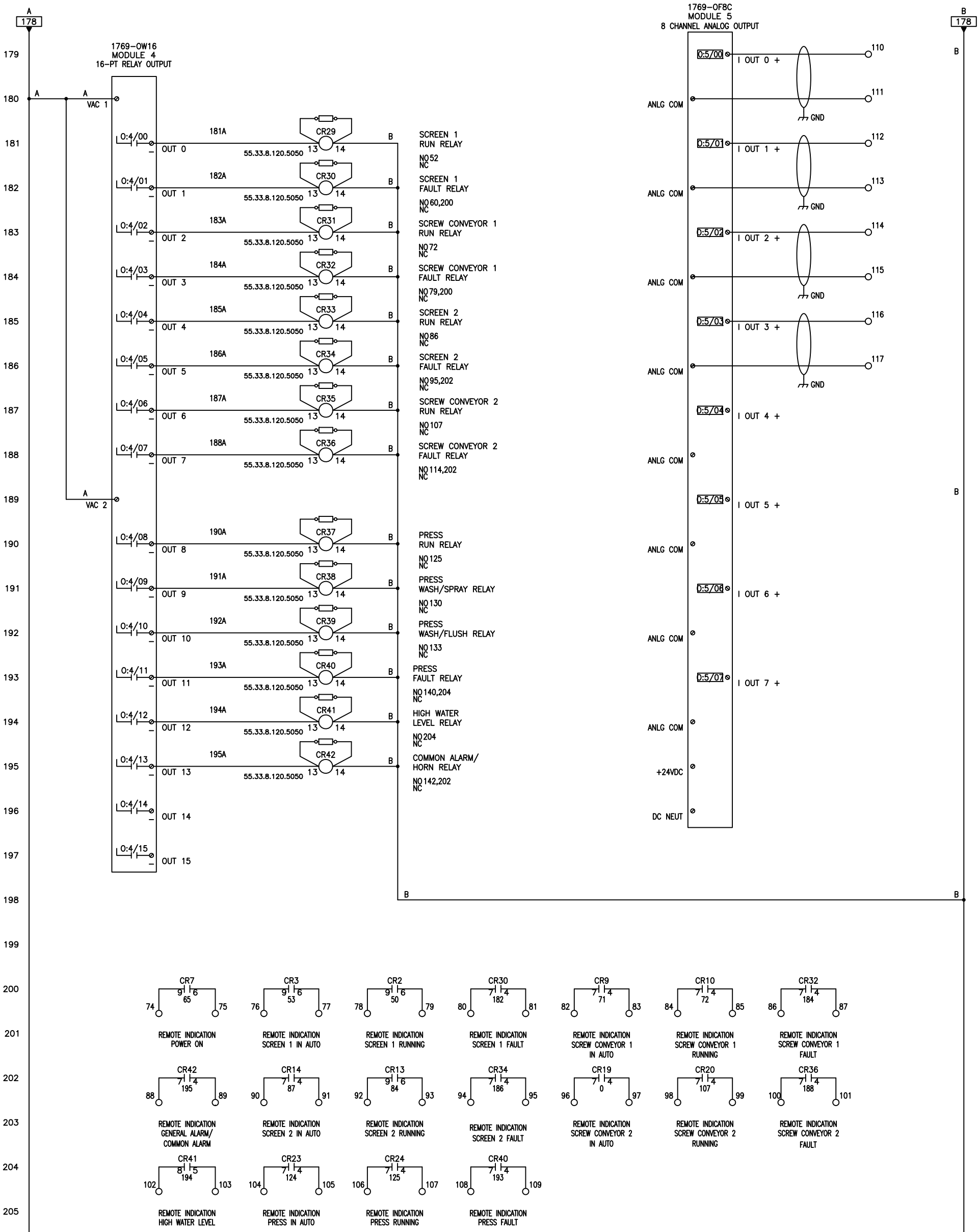
SCALE: NONE		DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 6 OF 8	REVIEWED BY: SES
TITLE: ELECTRICAL SCHEMATIC		PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL		DRAWING NUMBER: ED-7734-F



CAUTION!

THIS CONTROL PANEL IS DESIGNED TO BE MOUNTED IN A NON-EXPLOSIVE ENVIRONMENT. INSTALL PROPER CONDUIT RUNS AND SEALING FITTINGS BETWEEN EXPLOSIVE AND NON-EXPLOSIVE ENVIRONMENTS PER NATIONAL ELECTRIC CODES.

——— CONTROL WIRING

– – – – – – – – – FIELD WIRING

○ MASTER CONTROL PANEL TERMINAL
□ SCREW CONVEYOR LOCAL/J-BOX TERMINAL
◇ BAR SCREEN LCS/J-BOX TERMINAL
⬡ STARTING PANEL TERMINAL

VULCAN INDUSTRIES, INC. IS NOT RESPONSIBLE FOR INTERCONNECTING CONDUIT OR WIRING BETWEEN THE EQUIPMENT AND THE CONTROL PANEL OR BETWEEN THE CONTROL PANEL AND PLANT TERMINATION POINTS.

1. CONTROL PANELS NEMA 4X 304SS.
2. LOCAL CONTROL STATIONS NEMA 7.
3. SCREEN LIMIT SWITCHES NEMA 7/6P.

DENOTES LOCATED IN STARTING PANEL

DENOTES DOOR MOUNTED

DENOTES FIELD MOUNTED

REV		
2		
1	7/17/2023	SES

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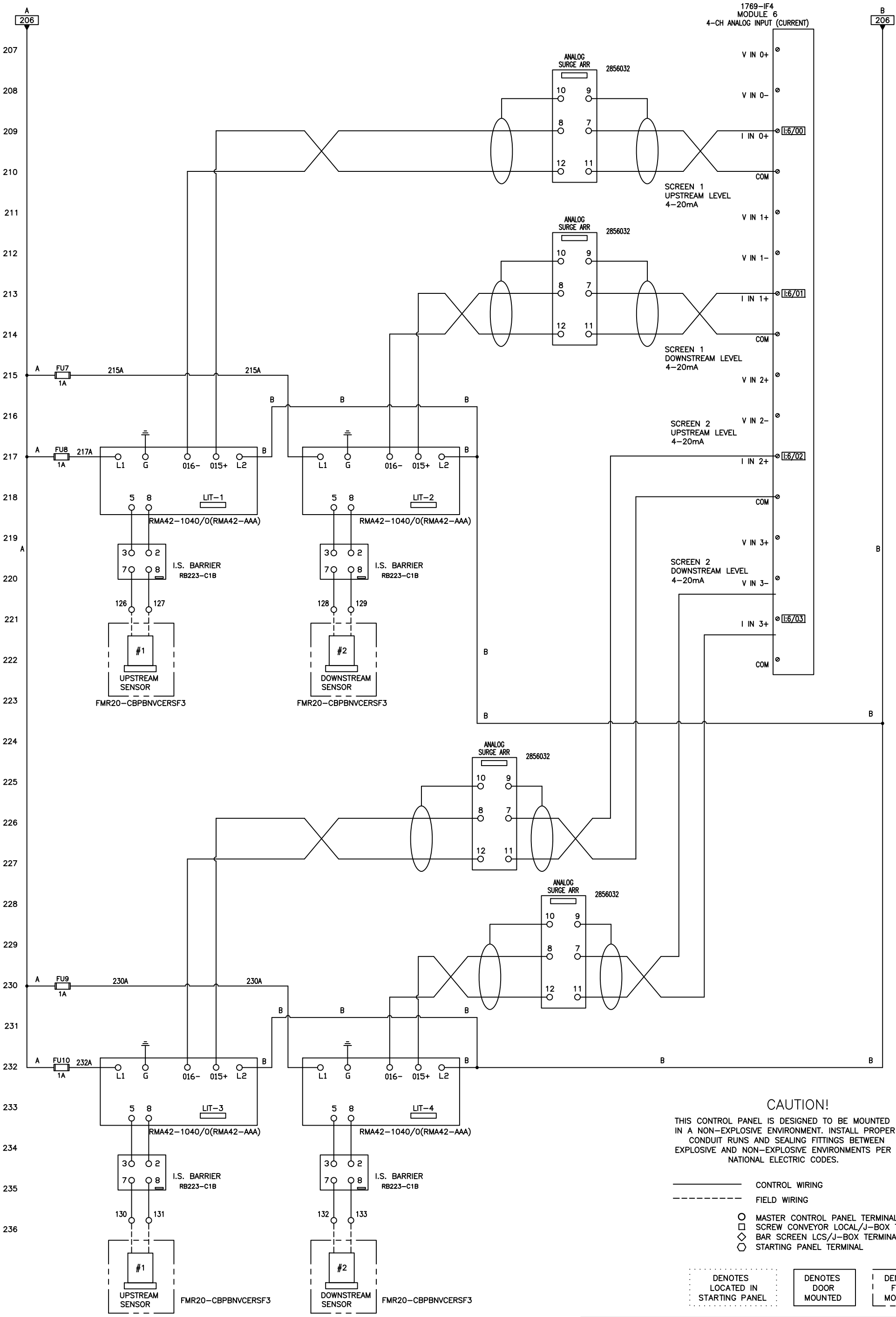
SCALE: NONE		DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 7 OF 8	REVIEWED BY: SES
TITLE: ELECTRICAL SCHEMATIC		PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL		DRAWING NUMBER: ED-7734-G



CAUTION!

THIS CONTROL PANEL IS DESIGNED TO BE MOUNTED IN A NON-EXPLOSIVE ENVIRONMENT. INSTALL PROPER CONDUIT RUNS AND SEALING FITTINGS BETWEEN EXPLOSIVE AND NON-EXPLOSIVE ENVIRONMENTS PER NATIONAL ELECTRIC CODES.

CONTROL WIRING

FIELD WIRING

- MASTER CONTROL PANEL TERMINAL
- SCREW CONVEYOR LOCAL/J-BOX TERMINAL
- BAR SCREEN LCS/J-BOX TERMINAL
- STARTING PANEL TERMINAL

DENOTES LOCATED IN STARTING PANEL

DENOTES DOOR MOUNTED

DENOTES FIELD MOUNTED

VULCAN INDUSTRIES, INC. IS NOT RESPONSIBLE FOR INTERCONNECTING CONDUIT OR WIRING BETWEEN THE EQUIPMENT AND THE CONTROL PANEL OR BETWEEN THE CONTROL PANEL AND PLANT TERMINATION POINTS.

1. CONTROL PANELS NEMA 4X 304SS.
2. LOCAL CONTROL STATIONS NEMA 7.
3. SCREEN LIMIT SWITCHES NEMA 7/6P.

REV		
2		
1	7/17/2023	SES

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SCALE: NONE		DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 8 OF 8	REVIEWED BY: SES
TITLE: ELECTRICAL SCHEMATIC		PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL		DRAWING NUMBER: ED-7734-H

MASTER CONTROL PANEL
TERMINAL BLOCKS

1		
2		
3		
4		
5		
6		
7		
8	FIELD	
9	WIRING	
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23	FIELD	
24	WIRING	
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37	FIELD	
38	WIRING	
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		
51	FIELD	
52	WIRING	
53		
54		
55		
56		
57		
58		
59		
60		
61		
62		
63		
64	FIELD	
65	WIRING	
66		
67		
68		
69		
70		
71	FIELD	TO PRESS WASH SPRAY SOLENOID VALVE
72	WIRING	TO PRESS WASH FLUSH SOLENOID VALVE
73		NEUTRAL FOR PRESS SOLENOID VALVES
74		REMOTE INDICATION POWER ON
75		
76		REMOTE INDICATION SCREEN 1 IN AUTO
77		
78		REMOTE INDICATION SCREEN 1 RUNNING
79		
80		REMOTE INDICATION SCREEN 1 FAULT
81		
82		REMOTE INDICATION SCREW CONVEYOR 1 IN AUTO
83		
84		REMOTE INDICATION SCREW CONVEYOR 1 RUNNING
85		
86		REMOTE INDICATION SCREW CONVEYOR 1 FAULT
87		
88		REMOTE INDICATION GENERAL ALARM/COMMON ALARM
89		
90		REMOTE INDICATION SCREEN 2 IN AUTO
91		
92		REMOTE INDICATION SCREEN 2 RUNNING
93		
94		REMOTE INDICATION SCREEN 2 FAULT
95		
96		REMOTE INDICATION SCREW CONVEYOR 2 IN AUTO
97		
98		REMOTE INDICATION SCREW CONVEYOR 2 RUNNING
99		
100		REMOTE INDICATION SCREW CONVEYOR 2 FAULT
101		
102		REMOTE INDICATION HIGH WATER LEVEL
103		
104		REMOTE INDICATION PRESS IN AUTO
105		
106		REMOTE INDICATION PRESS RUNNING
107		
108		REMOTE INDICATION PRESS FAULT
109		
110		SCREEN 1 UPSTREAM LEVEL 4–20mA
111		
112		SCREEN 1 DOWNSTREAM LEVEL 4–20mA
113		
114		SCREEN 2 UPSTREAM LEVEL 4–20mA
115		
116		SCREEN 2 DOWNSTREAM LEVEL 4–20mA
117		
118		SPARE
119		
120		
121		
122		
123		
124		
125		

126	SCREEN 1 UPSTREAM LEVEL SENSOR
127	
128	SCREEN 1 DOWNSTREAM LEVEL SENSOR
129	
130	SCREEN 2 UPSTREAM LEVEL SENSOR
131	
132	SCREEN 2 DOWNSTREAM LEVEL SENSOR
133	

M–1–1–1 SCREEN MOUNTED LCS/J–BOX
TERMINAL BLOCKS

1	MOTOR THERMAL/BRAKE T–STAT
2	
3	EMERGENCY STOP PB NC CONTACT
4	
5	FROM F/O/R FORWARD CONTACT
6	FROM F/O/R REVERSE CONTACT
7	FROM H/O/A AUTO CONTACT
8	TO RUNNING INDICATOR
9	TO FAULT INDICATOR
10	NEUTRAL FOR RUNNING & FAULT INDICATOR
11	TO PILOT LIGHT PUSH TO TEST CIRCUIT
12	END TRAVEL LIMIT SWITCH N.C.H.O.
13	
14	OVERROTATE LIMIT SWITCH N.O.
15	
16	MOTOR HEATER/BRAKE HEATER
17	

M–1–2–1 SCREW CONVEYOR MOUNTED LCS/J–BOX
TERMINAL BLOCKS

18	MOTOR THERMAL
19	
20	CABLE OPERATED EMERGENCY STOP SWITCH
J	
	EMERGENCY STOP PB NC CONTACT
21	
22	FROM F/O/R FORWARD CONTACT
23	FROM F/O/R REVERSE CONTACT
24	FROM H/O/A AUTO CONTACT
25	TO RUNNING INDICATOR
26	TO FAULT INDICATOR
27	NEUTRAL FOR RUNNING & FAULT INDICATOR
28	TO PILOT LIGHT PUSH TO TEST CIRCUIT

M–1–1–2 SCREEN MOUNTED LCS/J–BOX
TERMINAL BLOCKS

29	MOTOR THERMAL/BRAKE T–STAT
30	
31	EMERGENCY STOP PB NC CONTACT
32	
33	FROM F/O/R FORWARD CONTACT
34	FROM F/O/R REVERSE CONTACT
35	FROM H/O/A AUTO CONTACT
36	TO RUNNING INDICATOR
37	TO FAULT INDICATOR
38	NEUTRAL FOR RUNNING & FAULT INDICATOR
39	TO PILOT LIGHT PUSH TO TEST CIRCUIT
40	END TRAVEL LIMIT SWITCH N.C.H.O.
41	
42	OVERROTATE LIMIT SWITCH N.O.
43	
44	MOTOR HEATER/BRAKE HEATER
45	

M–1–2–2 SCREW CONVEYOR MOUNTED LCS/J–BOX
TERMINAL BLOCKS

46	MOTOR THERMAL
47	
48	CABLE OPERATED EMERGENCY STOP SWITCH
J	
	EMERGENCY STOP PB NC CONTACT
49	
50	FROM F/O/R FORWARD CONTACT
51	FROM F/O/R REVERSE CONTACT
52	FROM H/O/A AUTO CONTACT
53	TO RUNNING INDICATOR
54	TO FAULT INDICATOR
55	NEUTRAL FOR RUNNING & FAULT INDICATOR
56	TO PILOT LIGHT PUSH TO TEST CIRCUIT

PRESS LCS
TERMINAL BLOCKS

57	MOTOR THERMAL OR JUMPER
58	
59	EMERGENCY STOP PB NC CONTACT
60	
61	FROM H/O/A HAND CONTACT
62	FROM H/O/A AUTO CONTACT
63	FROM WASH SPRAY H/O/A HAND CONTACT
64	FROM WASH SPRAY H/O/A AUTO CONTACT
65	FROM WASH FLUSH H/O/A HAND CONTACT
66	FROM WASH FLUSH H/O/A AUTO CONTACT
67	TO RUNNING INDICATOR
68	TO FAULT INDICATOR
69	NEUTRAL FOR RUNNING & FAULT INDICATOR
70	TO PILOT LIGHT PUSH TO TEST CIRCUIT

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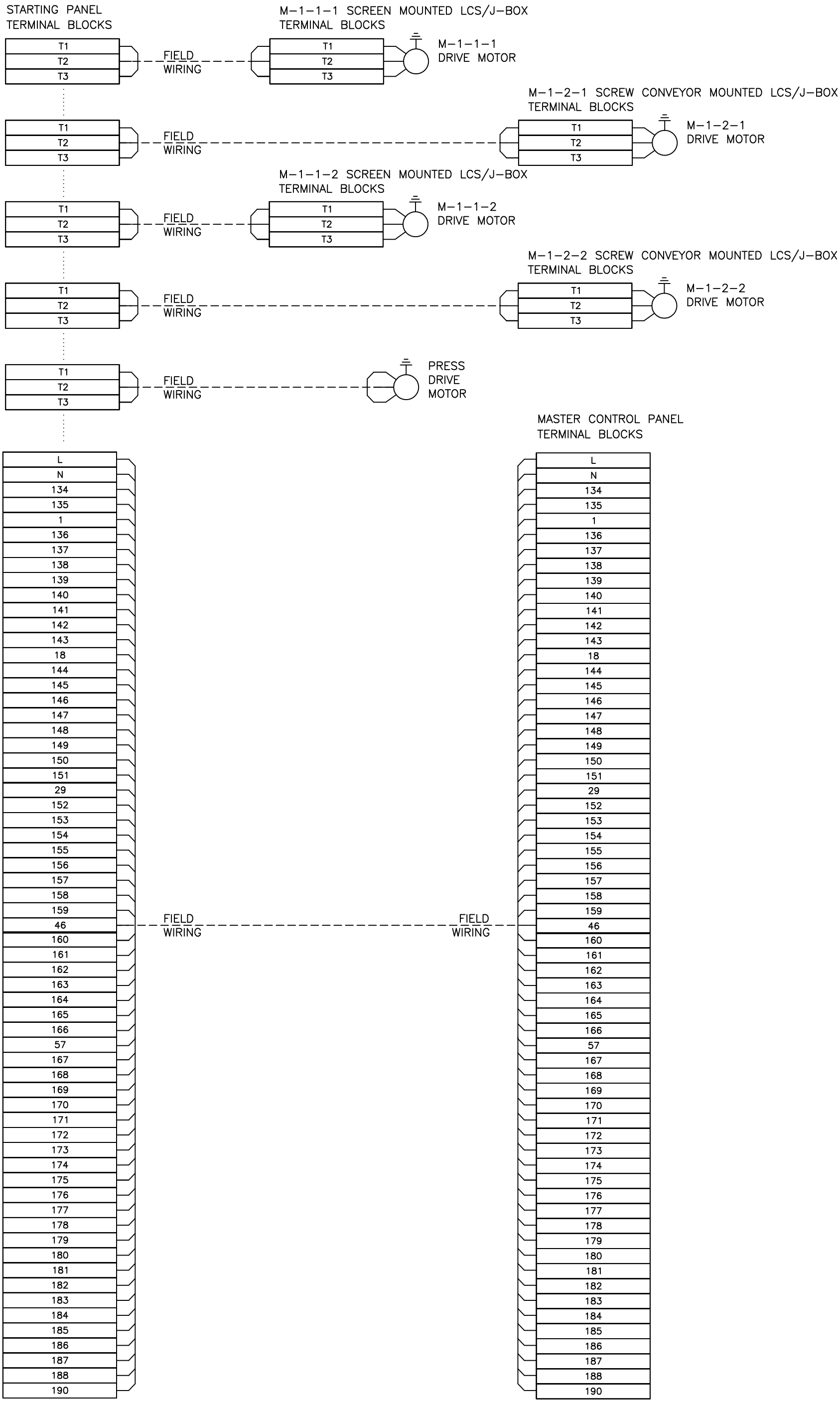
SCALE: NONE			DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 1 OF 1		REVIEWED BY: SES
TITLE: MASTER CONTROL PANEL TERMINAL BLOCKS			PROJECT NUMBER: 23107
REV 2			
REV 1	7/17/2023	SES	PROJECT: TUSCALOOSA, AL
			DRAWING NUMBER: ED-7735-A



REV		
2		
1	7/17/2023	SES

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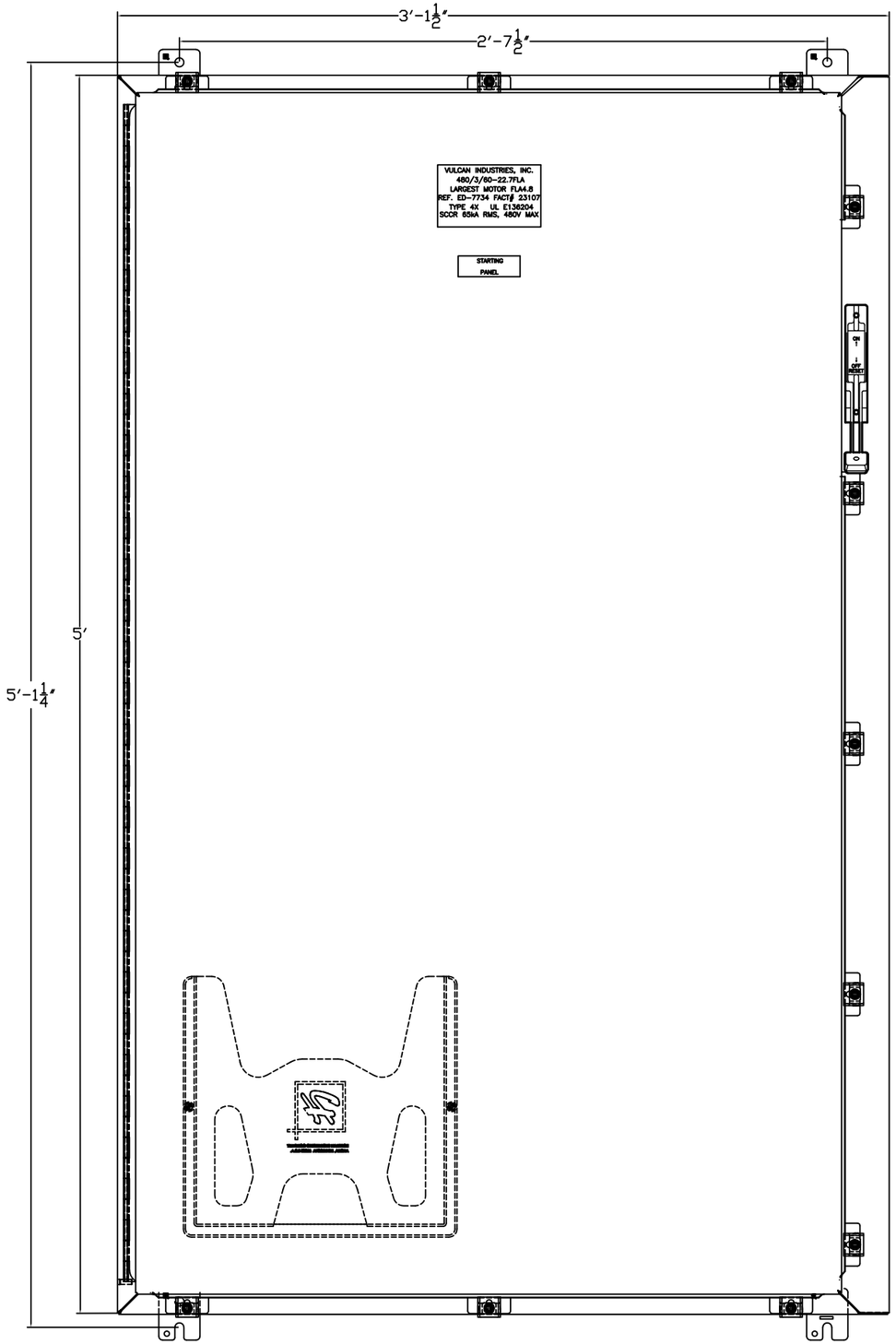
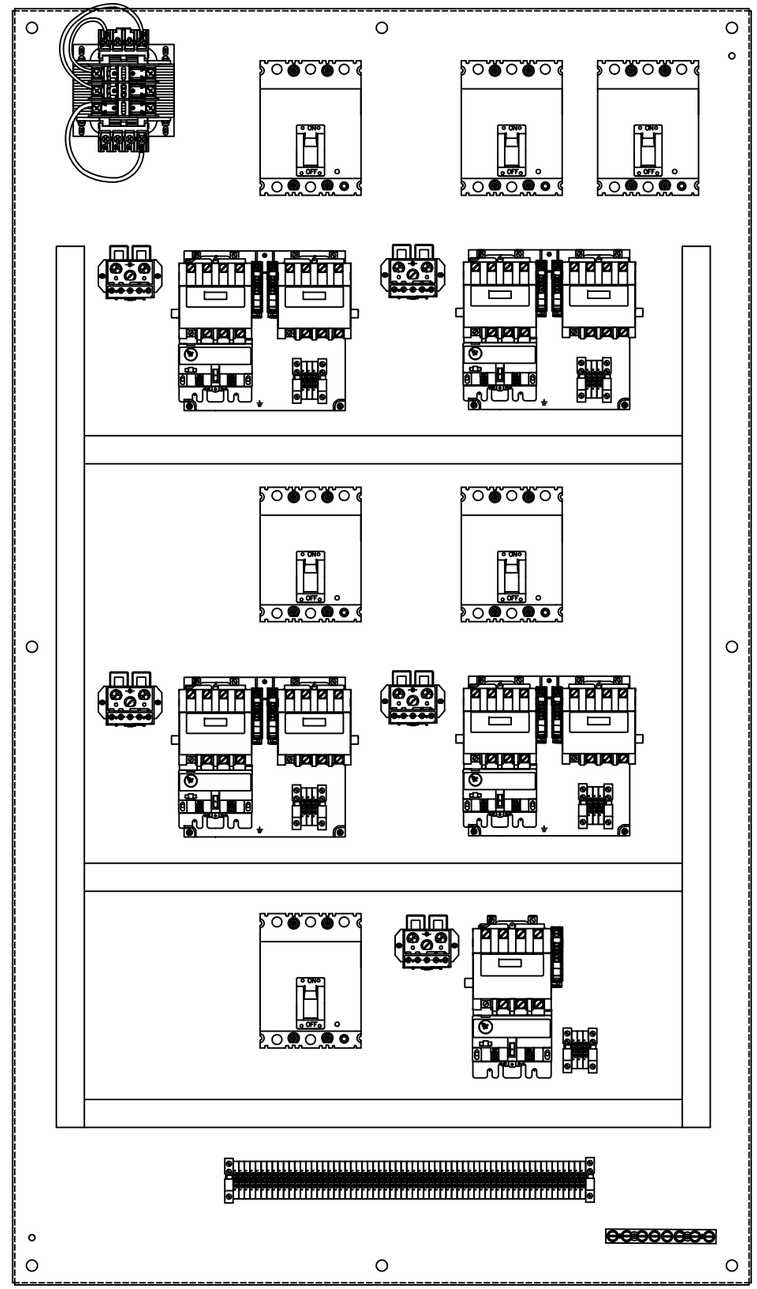
SCALE: NONE		DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 1 OF 1	REVIEWED BY: SES
TITLE: STARTING PANEL TO MASTER PANEL TB		PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL		DRAWING NUMBER: ED-7735-B





ENCLOSURE NEMA 4X 304SS
HOFFMAN # A48H3612SSLP

NO CONDUIT ENTRANCES
PROVIDED IN THE ENCLOSURE

TAGS WHITE W/BLACK LETTERS

LAYOUT FOR REFERENCE ONLY

REV 2		
REV 1	7/17/2023	SES

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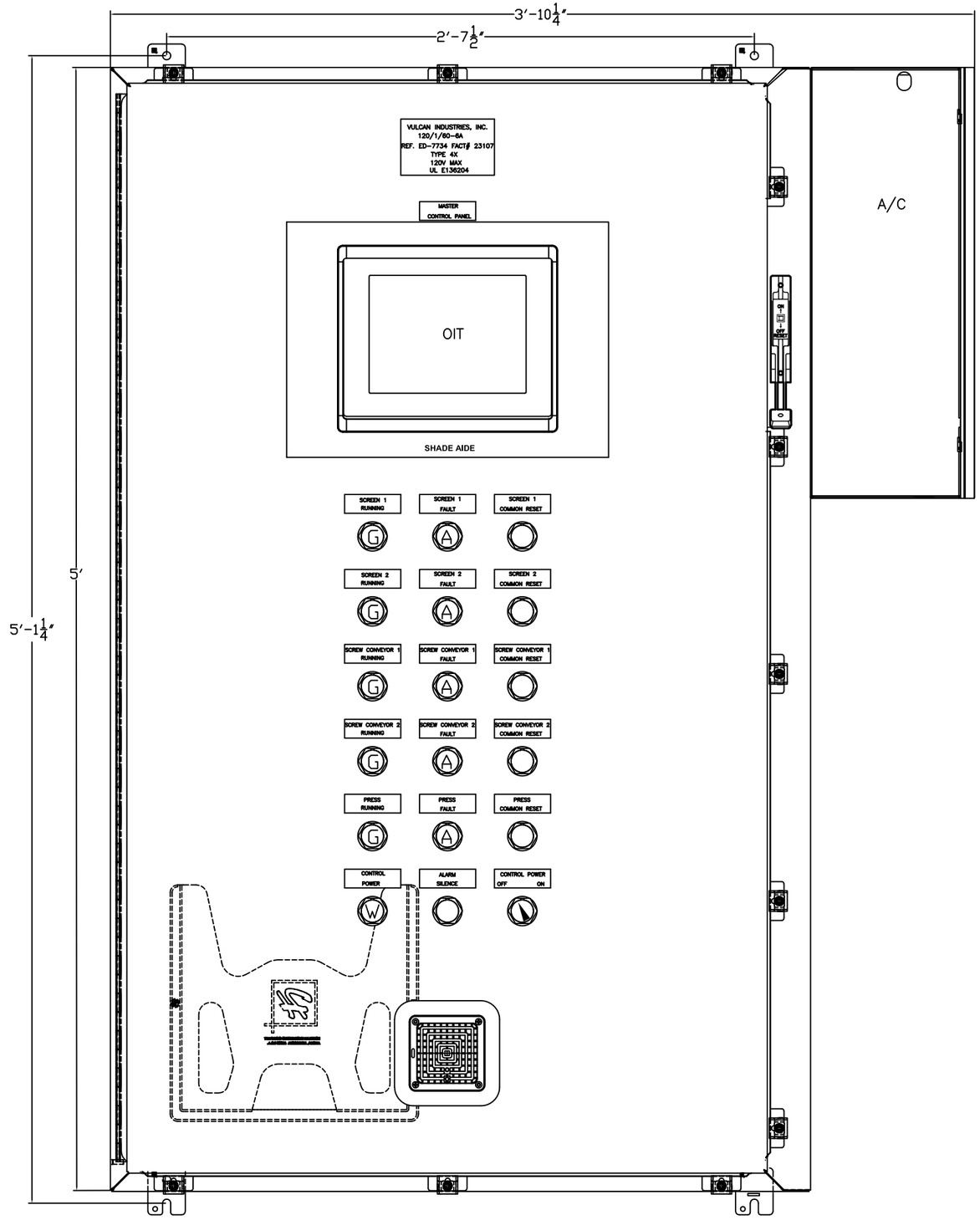
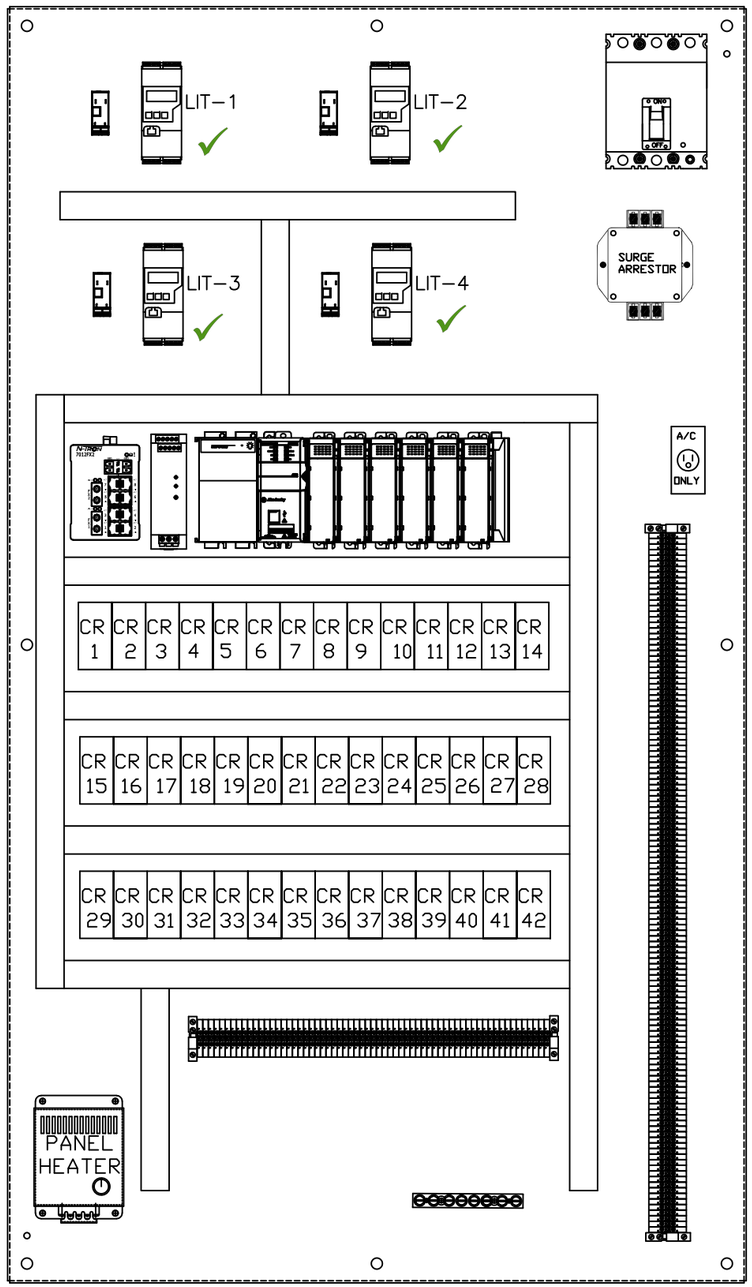
SCALE: NONE			DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 1 OF 1		REVIEWED BY: SES
TITLE: STARTNG PANEL LAYOUT			PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL			DRAWING NUMBER: ED-7736





ENCLOSURE NEMA 4X 304SS
HOFFMAN # A48H3612SSLP

NO CONDUIT ENTRANCES
PROVIDED IN THE ENCLOSURE

TAGS WHITE W/BLACK LETTERS

LAYOUT FOR REFERENCE ONLY

REV		
2		
1	7/17/2023	SES

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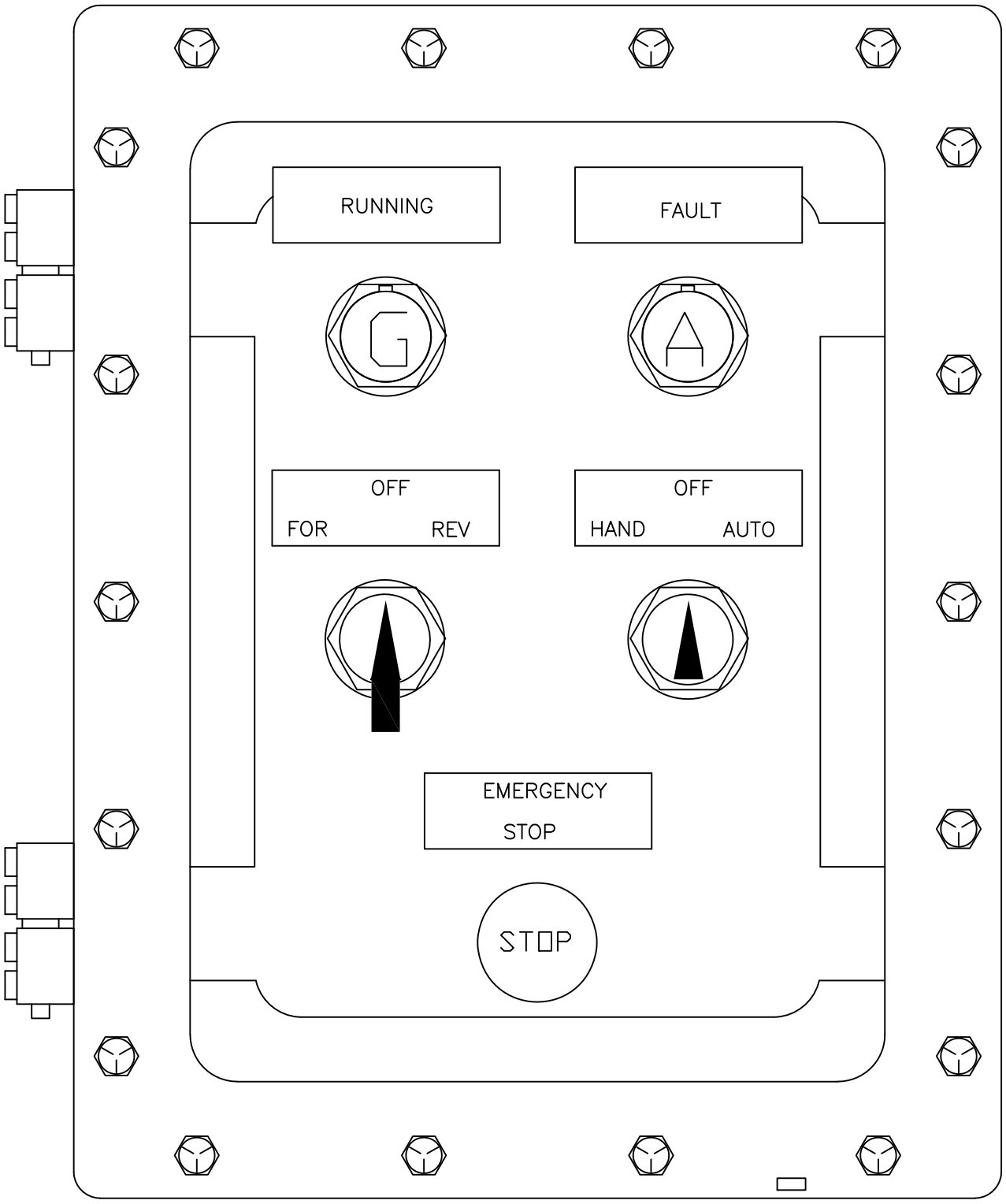
SCALE: NONE		DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 1 OF 1	REVIEWED BY: SES
TITLE: MASTER CONTROL PANEL LAYOUT		PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL		DRAWING NUMBER: ED-7737



TYPICAL OF 2

NEMA 7 ENCLOSURE
NJBEW071106HZG2

NEMA 7 PILOT DEVICES

FACTORY MOUNTED TO
BAR SCREEN SIDEFRAME

REV		
2		
1	7/17/2023	SES

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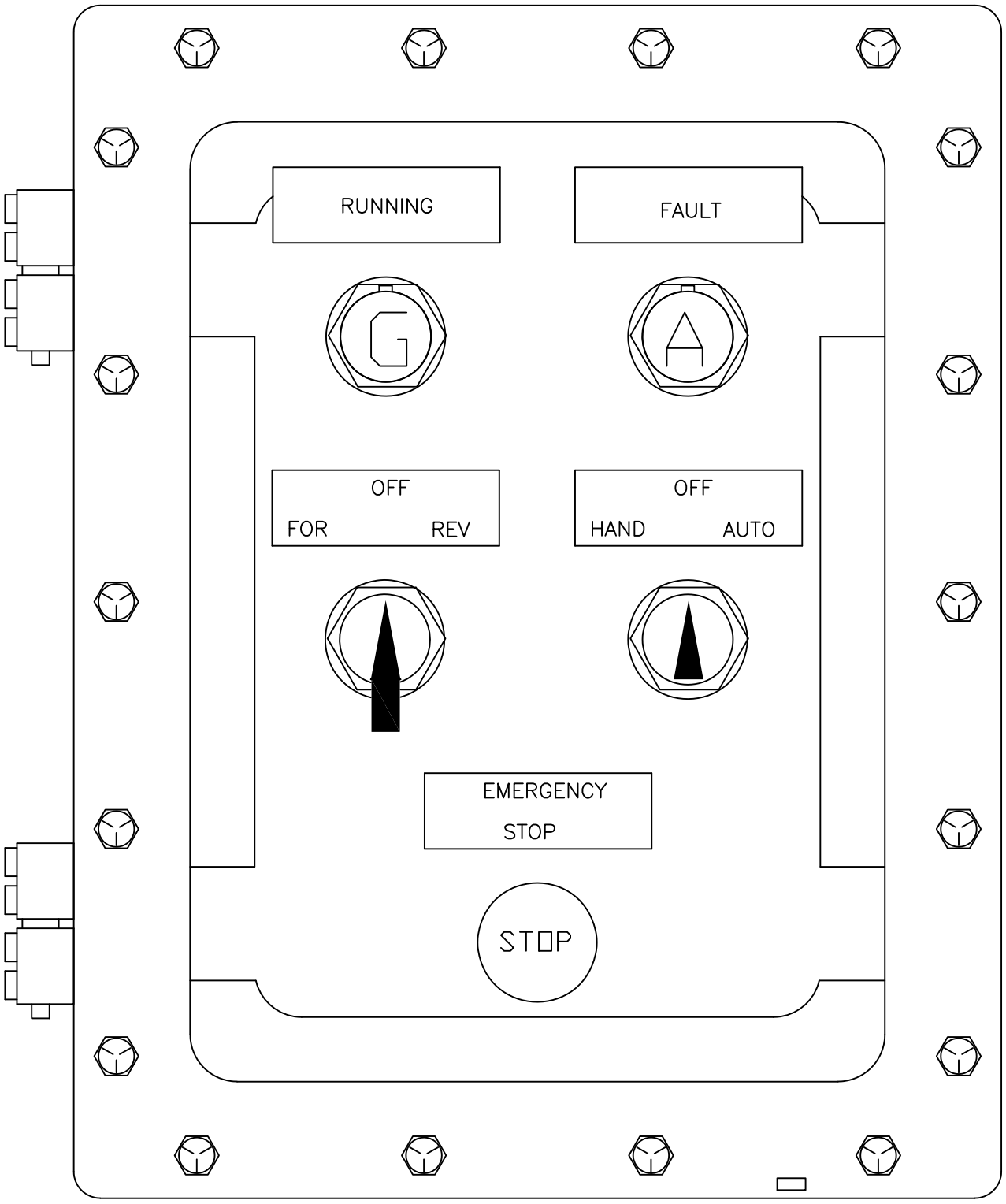
SCALE: NONE			DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 1 OF 1		REVIEWED BY: SES
TITLE: SCREEN LCS/J-BOX			PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL			DRAWING NUMBER: ED-7738



TYPICAL OF 2

NEMA 7 ENCLOSURE
NJBEW071106HZG2

NEMA 7 PILOT DEVICES

FACTORY MOUNTED TO
SCREW CONVEYOR DRIVE END

REV		
2		
1	7/17/2023	SES

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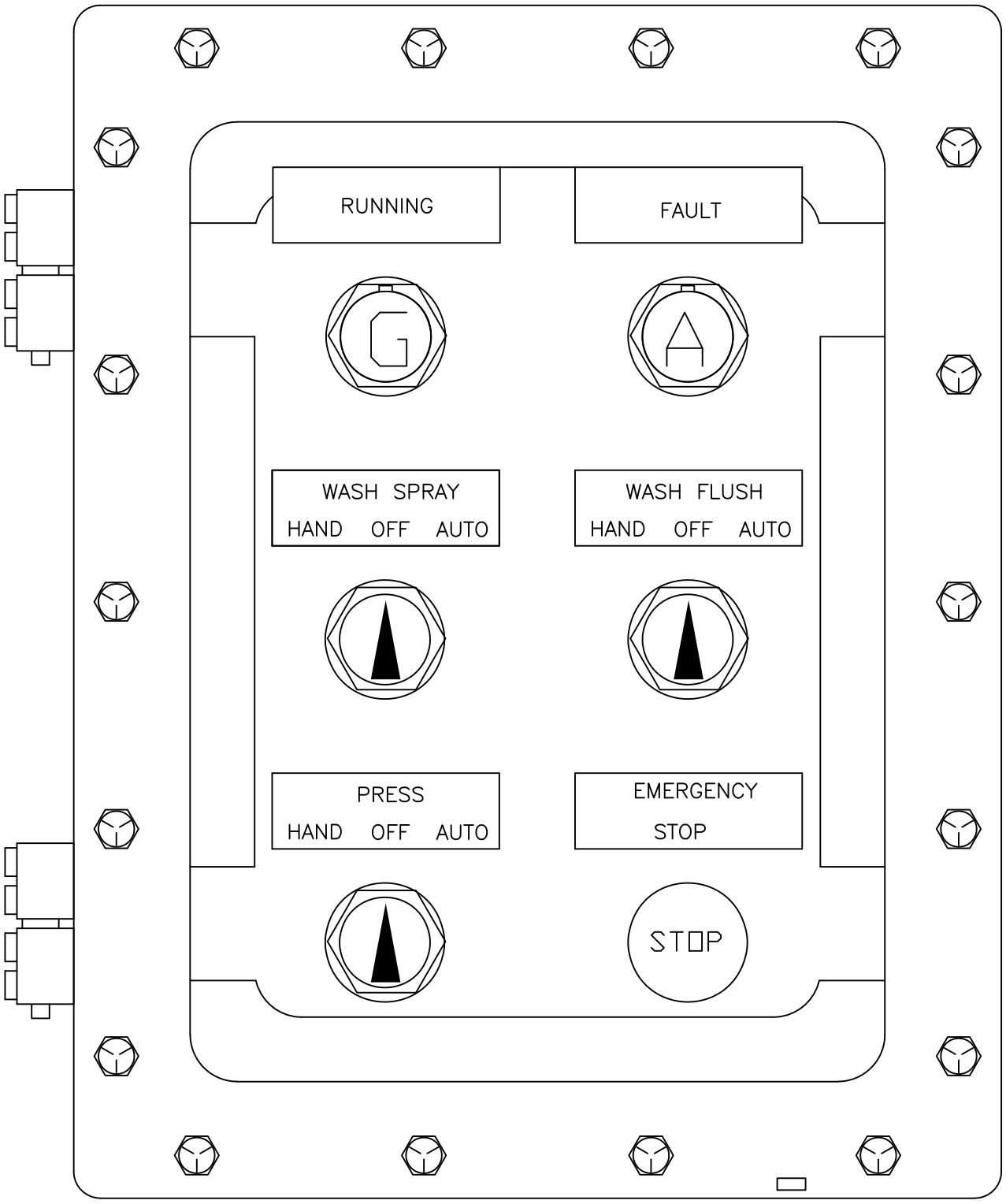
SCALE: NONE			DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 1 OF 1		REVIEWED BY: SES
TITLE: SCREW CONVEYOR LCS/J-BOX			PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL			DRAWING NUMBER: ED-7739



TYPICAL OF 1

NEMA 7 ENCLOSURE
NJBEW071106HZG2

NEMA 7 PILOT DEVICES

SHIPPPED LOOSE
FOR INSTALLATION BY OTHERS

REV		
2		
1	7/17/2023	SES

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SCALE: NONE			DRAWN BY: SES
DATE: 5/22/2023	SHEET NUMBER: 1 OF 1		REVIEWED BY: SES
TITLE: EXISTING PRESS LCS			PROJECT NUMBER: 23107
PROJECT: TUSCALOOSA, AL			DRAWING NUMBER: ED-7740

Electrical Components

CATALOG	DESCRIPTION	MANUFACTURER
800H-HR2A	SWITCH,2 POS,MTD,NEMA 4X	ALLEN BRADLEY
800H-AR2B	PUSH BUTTON,MOMENTARY,NEMA 4X	ALLEN BRADLEY
800H-QRTH2A	PILOT LIGHT,PTT,AMBER,NEMA 4X	ALLEN BRADLEY
800H-QRTH2G	PILOT LIGHT,PTT,GREEN,NEMA 4X	ALLEN BRADLEY
800H-QRTH2W	PILOT LIGHT,PTT,WHITE,NEMA 4X	ALLEN BRADLEY
800H-FPX6A5	EMERGENCY STOP PB,NEMA 7	ALLEN BRADLEY
800H-JP19KB7AXXX	SWITCH,3POS,SPRG RTN,NEMA 7	ALLEN BRADLEY
800H-JP2KB7AXXX	SELECTOR SWITCH,3 POS,MTD,NEMA 7	ALLEN BRADLEY
800H-PPTH16M	PILOT LIGHT - PTT- NEMA 7	ALLEN BRADLEY
1769-L30ER	COMPACTLOGIX PROCESSOR	ALLEN BRADLEY
1769-PA4	COMACTLOGIX POWER SUPPLY	ALLEN BRADLEY
1769-IA16	COMPACTLOGIX INPUT MODULE	ALLEN BRADLEY
1769-OW16	COMPACTLOGIX OUTPUT MODULE	ALLEN BRADLEY
1769-IF4	COMPACTLOGIX OUTPUT MODULE	ALLEN BRADLEY
1769-OF8C	COMPACTLOGIX ANALOG OUTPUT MODULE	ALLEN BRADLEY
2711P-T10C22D9P	OPERATOR INTERFACE 10",PERFORMANCE	ALLEN BRADLEY
RS-1X	CABLE-OPERATED SWITCH	CCC
FAZ-C1/1-NA-SP	CIRCUIT BREAKER,SP,1A	EATON ✓
FAZ-C6/1-NA-SP	CIRCUIT BREAKER,SP,6A	EATON ✓
EGH2015FFG	CIRCUIT BREAKER,15A,2 POLE	EATON ✓
EGH3015FFG	CIRCUIT BREAKER,15A,3 POLE	EATON ✓
EGH3030FFG	CIRCUIT BREAKER,30A,3 POLE	EATON ✓
AN19DN0A5E005	NON-REVERSING CONTACTOR	EATON ✓
AN59DN0A5E020	REVERSING CONTACTOR	EATON ✓
ZEB-XRR-120	MOL RESET MODULE	EATON ✓
EHMFS03	FLANGED DISCONNECT MECHANISM/HANDLE	EATON ✓
FMR20-CBPBNVCERSF3	RADAR SENSOR W/65' CABLE	ENDRESS-HAUSER
RB223-C1B	TRANSDUCER I.S. BARRIER	ENDRESS-HAUSER
RMA42-1040/0(RMA42-AAA)	RADAR TRANSMITTER	ENDRESS-HAUSER
350TR-120	ALARM HORN	FEDERAL SIGNAL
NJBEW071106HZG2	ENCLOSURE	GEDNEY
1112524-B4	PROXIMITY LIMIT SWITCH,NEMA 7	GO SWITCH
AMS4	MAGNET	GO SWITCH

Electrical Components

A60HS3712SSLP	ENCLOSURE,FLANGED DISC,NEMA 4X 304SS	HOFFMAN
A60P36	BACK PANEL	HOFFMAN
CR230216G015	AIR CONDITIONER NEMA 4X	HOFFMAN
DAH1001A	PANEL HEATER	HOFFMAN
RH3B-ULCAC120V	RELAY,3PDT,W/INDICATOR	IDEC
SH3B-05	RELAY BASE ,3PDT	IDEC
ITCF12010	SURGE ARRESTOR	INNOVATIVE TECHNOLOGIES
KLDR-1	FUSE	LITTELFUSE
KLDR-3	FUSE	LITTELFUSE
KLDR-6	FUSE	LITTELFUSE
7012FX2-SC	ETHERNET SWITCH/FIBER/MANAGED	NTRON/RED LION
UGB2/0-414-6	GROUND BAR	PANDUIT
5361GRY	SINGLE RECEPTACLE	PASS & SEYMOUR
SS7	SINGLE RECEPTACLE COVER	PASS & SEYMOUR
2856032	PLUGTRAB PT, ANALOG	PHOENIX CONTACT
2856113	BASE FOR 285632	PHOENIX CONTACT
2866750	24VDC POWER SUPPLY	PHOENIX CONTACT
3044102	UNIVERSAL TERMINAL BLOCK - UT 4	PHOENIX CONTACT
3047028	END CLAMP - E/UK	PHOENIX CONTACT
800886	END COVER	PHOENIX CONTACT
RCS-1A-6V	PLC VARISTOR 120VAC	RK ELECTRONICS
H87A485-4X	SHADE AIDE OIT SS COVER	SMITH & LOVELESS
9070TF750D1	CONTROL POWER TRANSFORMER	SQD OK
TSBSB05	CURRENT SENSING RELAY	TSUBAKI

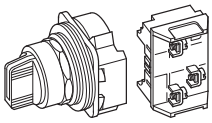
2-Position Selector Switch Devices, Non-Illuminated

Standard Knob Operator
Cat. No. 800T-H2A

Knob Lever Operator
Cat. No. 800T-H17A

Standard Knob Operator
Cat. No. 800H-HR2A

800 T ___ – HA 2 A
a b c d e



a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

b

Finger-Safe Guards	
Code	Description
Blank	No guards
C	Guards on terminals

c

Knob Insert Colors		
800T Type 4/13	Description	800H Type 4/4X/13
Code		Code
H	White	HR
HX	Packet of colored inserts‡	HRX
Metal Wing Lever Colors♣		
Code	Color	Code
HA	Red	—
HG	Grey	—

d

Operator Type and Function	
Standard Knob	
Code	Operator Function
2	Maintained
4	Spring return from left§
5	Spring return from right
Knob Lever♣	
Code	Operator Function
17	Maintained
18	Spring return from left§
19	Spring return from right
Metal Wing Lever♣	
Code	Operator Function
11	Maintained
15	Spring return from left§
16	Spring return from right
Coin Slot♣	
Code	Operator Function
6	Maintained
7	Spring return from left
8	Spring return from right

e

Contact Block(s)			
Code	Description		
	Contact Configuration	2-Position	
Blank	No contacts	—	—
Standard			
D1	1 N.O.	O	X
D2	1 N.C.	X	O
A	1 N.O. - 1 N.C.	O	X
		X	O
B	2 N.O. - 2 N.C.	O	X
		X	O
		O	X
		X	O
Max Duty (Horsepower Rated)Δ			
D1M	1 N.O.		
D2M	1 N.C.		
Pen*TUFF* (Low Voltage)Δ			
D1V	1 N.O.		
D2V	1 N.C.		
AV	1 N.O. - 1 N.C.		
BV	2 N.O. - 2 N.C.		
Class1, Div. 2			
Logic ReedΔ			
D1R	1 N.O.		
D2R	1 N.C.		
AR	1 N.O. - 1 N.C.		
BR	2 N.O. - 2 N.C.		
Sealed SwitchΔ			
D1P	1 N.O.		
D2P	1 N.C.		
AP	1 N.O. - 1 N.C.		
BP	2 N.O. - 2 N.C.		
Stackable Sealed SwitchΔ			
D1Y	1 N.O.		
D2Y	1 N.C.		
AY	1 N.O. - 1 N.C.		
BY	2 N.O. - 2 N.C.		

‡ One insert of each color (blue, green, orange, red, and yellow).
§ Target tables are reversed from those shown.
♣ Only available on Bul. 800T, Type 4/13 operators.
Δ Contact target tables same as those listed for standard contact blocks.

Momentary Contact Push Button Devices, Non-Illuminated

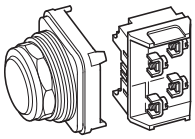
Flush Head Unit
Cat. No. 800T-A1A

Extended Head Unit
Cat. No. 800T-B6A

Booted Unit
Cat. No. 800H-R2A

Bootless Flush Head Unit
Cat. No. 800H-AR1A

800 T ___ – A 1 ___ A
a b c d e f



a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

b

Finger-Safe Guards	
Code	Description
Blank	No guards
C	Guards on terminals

c

Operator Type		
800T Type 4/13	Description	800H Type 4/4X/13
Code		Code
A	Flush head	AR
B	Extended head	BR
D	Mushroom head	DR
DX	Mushroom head less color cap	DRX
—	Bootless guarded head	GR
—	Booted head	R★

d

Color Cap	
Code	Description
Blank	Used only when ordering Operator Type DX/DRX
1	Green
2	Black
3	Orange‡

d (cont'd)

Color Cap	
Code	Description
4	Grey‡
5	White‡
6	Red
7	Blue
9	Yellow

e

Special Mushroom Head	
Code	Description
J♣	Jumbo mushroom head — plastic
L♣	Jumbo mushroom head — metal

Note: Special mushroom head options only apply to mushroom head operator type code D/DR (Table c).

f

Contact Block(s)	
Code	Description
Blank	No contacts
Standard	
D1	1 N.O.
D2	1 N.C.
D3	1 N.O.E.M.
D4	1 N.C.L.B.
D5	1 N.O. (Mini)
D6	1 N.C. (Mini)
A1	1 N.C.L.B. - 1 N.O.
A2	2 N.O.§
A4	2 N.C.
A7	1 N.C.L.B. - 1 N.C.
A	1 N.O. - 1 N.C.
B	2 N.O. - 2 N.C.

f (cont'd)

Contact Block(s)	
Code	Description
Pen*TUFF* (Low Voltage)	
D1V	1 N.O.
D2V	1 N.C.
D3V	1 N.O.E.M.
D4V	1 N.C.L.B.
AV	1 N.O. - 1 N.C.
BV	2 N.O. - 2 N.C.
Time Delay	
T	1 N.O. Depress close, delayed opening
S	1 N.C. Depress open, delayed closure
Snap Action	
M	1 N.O. - 1 N.C.
N	2 N.O. - 2 N.C.
Class 1, Div. 2	
Logic Reed	
D1R	1 N.O.
D2R	1 N.C.
A2R	2 N.O.§
A4R	2 N.C.
AR	1 N.O. - 1 N.C.
BR	2 N.O. - 2 N.C.

f (cont'd)

Contact Block(s)	
Code	Description
Class 1, Div. 2	
Sealed Switch	
D1P	1 N.O.
D2P	1 N.C.
AP	1 N.O. - 1 N.C.
BP	2 N.O. - 2 N.C
Stackable Sealed Switch	
D1Y	1 N.O.
D2Y	1 N.C.
A2Y	2 N.O.
A4Y	2 N.C.
AY	1 N.O. - 1 N.C.
BY	2 N.O. - 2 N.C

Time Delay Contacts

Series C field installable kits can only be used with Series T or later operators. Adjustable range of 0.5 to 15 s + 25%. Maximum continuous current Ith 5 A.

Snap Action Contacts

Snap-action contacts feature a quick make, quick break snap-action mechanism that is only available on factory assembled units. Maximum continuous current I_{th} 10 A.

★ Underlying operators are extended head. Boot material is chlorosulfonated polyethylene.
‡ Not available for booted operators.
§ A2 and A2R contact blocks cannot be stacked upon, but can stack on other contact blocks.
♣ Jumbo mushroom heads not available in white color.

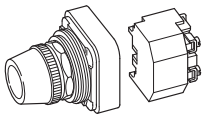
Pilot Light Devices

Transformer Type Pilot Light
Cat. No. 800T-P16R

Push-to-Test Pilot Light
Cat. No. 800T-PT16R

(Push-to-Test)

800	T		–	P	T		16	G	AR
	a	*b*		*c*	*d*	*e*	*f*	*g*	*h*



a

Protection Rating	
Code	Description
T	Metal, Type 4/13
H	Plastic, Type 4/4X/13

b

Finger-Safe Guards	
Code	Description
Blank	No guards
C	Guards on terminals

c

Power Module Type		
800T Type 4/13	Description	800H Type 4/4X/13
Code		Code
P	Transformer (or dual input)	PR
Q	Full voltage/ Universal	QR

d

Lamp Test Options	
Code	Description
Blank	No test option∇
T	Push-to-test
D	Dual input — diode∆♠
DT	Dual input — transformer relay♠
Note: Push-to-test supplied with factory jumpered contact block.	

e

Illumination Options	
Code	Description
Blank	Incandescent
H	LED♣

f

Voltage	
Transformer	
Code	Description
16	120V AC 50/60 Hz
26	240V AC 50/60 Hz
46	480V AC 50/60 Hz
56	600V AC 50/60 Hz
Full Voltage — Incandescent	
12	12V AC/DC
24	24V AC/DC
48	48V AC/DC
10	120V AC/DC
20	240V AC/DC
Universal — LED	
2	12…130V AC/DC
Dual Input	
16	120V AC
24	24V AC/DC (Dual input diode only)

g

Lens Color		
Code	Color	Glass Code #
Blank	No lens	Blank
A	Amber	D
B	Blue	E
C	Clear	F
G	Green	H
R	Red	J
W	White	K

h

Contact Blocks (Push-to-test units only)	
Code	Description
Standard	
Blank	1 N.O. - 1 N.C.
Pen*TUFF* (Low Voltage)	
AV	1 N.O. - 1 N.C.
Class 1, Div. 2	
Logic Reed	
AR	1 N.O. - 1 N.C.
Sealed Switch	
~~AP~~	~~1 N.O. 1 N.C.~~
Stackable Sealed Switch	
AY	1 N.O. - 1 N.C.

∇ Non-push-to-test pilot lights using the universal LED option cannot be ordered as Bul. 800HC or 800TC. The terminals are finger-safe as standard.
∆ Diode type dual input provides circuit isolation via opposing diodes. Not recommended for use with solid-state outputs.
♠ Dual input devices (diode or transformer type) cannot be ordered as Bul. 800HC or 800TC. Finger-safe terminal guards are not available.
♣ LED illumination option is not available with diode type dual input.
Glass lens available on 800T pilot lights only. Not available on push-to-test units.

Push Pull Units

2-position, Non-illuminated

2-position Push-Pull
Cat. No. 800H-FPX6A5

800	H	–	FPX		1	A1
	a		b	c	d	e

a	
Barrel Type	
Code	**Description**
H	Standard barrel
HL	Long barrel

b	
Operator Type	
Code	**Description**
FPX	Push-pull unit

c	
Head Type	
Code	**Description**
Blank	Mushroom head
J	Jumbo mushroom head (1)

d	
Color Cap	
Code	**Description**
Blank	No cap
1	Green
2	Black
4	Gray (silver)
6	Red
7	Blue
9	Yellow (gold)

e			
Contact Blocks			
Code	**Operator Position**		**Description**
	 **Out**	 **In**	
Standard			
Blank	—	—	No contacts
A1	0 X	X 0	1 N.O. - 1 N.C.L.B. (2)
A5	X X	0 0	2 N.C.L.B. (2)
D1	0	X	1 N.O.
D4	X	0	1 N.C.L.B. (2)
PenTUFF (Low Voltage)			
D1V	0	X	1 N.O.
AV	0 X	X 0	1 N.O. - 1 N.C.
Note: X = Closed/0 = Open			

(1) Not valid with color cap option code Blank (Table d)

(2) Normally closed late break contact. When button is pushed from the OUT to the IN position, the mechanical detent action of the operator occurs before electrical contacts change state. When the button is pulled from the IN to the OUT position, the electrical contacts change state before the mechanical detent occurs.

3-position, Non-illuminated

Standard Knob Operator
Cat. No. 800H-JP2KB7AXXX

Knob Lever Operator
Cat. No. 800H-JP17KB7AXXX

Metal Wing Lever Operator
Cat. No. 800H-JP11KB7AXXX

800	**H**	**–**	**JP**		**2**	**KB7**	**AAXX**	**(Knob/Wing Lever)**
	a		b	c	d	e	f	
800	**H**	**–**	**JP**	**41**		**KB7**	**AAXX**	**(Cylinder Lock)**
	a		b	c_1	d_1	e	f	

a	
Barrel Type	
Code	**Description**
H	Standard barrel
HL	Long barrel

b	
Number of Positions	
Code	**Description**
JP	3-position

c	
Knob Insert Colors (1)	
Code	**Description**
Blank	White knob insert or cylinder lock operator
X	Packet of colored inserts (2)
Metal Wing Lever Colors	
A	Red
Blank	Gray

(1) Each standard and knob lever operator is factory-assembled with a white insert. Other colors are available, factory-assembled, if ordered in quantities of 10 or more.
(2) One insert of each color (blue, green, orange, red, and yellow).

c_1	
Cylinder Lock Operator Locking Position	
Code	**Description**
Maintained Position	
41	Left
42	Center
43	Right
44	All
45	Left and center
46	Right and left
47	Right and center
Spring Return from Left	
50	Center
52	Right
51	Right and center
Spring Return from Right	
69	Left
38	Center
73	Left and center
Spring Return from Both	
631	Center

d	
Operator Type and Function	
Code	**Description**
Standard Knob	
2	Maintained
4	Spring return from left
5	Spring return from right
91	Spring return from both
Knob Lever	
17	Maintained
18	Spring return from left
19	Spring return from right
20	Spring return from both
Metal Wing Lever (1)	
11	Maintained
15	Spring return from left
16	Spring return from right
141	Spring return from both

(1) Wing levers are not suitable with **KE7** cam code (Table 9).

d_1	
Operator Type and Function	
Code	**Key Number** (1)
Blank	D018 (standard key)

(1) See page 13 for additional key codes.

e	
Cam Options (1)	
Code	**Description**
KB7	Standard cam KB7
KA1	Cam KA1
KA7	Cam KA7

(1) For more cam descriptions, see Table 9.

f	
Contact Blocks	
Code	**Description**
Blank	No contacts
AXXX	Two contact targets for a given cam as shown in the W (white side) column of Table 9.
AAXX	Two contact targets for a given cam as shown in the W (white side) column of Table 9 and 2 contact targets for the same cam as shown in the B (black side) column of Table 9. (One Cat. No. 800T-XA contact block per side. Two contact blocks total.)

Table 9 - Cam and Contact Block Functionality Table

Contact Block Suffix Code	Contact Block Side	Circuits	Cam Codes (1)																																									
			KB7 (Std.)			KA1			KA7			KC1			KC7			KD7			KE7			KQ1			KQ7			KR1			KR7			KT1			KT7			KU7		
A_, B_, H_, C_	White	A	X	0	0	X	0	0	0	0	X	0	0	X	X	0	0	0	0	X	X	0	0	X	0	X	X	0	X	X	0	X	X	0	X	0	0	X	X	0	0	X	0	0
		B	0	0	X	0	X	0	0	X	0	0	X	0	0	X	0	0	X	0	0	X	X	0	X	0	0	X	0	0	X	0	0	X	0	X	0	0	0	0	X	0	X	0
B_, H_, C_	Black	A	X	0	0	X	0	0	0	0	X	0	0	X	X	0	0	X	0	0	0	0	X	0	0	X	X	0	0	0	0	X	X	0	0	0	0	X	X	0	0	0	0	X
		B	0	0	X	0	X	0	0	X	0	X	0	0	0	0	X	0	X	0	X	X	0	0	X	0	0	X	0	X	X	0	0	X	X	X	X	0	0	X	X	X	X	0
H_, C_	White	A	X	0	0	X	0	0	0	0	X	0	0	X	X	0	0	0	0	X	X	0	0	X	0	X	X	0	X	X	0	X	X	0	X	0	0	X	X	0	0	X	0	0
		B	0	0	X	0	X	0	0	X	0	0	X	0	0	X	0	0	X	0	0	X	X	0	X	0	0	X	0	0	X	0	0	X	0	X	0	0	0	0	X	0	X	0
C_	Black	A	X	0	0	X	0	0	0	0	X	0	0	X	X	0	0	X	0	0	0	0	X	0	0	X	X	0	0	0	0	X	X	0	0	0	0	X	X	0	0	0	0	X
		B	0	0	X	0	X	0	0	X	0	X	0	0	0	0	X	0	X	0	X	X	0	0	X	0	0	X	0	X	X	0	0	X	X	X	X	0	0	X	X	X	X	0

(1) X = Closed, 0 = Open

Pilot Light Units

Transformer Type Pilot Light
Cat. No. 800H-PP16M

Push-to-Test Pilot Light
Cat. No. 800H-PPT16M

Pigtail Pilot Light
Cat. No. 800H-LP24M

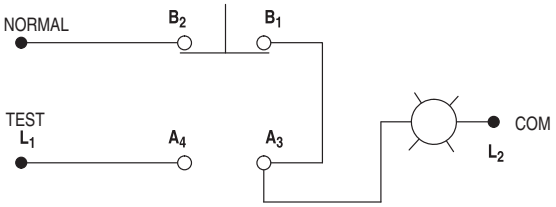
Type	Lamp Type	Supply Voltage	Lens Color✶	Pilot Light Cat. No.❄	Push-to-Test Cat. No.❄‡	Pigtail Cat. No.❄§
Operator only♣				800H-QPN00	800H-QPB00XX	—
Full voltage	Incandescent	24V AC/DC	Multi-color kit	800H-QP24M	800H-QPT24M	800H-LP24M
		120V AC/DC		**800H-QP10M**	**800H-QPT10M**	**800H-LP10M**
	No lamp	0…250V AC/DC	No lens	800H-QPN25	800H-QPTN25	800H-LPN25
	LED	24V AC/DC	Multi-color kit	—	—	800H-LPH24M
		120V AC		—	—	800H-LPH10M
Universal	LED	12…130V AC/DC	Multi-color kit	**800H-QPH2M**	800H-QPTH2M	—
Transformer	Incandescent	120V AC, 50/60 Hz	Multi-color kit	**800H-PP16M**	800H-PPT16M	—
	LED			800H-PPH16M	800H-PPTH16M	—

✶ Units ship with multi-color insert packet including amber, blue, green, red, and white.
❄ For long barrel versions, add an **L** to the cat. no. **Example:** Cat. No. 800H**L**-QPH2M
‡ Includes one standard Cat. No. 800T-XA (1 N.O./1 N.C.) contact block.
§ Pigtail length is 7 in.
♣ Operator only supplied without power module, lamp, lens cap, or contact blocks.

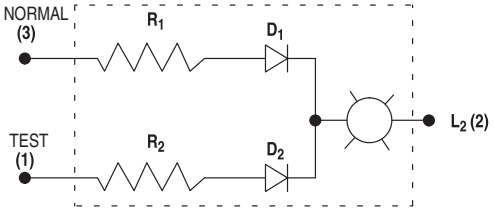
Typical Pilot Light Wiring Diagrams

See applicable Codes and Laws.

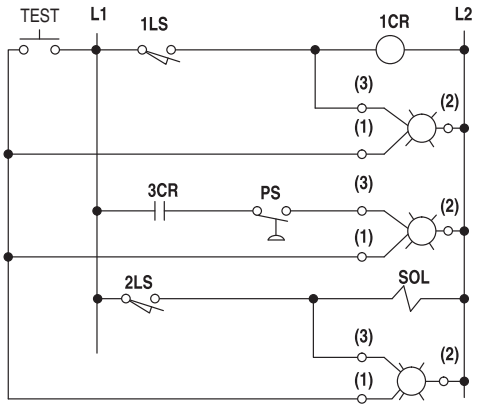
Push-to-Test Pilot Light Device Schematic



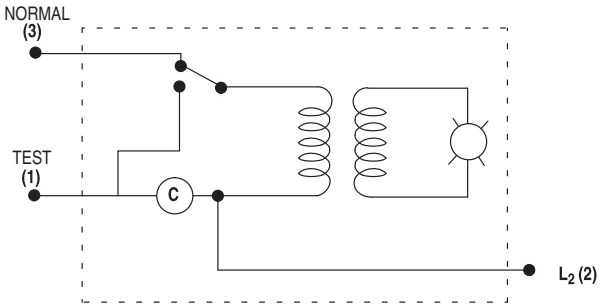
Dual Input Diode Pilot Device Schematic



Dual Input Pilot Light Typical Application Wiring Diagram



Dual Input Pilot Light Transformer Type Device Schematic



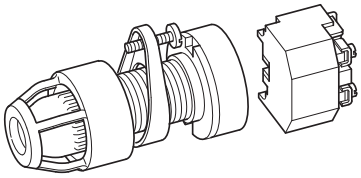
10

Hazardous Location Push Buttons

Product Selection

Pilot Light Units

800	H	–	PP	T		16	M
	a		*b*	*c*	*d*	*e*	*f*



a

Barrel Type	
Code	Description
H	Standard barrel length
HL	Long barrel

b

Power Module Type	
Code	Description
PP	Transformer (or dual input)
QP	Full voltage/Universal
LP	Pigtail — full voltage❄
LPK	Pigtail — full voltage❄ (for dual push buttons)

c

Lamp Test Options	
Code	Description
Blank	No test option
T	Push-to-test
D	Dual input — diode‡
DT	Dual input — transformer relay‡

d

Illumination Option	
Code	Description
Blank	Incandescent
H	LED♣

e

Voltage	
Transformer	
Code	Description
16	120V AC, 50/60 Hz
26	240V AC, 50/60 Hz
46	480V AC, 50/60 Hz
56	600V AC, 50/60 Hz
Full Voltage — Incandescent	
Code	Description
24	24V AC/DC
10	120V AC/DC
20	240V AC/DC
Universal — LED	
Code	Description
2	12…130V AC/DC
Dual Input	
Code	Description
16	120V AC
24	24V AC/DC✦
Pigtail	
Code	Description
24	24V AC/DC
10	120V AC/DC
20	240V AC/DC

f

Lens Color	
Code	Color
Blank	No lens with no contacts
M	Multi-color✶

Note: Push-to-test pilot light is supplied with a factory jumpered 800T-XA, 1 N.O - 1 N.C contact block.
✶ Multi-color insert packet includes amber, blue, green, red, and white
❄ Lamp test options is not available with pigtail.
‡ Only available with power module type code **PP**.
♣ LED illumination option is not available with diode type dual input lamp test options.
✦ Dual input diode only.

CompactLogix™ 5370 L3 Programmable Automation Controllers

Allen-Bradley

1769-L30ER, -L30ERM, -L30ER-NSE, -L33ER, -L33ERM, -L36ERM

Features and Benefits

The CompactLogix 5370 L3 controllers deliver scalable, affordable control ideal for applications from small stand-alone equipment to high performance indexing tables, process skids, case packers and erectors, and packaging.

Machine builders and end users can take advantage of the cost-saving features of these controllers:

- Support for Integrated Motion on EtherNet/IP
- Support for Device Level Ring (DLR) network topologies
- Built-in energy storage eliminates the need for lithium batteries
- Support reuse of existing 1769 I/O
- Removable 1GB secure digital (SD) card improves data integrity
- Flexible memory options up to 3MB
- Added features for hazardous environments (NSE version)
- Support for Kinematics eliminates the need for additional robot controllers and software
- Open socket capability allows support for Modbus TCP as well as devices such as printers, barcode readers and servers

Reduce cost and time to market with CompactLogix 5370 L3 Programmable Automation Controllers.

Expanding on the scalability of the Logix family of controllers, the CompactLogix 5370 L3 programmable automation controllers (PAC) are designed to meet the growing need for a higher performance controller in a compact and affordable package.

As part of the Integrated Architecture system, the CompactLogix 5370 L3 controllers use the same programming software, network protocol, and information capabilities as all Logix controllers, providing a common development environment for all control disciplines.

Integrated Motion on EtherNet/IP

The CompactLogix 5370 L3 controller provides a strong motion solution for customers looking for performance and cost competitiveness.

- Supports up to 16 axes of integrated motion
- Together with the Kinetix 350, offers cost-effective, scalable motion solution

Network Capabilities

With dual Ethernet ports and an integrated Ethernet switch, these controllers now support Device Level Ring (DLR) network topologies, simplifying integration of components in your control system and reducing system cost:

- Provides resiliency from loss of one network connection
- Allows replacement of devices one at a time without stopping production
- Reduces the number of Ethernet switches in the control system

Features for Hazardous Environments

The No Stored Energy (NSE) version of the CompactLogix 5370 L3 offers additional features for hazardous environments found in industries such as mining and oil and gas.

- Allows safe transport of controller in and out of mining areas
- Powered down controller has less than 200uJ of residual energy stored in each component
- No consequences of arc or spark to cause an explosion in gaseous environment

LISTEN. THINK. SOLVE.®

CompactLogix 5370 L3 Controller Product Specifications

	1769-L30ER	1769-L30ERM	1769-L30ER-NSE	1769-L33ER	1769-L33ERM	1769-L36ERM
User memory	1 MB	1 MB	1 MB	2 MB	2 MB	3 MB
Controller tasks	32	32	32	32	32	32
Programs per task	100	100	100	100	100	100
Integrated Motion	--	4 axis CIP motion position loop axis	--	--	8 axis CIP motion position loop axis	16 axis CIP motion position loop axis
Package Size	55mm wide x 118mm high x 105mm deep					
Certifications	cULH (Class I Division 2), KCC / UL (UL 508), ULH (Class I & II, Division 2 and Class III, Divisions 1 & 2) / ATEX, CE, C-Tick / Marine and GOST certifications in 2012					
Local Expansion Modules	8	8	8	16	16	30
Local Expansion I/O Points (Max)	256	256	256	512	512	960
Communication Module Additions	DeviceNet with 1769-SDN or 3rd party					
Flash Memory Card	Industrially rated and certified Secure Digital (SD) memory card (1 and 2 GB options); all controllers shipped with 1 GB card					
Servo Drives (Position Loop CIP)	--	4	--	--	8	16
Ethernet I/O IP nodes	16	16	16	32	32	48
Virtual axes	100	100	100	100	100	100
Feedback only, torque, velocity, Vhz (max CIP motion drives)	--	16	--	--	32	48
Axes/ms	--	2	--	--	2	2
Kinematics support	--	yes	--	--	yes	yes
Software / Firmware	RSLogix 5000 V20 and RSLinx Classic V2.59 Firmware v20.1x or later					

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Step 4 - Select:

- *if power consumption exceeds the maximum for a single power supply, install additional banks and power supplies*

Select Power Supplies

Compact I/O power supplies distribute power from either side of the power supply. For example, a 2A at 5V dc power supply (1769-PA2, -PB2) can provide 1A to the right side of the power supply and 1A to the left. A 4A at 5V dc power supply (1769-PA4, -PB4) can provide 2A to the right side of the power supply and 2A to the left.

Specification	1769-PA2	1769-PB2	1769-PA4	1769-PB4
Description	Compact 124/240V ac Expansion Power Supply	Compact 24V dc Expansion Power Supply	Compact 124/240V ac Expansion Power Supply	Compact 24V dc Expansion Power Supply
Operating Voltage Range	85…265V ac (wide range; no jumper or DIP switch required), 47…63 Hz	19.2…31.2V dc	85…132V ac or 170…265V ac (switch selectable), 47…63 Hz	19.2…32V dc
Power Consumption, Max.	100 VA @ 120V ac 130 VA @ 240V ac	50 VA @ 24V dc	200 VA @ 120V ac 240 VA @ 240V ac	100 VA @ 24V dc
Current Capacity (Amps) at 5V	2.0 A♆		4.0 A❄	
Current Capacity (Amps) at 24V	0.8 A‡		2.0 A§	
24V dc User Power Capacity (0° to 55°C)	250 mA	—	—	—
Inrush Current, Max.	25 A @ 132V ac 10 Ω source impedance 40 A @ 265V ac 10 Ω source impedance	30 A @ 31.2V dc	25 A @ 132V ac 10 Ω source impedance 40 A @ 265V ac 10 Ω source impedance	30 A @ 31.2V dc
Line Loss Ride Through	10 ms…10 s		5 ms…10 s	
Short Circuit Protection (Yes/No)	Front Access Fuse (replacement part number: Wickmann 19195-3.15A, Wickmann 19343-1.6A, or Wickmann 19181-4A)	Front Access Fuse (replacement part number: Wickmann 19193-6.3A)	Front Access Fuse (replacement part number: Wickmann 19195-3.15A or Wickmann 19181-4A)	Front Access Fuse (replacement part number: Wickmann 19193-6.3A)
Overvoltage Protection	for both +5V dc and for +24V dc			
Isolation Voltage	Verify by one of the following tests: 1836V ac for 1s or 2596V dc for 1s 265V Working Voltage (IEC Class 1 - grounding required)	Verify by one of the following tests: 1200V ac for 1s or 1697V dc for 1s 75V Working Voltage (IEC Class 1 - grounding required)	Verify by one of the following tests: 1836V ac for 1s or 2596V dc for 1s 265V Working Voltage (IEC Class 1 - grounding required)	Verify by one of the following tests: 1200V ac for 1s or 1697V dc for 1s 75V Working Voltage (IEC Class 1 - grounding required)
Power Supply Distance Rating	8 modules♣↗			

Certifications: UL 508, CSA (Class I, Division 2, Group A, B, C, D), CE

1769-IA16

Compact 120V AC input module

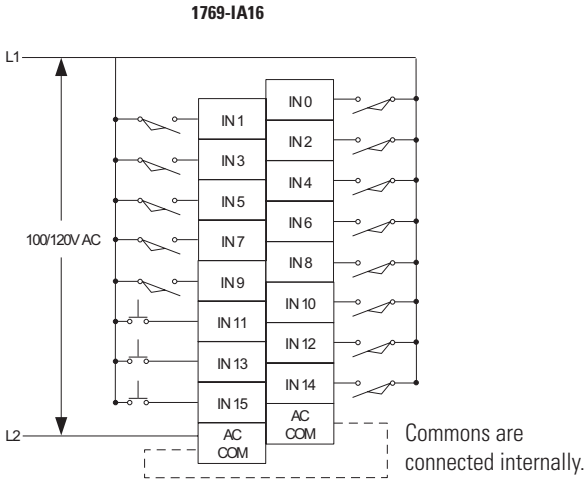


Table 4 - Technical Specifications - 1769-IA16

Attribute	1769-IA16
Inputs	16 (16 points/group, internally connected commons)
Voltage category	100/120V AC
Operating voltage range	79…132V AC, 47…63 Hz
Input delay, on	20 ms
Input delay, off	20 ms
Current draw @ 5.1V	115 mA
Heat dissipation, max	3.30 W
Off-state voltage, max	20V AC
Off-state current, max	2.5 mA
On-state voltage, min	79V AC
On-state current, min	5 mA @ 74V AC
On-state current, max	12 mA @ 120V AC
Inrush current, max(1)	250 mA
Input impedance, max	12 kΩ @ 50 Hz 10 kΩ @ 60 Hz
Isolation voltage	Verified by one of the following dielectric tests: 1517V AC for 1 s or 2145V DC for 1 s, input point to bus 132V AC working voltage (IEC Class 2 reinforced insulation)
Weight, approx	280 g (0.61 lb)
Dimensions (HxWxD), approx	118 x 35 x 87 mm (4.65 x 1.38 x 3.43 in.) Height with mounting tabs 138 mm (5.43 in.)
Slot width	1
Module location	DIN rail or panel mount

Table 4 - Technical Specifications - 1769-IA16

Attribute	1769-IA16
Power supply	1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4
Power supply distance rating	8 modules
Terminal screw torque	0.68 N•m (6 lb•in)
Retaining screw torque	0.46 N•m (4.1 lb•in)
Wire size	(22…14 AWG) solid (22…16 AWG) stranded
Wire type	Cu-90 °C (194 °F)
IEC input compatibility	Type 1+
Replacement terminal block	1769-RTBN18 (1 per kit)
Replacement door label	1769-RL1 (2 per kit)
Replacement door	1769-RD (2 per kit)
Vendor ID code	1
Product type code	7
Product code	82
Enclosure type rating	None (open-style)

(1) A current limiting resistor can be used to limit inrush current; however, the operating characteristics of the AC input circuit will be affected. If a 6.8 kΩ (2.5 W minimum) resistor is placed in series with the input, the inrush current is reduced to 35 mA. In this configuration, the minimum on-state voltage increases to 92V AC. Before adding the resistor in a hazardous environment, be sure to consider the operating temperature of the resistor and the temperature limits of the environment. The operating temperature of the resistor must remain below the temperature limit of the environment.

Table 5 - Certifications - 1769-IA16

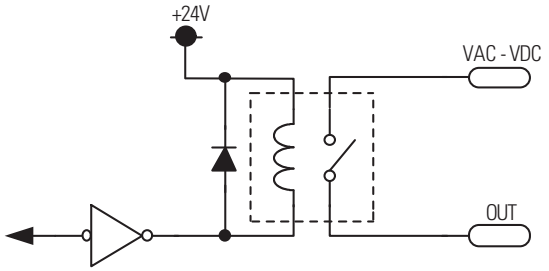
Certification(1)	1769-IA16
c-UL	C-UL certified (under CSA C22.2 No. 142) UL 508 listed Class I, Division 2 Group A,B,C,D Hazardous Locations (UL 1604, C-UL under CSA C22.2 No. 213)
CE	CE compliant for all applicable directives
C-Tick	AustralianRadiocommunications Act, compliant with: • AS/NZS cispr 11; Industrial Enclosure

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1769-0W16

Compact AC/DC relay contact module

Simplified Output Circuit Diagram



1769-0W16

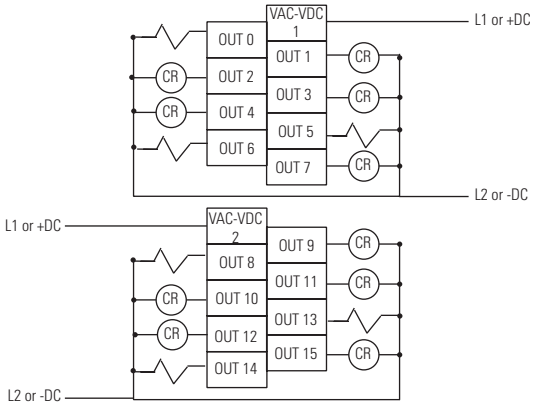


Table 83 - Technical Specifications - 1769-0W16

Attribute	1769-0W16
Outputs	16 normally open (8 points/group)
Operating voltage range	5…265V AC 5…125V DC
Delay, on	10 ms
Delay, off	10 ms
Current draw @ 5.1V	205 mA
Current draw @ 24V	180 mA
Heat dissipation, max	4.75 W
Off-state leakage, max	0 mA
On-state current, min	10 mA @ 5V DC
Current per point, max	2.5 A
Current per module, max	20 A
Isolation voltage	Verified by one of the following dielectric tests: 1836V AC for 1 s or 2596V DC for 1 s, output point to bus 265V AC working voltage (IEC Class 2 reinforced insulation) Verified by one of the following dielectric tests: 1836V AC for 1 s or 2596V DC for 1 s, group to group 265V AC working voltage (basic insulation) 150V AC working voltage (IEC Class 2 reinforced insulation)
Weight, approx	450 g (0.99 lb)
Dimensions (HxWxD), approx	118 x 52.5 x 87 mm (4.65 x 2.07 x 3.43 in.) Height with mounting tabs 138 mm (5.43 in.)
Slot width	1.5
Module location	DIN rail or panel mount
Power supply	1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4
Power supply distance rating	8 modules

Table 83 - Technical Specifications - 1769-0W16

Attribute	1769-0W16
Terminal screw torque	0.68 N•m (6 lb•in)
Retaining screw torque	0.46 N•m (4.1 lb•in)
Wire size	(22…14 AWG) solid (22…16 AWG) stranded
Wire type	Cu-90 °C (194 °F)
Replacement terminal block	1769-RTBN18 (1 per kit)
Replacement door label	1769-RL1 (2 per kit)
Replacement door	1769-RD (2 per kit)
Vendor ID code	1
Product type code	7
Product code	85
Enclosure type rating	None (open style)

Table 84 - Relay Contact Ratings - 1769-0W16

Volts, max	Continuous Amps per Point, max	Amperes(1)		Voltamperes		NEMA ICS 2-125
		Make	Break	Make	Break	
240V AC	2.5 A	7.5 A	0.75 A	1800VA	180VA	C300
120V AC		15 A	1.5 A			
125V DC	1.0 A	0.22 A(2)		28VA		R150
24V DC	2.0 A	1.2 A(2)		28VA		—

(1) Connecting surge suppressors across your external inductive load will extend the life of the relay contacts.

(2) For DC voltage applications, the make/break ampere rating for relay contacts can be determined by dividing 28VA by the applied DC voltage. For example, 28VA/48V DC = 0.58 A. For DC voltage applications less than 48V, the make/break ratings for relay contacts cannot exceed 2 A.

Table 85 - Certifications - 1769-0W16

Certification(1)	1769-0W16
c-UL	C-UL certified (under CSA C22.2 No. 142) UL 508 listed Class I, Division 2 Group A,B,C,D Hazardous Locations (UL 1604, C-UL under CSA C22.2 No. 213)
CE	CE compliant for all applicable directives
C-Tick	C-Tick compliant for all applicable directives AustralianRadiocommunications Act, compliant with: • AS/NZS cispr 11; Industrial Enclosure

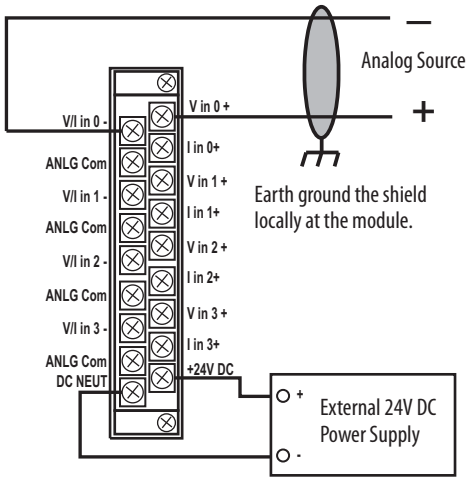
(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1769-IF4

Compact voltage/current analog input module

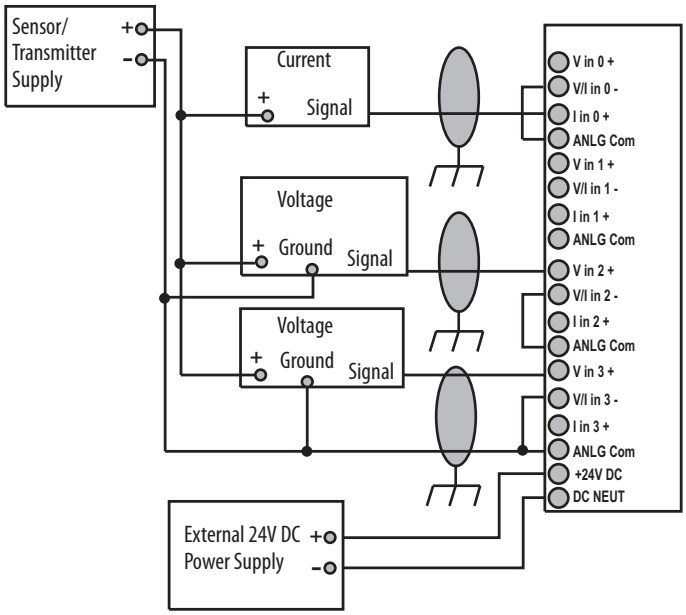
1769-IF4 Differential Inputs

Belden 8761 Cable (or equivalent)



The external power supply must be rated Class 2, with a 24V DC range of 20.4…26.4V DC and 60 mA minimum. Series B and later modules support this option.

1769-IF4 Single-ended Sensor/Transmitter Inputs



1769-IF4 Mixed Transmitter Inputs

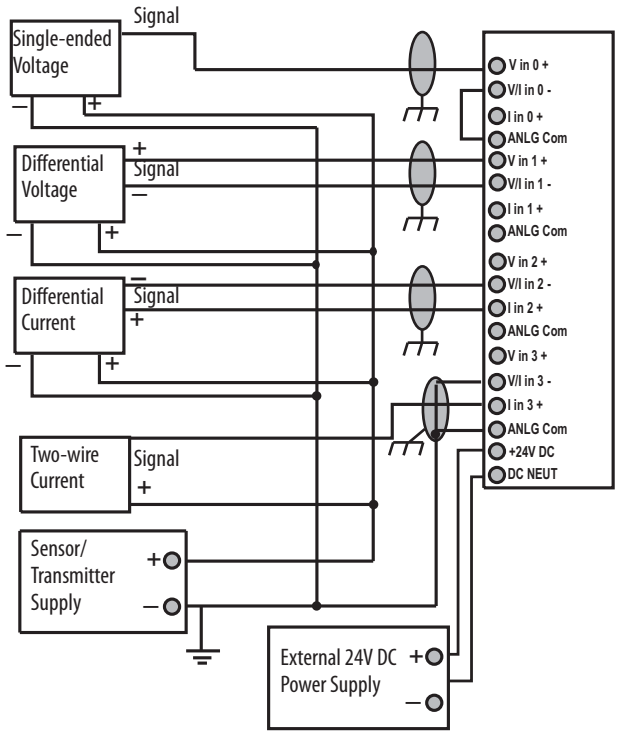


Table 6 - Technical Specifications - 1769-IF4

Attribute	1769-IF4
Inputs	4 differential or single-ended
Input range	±10V 0…10V 0…5V 1…5V 0…20 mA 4…20 mA
Full scale range[1]	±10.5V -0.5…10.5V -0.5…5.25V 0.5…5.25V 0…21 mA 3.2…21 mA
Current draw @ 5.1V	120 mA
Current draw @ 24V	60 mA
Heat dissipation, max	2.52 W
Converter type	Delta Sigma
Resolution [2]	14 bits (unipolar) 14 bits plus sign (bipolar)
Rated working voltage[3]	30V AC/30V DC
Common mode voltage range[4]	±10V DC max per channel
Common mode rejection	> 60 dB @ 50 and 60 Hz with the 50 or 60 Hz filter selected, respectively
Normal mode rejection ratio	-50 dB @ 50 and 60 Hz with the 50 or 60 Hz filter selected, respectively
Input impedance	Voltage: 220 kΩ Current: 250 Ω
Accuracy[5]	Voltage: ±0.2% full scale @ 25 °C (77 °F) Current: ±0.35% full scale @ 25 °C (77 °F)
Accuracy drift with temperature	Voltage: ±0.003% per °C Current: ±0.0045% per °C
Nonlinearity	±0.03%
Repeatability[6]	±0.03%
Module error	Voltage: ±0.3% Current: ±0.5%
Overload at input terminals, max[7]	Voltage: ±30V DC continuous, 0.1 mA Current: ±32 mA continuous, ±7.6V DC
Isolation voltage	500V AC or 710V DC for 1 minute (qualification test), group to bus 30V AC/30V DC working voltage (IEC Class 2 reinforced insulation)
Weight, approx	300 g (0.65 lb)
Dimensions (HxWxD), approx	118 x 35 x 87 mm (4.65 x 1.38 x 3.43 in.) Height with mounting tabs 138 mm (5.43 in.)
Slot width	1
Module location	DIN rail or panel mount
Power supply	1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4
Optional 24V DC Class 2 power supply voltage range[8]	20.4…26.4V DC
Power supply distance rating	8 modules

Table 6 - Technical Specifications - 1769-IF4

Attribute	1769-IF4
Terminal screw torque	0.68 N•m (6 lb•in)
Retaining screw torque	0.46 N•m (4.1 lb•in)
Wire size	(22…14 AWG) solid (22…16 AWG) stranded
Wire type	Cu-90 °C (194 °F)
Replacement terminal block	1769-RTBN18 (1 per kit)
Replacement door label	1769-RL2 series B (2 per kit)
Replacement door	1769-RD (2 per kit)
Vendor ID code	1
Product type code	10
Product code	35
Enclosure type rating	None (open-style)

(1) The over- or under-range flag will come on when the normal operating range (over/under) is exceeded. The module will continue to convert the analog input up to the maximum full scale range. The flag automatically resets when within the normal operating range.

(2) Resolution is dependent upon your filter selection. The maximum resolution is achieved with either the 50 or 60 Hz filter selected.

(3) Rated working voltage is the maximum continuous voltage that can be applied at the input terminal, including the input signal and the value that floats above ground potential (for example, 10V DC input signal and 20V DC potential above ground).

(4) For proper operation, both the plus and minus input terminals must be within ±10V DC of analog common.

(5) Includes offset, gain, nonlinearity, and repeatability error terms.

(6) Repeatability is the ability of the input module to register the same reading in successive measurements for the same input signal.

(7) Damage may occur to the input circuit if this value is exceeded.

(8) If the optional 24V DC Class 2 power supply is used, the 24V DC current draw from the bus is 0 mA.

Table 7 - Response Speed - 1769-IF4

Filter Frequency	Cut-off Frequency	Step Response	Channel Update
50 Hz	13.1 Hz	60 ms	22 ms
60 Hz	15.7 Hz	50 ms	19 ms
250 Hz	65.5 Hz	12 ms	6 ms
500 Hz	131 Hz	6 ms	4 ms

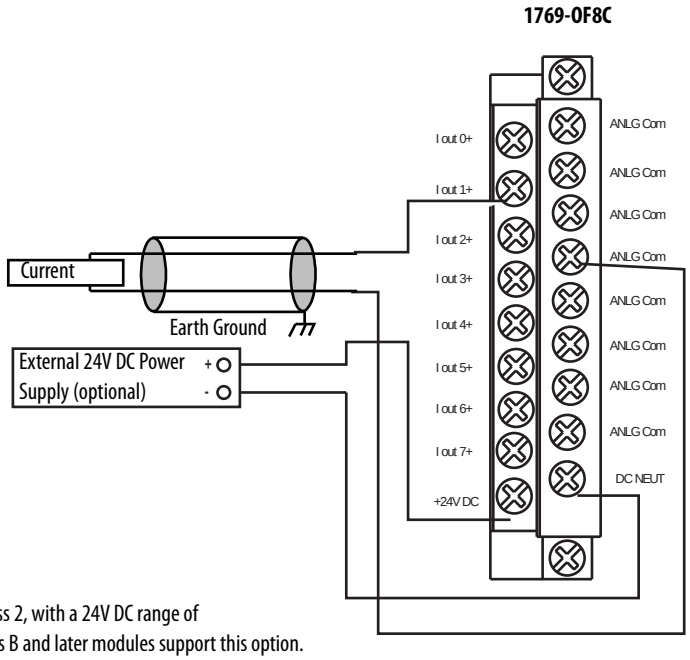
Table 8 - Certifications - 1769-IF4

Certification(1)	1769-IF4
c-UL	C-UL certified (under CSA C22.2 No. 142) UL 508 listed Class I, Division 2 Group A,B,C,D Hazardous Locations (UL 1604, C-UL under CSA C22.2 No. 213)
CE	CE compliant for all applicable directives
C-Tick	AustralianRadiocommunications Act, compliant with: • AS/NZS cispr 11; Industrial Enclosure

(1) When marked. See the Product Certification link at http://www.ab.com for Declarations of Conformity, Certificates, and other certification details.

1769-0F8C

Compact current output analog module



The external power supply must be rated Class 2, with a 24V DC range of 20.4…26.4V DC and 60 mA minimum. Series B and later modules support this option.

Technical Specifications - 1769-0F8C

Attribute	1769-0F8C
Outputs	8 single-ended
Output range	0…20 mA 4…20 mA
Full scale range[1]	0…21 mA 3.2…21 mA
Resolution	16 bits (unipolar) 0…20 mA: 15.91 bits, 0.323 µA/bit 4…20 mA: 15.59 bits, 0.323 µA/bit
Bus current draw	5V DC, 145 mA 24V DC, 185 mA
Heat dissipation, max	2.69 W
Conversion rate (all channels), max	5 ms
Step response to 63%[2]	< 2.9 ms
Resistive load on current output	0…500 Ω (includes wire resistance)
Inductive load (current outputs), max	0.1 mH
Field calibration	None required
Accuracy[3]	±0.35% full scale @ 25 °C (77 °F)
Accuracy drift with temperature	±0.0058% per °C
Output ripple[4]	±0.05% @ 0…50 kHz
Nonlinearity	±0.05%
Repeatability[5]	±0.05%
Module error	±0.55%
Offset error	±0.05%
Output impedance	> 1 MΩ

Technical Specifications - 1769-OF8C

Attribute	1769-OF8C
Open and short-circuit protection	Yes
Short-circuit protection, max	21 mA
Output overvoltage protection	Yes
Output response at system powerup and power down	±0.5V DC spike for < 5 ms
Rated working voltage(6)	30V AC/30V DC
Isolation voltage	500V AC or 710V DC for 1 min (qualification test), output group to bus 30V AC/30V DC working voltage (IEC Class II reinforced insulation)
Weight, approx	281 g (0.62 lb)
Dimensions (HxWxD), approx	118 x 35 x 87 mm (4.65 x 1.38 x 3.43 in.) Height with mounting tabs 138 mm (5.43 in.)
Slot width	1
Module location	DIN rail or panel mount
Power supply	1769-PA2, 1769-PB2, 1769-PA4, 1769-PB4
Optional 24V DC Class 2 power supply voltage range(7)	20.4…26.4V DC
Power supply distance rating	8 modules
Terminal screw torque	0.68 N•m (6 lb•in)
Retaining screw torque	0.46 N•m (4.1 lb•in)
Wire size	(22…14 AWG) solid (22…16 AWG) stranded
Wire type	Cu-90 °C (194 °F)
Replacement terminal block	1769-RTBN18 (1 per kit)
Replacement door label	1769-RL2 (2 per kit)
Replacement door	1769-RD (2 per kit)
Vendor ID code	1
Product type code	10
Product code	40
Input words	11
Output words	9
Configuration words	64
Enclosure type rating	None (open style)

(1) The over- or under-range flag comes on when the normal operating range (over/under) is exceeded. The module continues to convert the analog input up to the maximum full scale range. The flag automatically resets when within the normal operating range.
(2) Step response is the time between when the D/A converter was instructed to go from minimum to full range until the device is at 63% of full range.
(3) Includes offset, gain, nonlinearity, and repeatability error terms.
(4) Output ripple is the amount that a fixed output varies with time, which assumes a constant load and temperature.
(5) Repeatability is the ability of the input module to register the same reading in successive measurements for the same input signal.
(6) Rated working voltage is the maximum continuous voltage that can be applied at the input terminal, including the input signal and the value that floats above ground potential. For example, a 10V DC input signal and 20V DC potential above ground at the input terminal.
(7) If the optional 24V DC Class 2 power supply is used, the 24V DC current draw from the bus is 0 mA.

See Environmental Specifications - 1769 Compact I/O Modules on page 3.

Certifications - 1769-OF8C

Certification[1]	1769-OF8C
c-UL	C-UL certified (under CSA C22.2 No. 142) UL Listed Industrial Control Equipment, certified for US and Canada. UL Listed for Class I, Division 2 Group A,B,C,D Hazardous Locations, certified for U.S. and Canada. See UL File E194810.
CE	European Union 2014/30/EU EMC Directive, compliant with: • EN 61000-6-2; Industrial Immunity • EN 61000-6-4; Industrial Emissions
RCM	Australian Radiocommunications Act, compliant with: • AS/NZS CISPR 11; Industrial Enclosure
EAC	Russian Customs Union TR CU 020/2011 EMC Technical Regulation

(1) When marked. See the Product Certification link at http://www.rockwellautomation.com/global/certification/overview.page for Declarations of Conformity, Certificates, and other certification details.

PanelView Plus 7 – Performance Terminals

PanelView™ Plus 7 performance terminals are operator interface terminals. They monitor and control devices attached to ControlLogix® and CompactLogix™ controllers on an EtherNet/IP network. Animated graphic and text displays provide operators a view into the operating state of a machine or process. Operators interact with the control system by using touch screen or keypad input.

Features include the following:

- FactoryTalk® View Machine Edition software provides a familiar environment for creating HMI applications.
- Windows CE operating system with desktop access for configuration and third-party applications.
- Connection to ControlLogix or CompactLogix controllers.
- Ethernet communication that can support Device Level Ring (DLR), linear, or star network topologies.
- Web browser, Microsoft file viewers, text editor, PDF viewer, remote desktop connection, and media player on the terminal desktop.
- Conformal-coating available for all DC power, touch-only terminals, and the 15-inch DC power, touch/keypad terminal.
- Stainless steel, hygienic, brandless, DC-power, and conformal-coating are available for the 9-in. wide-screen, touch-only units and the 12-in. wide-screen, touch- only units.
- On-machine mounting available for the 12-inch wide-screen, DC-powered, touch-screen PanelView™ Plus 7 performance terminal. For more information, see ArmorView Plus 7 Terminals on page 21.

Terminal Features

Features	Description
High memory capacity	512 MB RAM and 512 MB storage Approx. 80 MB nonvolatile storage for applications
Power input	DC or AC
Communication ports	Two 10/100Base-T, Auto MDI/MDI-X, built-in DLR Ethernet port for controller communication
USB ports	Two USB 2.0 high-speed host port (type A) support removable flash drives for storage One high-speed 1.0 device port (type B) supports future connection to host computer
Secure Digital (SD) card slot	One SD card slot
Operating system	All terminals run the Windows CE 6.0 operating system (OS) which provides OS functionality that meets the needs of most users: • FTP server • VNC client/server • PDF reader • Active X controls • Third-party device support • FactoryTalk® ViewPoint
Software	FactoryTalk® View Machine Edition Station (runtime) software, version 8.0 or later, is preloaded and activated on each terminal Single license support for FactoryTalk ViewPoint software, version 1.2 or later, gives remote users access to terminal displays via a standard web browser HMI applications are developed with FactoryTalk View Studio for Machine Edition software, which is purchased separately
Preferred controller	ControlLogix

For complete technical specifications, certifications, and environmental specifications on the PanelView Plus 7 Performance terminals, refer to the PanelView Plus 7 Performance Terminals Technical Data, publication 2711P-TD009.

Terminal Selection

Model	TFT Color Display			Input Power	Brandless
	Cat No.	Size	Input		
700	2711P-T7C22D9P	7-in.	Touch	DC	
	2711P-T7C22D9PK[1]				
	2711P-T7C22D9P-B				x
	2711P-T7C22A9P			AC	
	2711P-T7C22A9P-B				x
	2711P-B7C22D9P		Touch with keypad	DC	
	2711P-B7C22D9P-B				x
	2711P-B7C22A9P			AC	
	2711P-B7C22A9P-B				x
900W	2711P-T9W22D9P	9-in. (Wide)	Touch	DC	
	2711P-T9W22D9PK[1]				
	2711P-T9W22D9P-B				x
	2711P-T9W22D9P-BSHK[2]				
	2711P-T9W22A9P			AC	
	2711P-T9W22A9P-B				x
1000	2711P-T10C22D9P	10-in.	Touch	DC	
	2711P-T10C22D9PK[1]				
	2711P-T10C22D9P-B				x
	2711P-T10C22A9P			AC	
	2711P-T10C22A9P-B				x
	2711P-B10C22D9P		Touch with keypad	DC	
	2711P-B10C22D9P-B				x
	2711P-B10C22A9P			AC	
	2711P-B10C22A9P-B				x
1200W	2711P-T12W22D9P[3]	12-in. (Wide)	Touch	DC	
	2711P-T12W22D9PK[1]				
	2711P-T12W22D9P-B				x
	2711P-T12W22D9P-BSHK[2]				
	2711P-T12W22A9P			AC	
	2711P-T12W22A9P-B				x
1500	2711P-T15C22D9P	15-in.	Touch	DC	
	2711P-T15C22D9PK[1]				
	2711P-T15C22D9P-B				x
	2711P-T15C22A9P			AC	
	2711P-T15C22A9P-B				x
	2711P-B15C22D9P		Touch with keypad	DC	
	2711P-B15C22D9PK[1]				
	2711P-B15C22D9P-B				x
	2711P-B15C22A9P			AC	
	2711P-B15C22A9P-B				x

Terminal Selection (Continued)

Model	TFT Color Display			Input Power	Brandless
	Cat No.	Size	Input		
1900	2711P-T19C22D9P	19-in.	Touch	DC	
	2711P-T19C22D9PK(1)				
	2711P-T19C22D9P-B				x
	2711P-T19C22A9P			AC	
	2711P-T19C22A9P-B				x

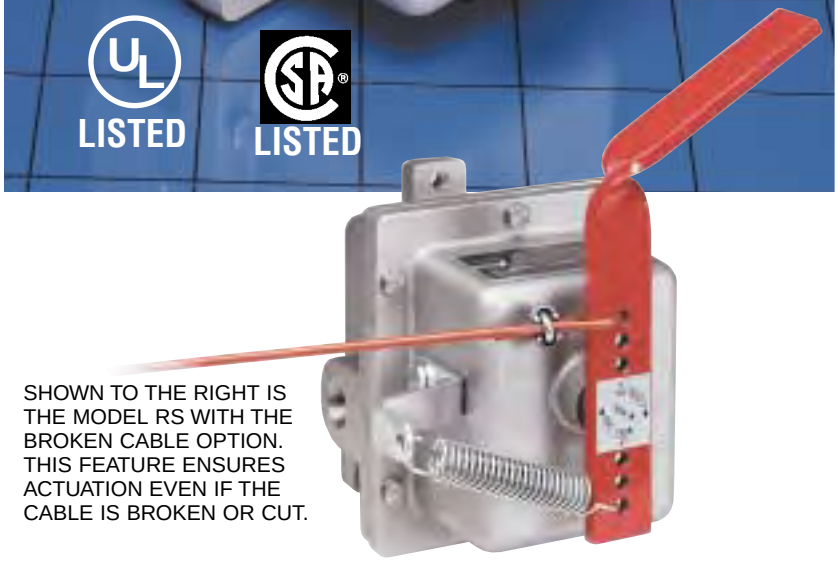
(1) This model includes conformal coating.
(2) No brand identity, stainless steel, hygienic, conformal coat.
(3) This model is included with the ArmorView Plus 7 product.

For information about accessories that are available for these terminals, see page 44.

MODEL RS

CABLE OPERATED SAFETY STOP SWITCH FOR CONVEYORS

The model RS Safety Stop Switch in operation for immediate shutdown of conveyor system at a sand and gravel company.



SHOWN TO THE RIGHT IS THE MODEL RS WITH THE BROKEN CABLE OPTION. THIS FEATURE ENSURES ACTUATION EVEN IF THE CABLE IS BROKEN OR CUT.

WHAT IT IS AND DOES:

The Model RS is a rugged safety switch that provides a quick positive shut off of dangerous equipment in emergencies or normal operation. It is actuated by a cable pulled by endangered personnel. The output contacts of the Model RS can control up to two separate circuits, one for machinery shutdown and one for alarm.

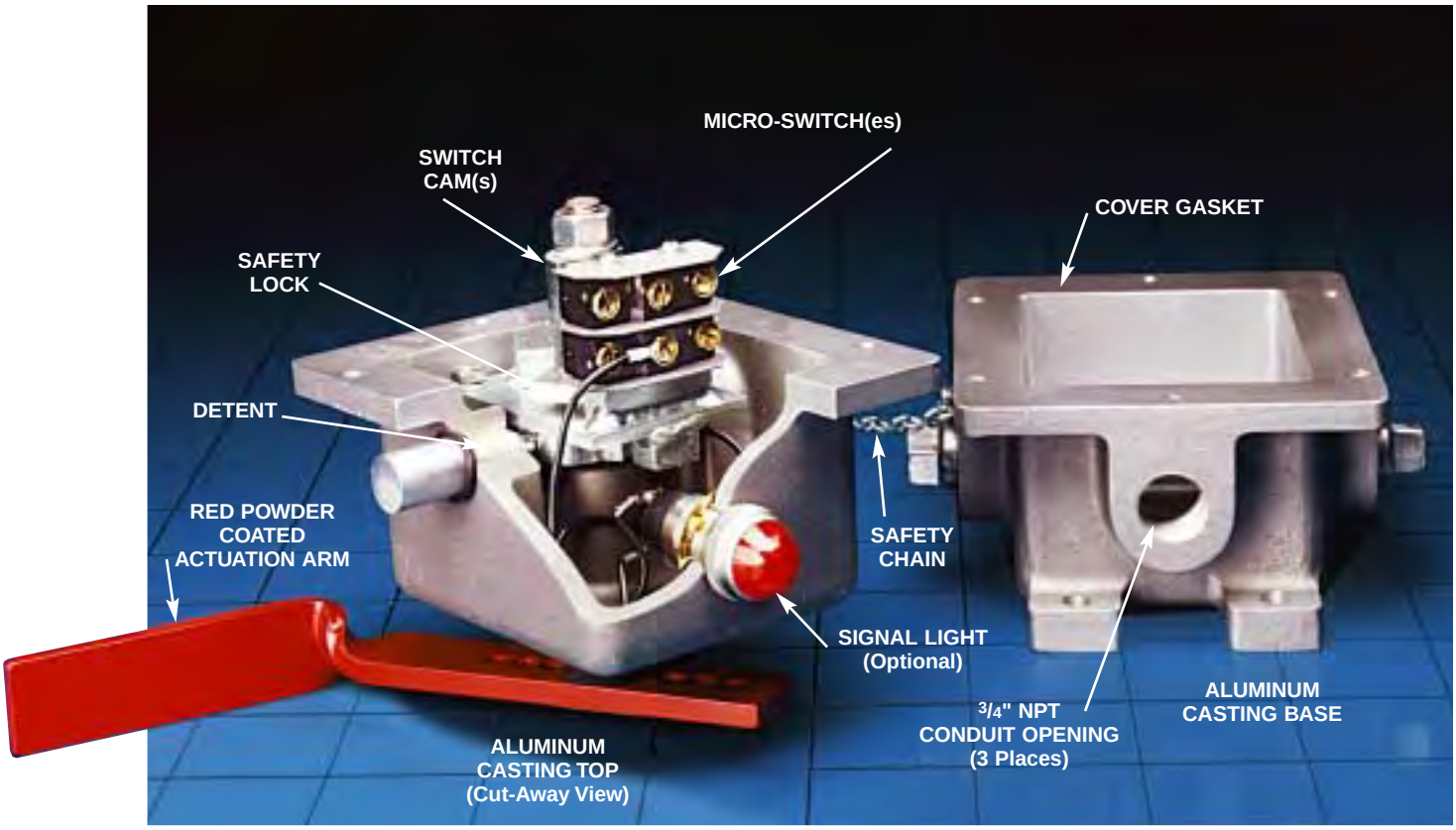
WHY IS IT NECESSARY?

Safety minded operators of conveyors, production lines, elevator equipment, assembly lines, material handling systems, cranes, etc. consider it a must for employee protection. Most states have safety statutes that require these switches on conveyor and related equipment. American National Standard Institute recommends their use in ANSI standard No. ASME B20.1 - 1993-5.11. This ANSI standard will probably soon become part of the Williams-Steiger Act of 1970-the OSHA Act.

EXCLUSIVE FEATURES

1. The Model RS is equipped with a positive safety lock. Having once been actuated, it cannot be accidentally reset causing dangerous equipment to restart. In order to reset the switch, the actuation arm must be pushed in and turned. It takes no longer and it makes this a true “safety” switch.
2. The Model RS is installed with cable extending in both directions from the actuating handle. There is one electrical connection inside. This simple arrangement eliminates the double electrical connections required in two ended units employing a separate micro switch for cable in each direction.
3. The actuation force required is simply adjusted in the field by a change in the position of the cable in holes provided in the actuation arm. One of our units will handle as much cable length as a double ended competitive unit and there is no longer a need to specify actuating force or right or left handed units.
4. The standard construction of the unit is a corrosion resistant aluminum housing complete with stainless steel hardware and red powder coated actuation handle. The actuation shaft is of stainless steel. Powder coated cast iron construction is available if necessary. Epoxy coating of either casting is also available if required.
5. The Model RS controls are listed by Underwriters Laboratories, Inc. and Canadian Standards Association. The general purpose models are listed for non hazardous atmospheres. Explosion proof models are listed for use in hazardous atmospheres as defined by the National Electric Code handbook and the National Electrical Manufacturers Association Standards for NEMA 7 and 9 hazardous locations. Specifically, they are listed for Class I, Groups C and D; and Class II, Groups E,F, and G.
6. Model RS offers the lowest cost per foot of protection because it incorporates fewer switches and less wiring is required. Cable may be extended in either or both directions with no changes required in the internal mechanism of the unit and the wiring is still of a simple uncomplicated nature.
7. The switch is available with a warning light that may be wired to indicate actuation. This permits easy identification of actuated switches in areas where visual identification is difficult.

UL Listed for General Purpose and EXPLOSION PROOF Environments . . . the only switch of its kind to meet these requirements



OPERATION OF THE UNIT:

The unit is usually installed with cable running in both directions from the crank type actuating arm. Each of the two sections of cable runs to a fixed point through eve-bolts spaced at regular intervals.

A pull on the cable at any point along its run will rotate the red actuation arm 60°. The actuation arm will end in a position that is easily seen from a distance, thus identifying the actuated unit. Two spring loaded detents riding on a hardened steel cam provide resistance to arm rotation. When the actuation force overcomes this resistance the assembly rotated the 60° and is locked in place by the detents. Affixed to the rotating shaft is a cam mechanism which actuates up to two micro switches during rotation. The micro switches are held in the actuated position by the detents.

To reset the unit and deactuate the micro switches, the actuation arm is pushed in a rotated backwards.

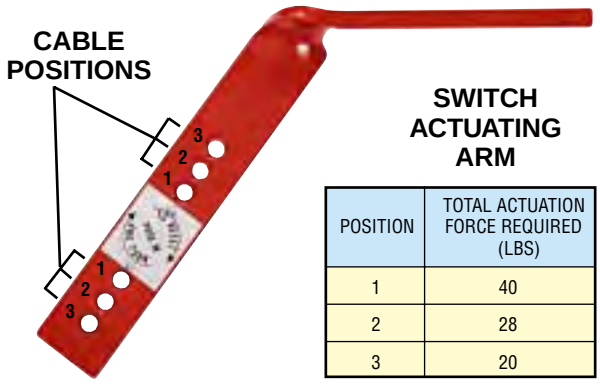
DETERMINATION OF NUMBER OF UNITS REQUIRED:

The Model RS control is designed so that a maximum of 100' of cable can be used on each side of the unit. S single switch can therefore cover a maximum of 200' of conveyor belt or other machinery. Of course, if necessary, cable can be extended in only one direction from either side of the unit. The electrical characteristics of the application will determine the numbers of micro switches to be specified in the unit: either one, or two. The environmental considerations will determine whether or not the unit is to be explosion proof or to have special paint or coatings. The possibility of a light to aid in identification of actuated units should be considered.

We recommend that high quality cable be used with the switch to assure proper actuation with no stretching. We recommend our own galvanized aircraft cable which is available with either vinyl or nylon coating. It is orange in color and weighs .0273 lbs. per foot and has an outside diameter of 3/16".

As shown in the chart and picture of the actuating arm, the actuation force can be varied by attaching the cable at any one of the three positions.

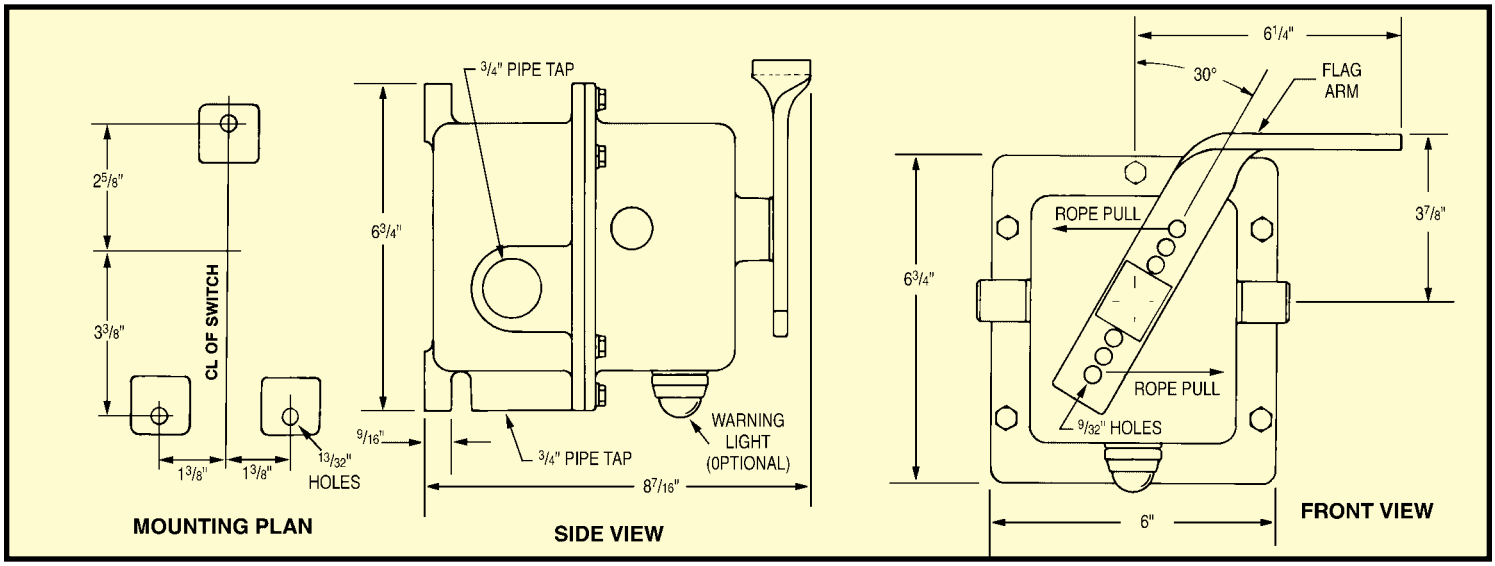
The cable should be supported by eyebolts every 8-10'. These supports ensure that the weight of the cable alone will not actuate the switch.



SWITCH ACTUATING ARM

POSITION	TOTAL ACTUATION FORCE REQUIRED (LBS)
1	40
2	28
3	20

MODEL RS DIMENSIONAL INFORMATION



TECHNICAL INFORMATION

MODEL	DESCRIPTION
RS-1	One sp/dt micro switch
RS-2	Two sp/dt micro switches
RS-2L	Two sp/dt micro switches with external signal light includes 110V lamp
RS-1X	Explosion proof with one sp/dt micro switch for NEMA 7 and 9
RS-2X	Explosion proof with two sp/dt micro switches for NEMA 7 and 9
RSB-1	One sp/dt switch w/cable break detection
RSB-1X	Explosion proof version
RSB-2	Two sp/dt switches w/cable break detection
RSB-2X	Explosion proof version

Standard Construction – rubber gaskets seal unit for outside applications listed by Underwriter Laboratories for for NEMA 4 dust-tight and raintight construction. Applies to units RS-1, RS-2, and RS-2L.
Housing – aluminum or cast iron. Epoxy coating available.
Conduit Opening – 3/4" NPT standard. 1" NPT optional. Standard units have three conduit openings., explosion proof have one at the bottom.
Actuating Arm – Red epoxy coated steel handle with stainless steel shaft.
Internal Cam and Wear Plate – hardened steel.
External Hardware – stainless steel
Switches – sp/dt micro switch. Rated 20 amp at 125, 250 or 480V AC. Switches may be wired for single throw operation, either normally open or normally closed as required.

INSTALLATION INSTRUCTIONS

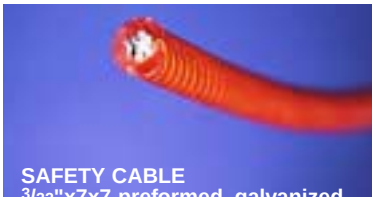
1. The controls should be mounted on a flat surface using the three mounting holes on the bottom half of the housing. The holes are designed for 3/8" bolts.
2. Each switch can cover a maximum of 200' of conveyor — 100' in each direction. Safety considerations dictate that not more than 100' of cable be attached on each side. More cable might result in too much slack, delaying actuation.
3. The eyebolts supporting the cable should be placed at intervals from 8-10'. Care must be taken that the cable does not become too slack. However, if the cable is too tight, false actuation of the switch might occur.
4. The Model RS control is designed for pilot duty. The control circuit should be wired through the motor starter circuit of the conveyor or other equipment to be controlled. Do not wire the unit directly into a heavy duty motor circuit.
5. The unit should be tested after installation by actuation of the cable. The protected equipment should stop and alarms should sound as required with a minimum of effort on the cable. Cable tension can be adjusted if necessary by changing the location of the cable on the handle.

RS-30 BRACKET for mounting the Model RS stop switch to the conveyor stringer at an idler

OPTIONAL CABLE AND FITTINGS

CABLE SUPPOET EYE BOLT
1/2"x6" plated, 2 1/2" long N.C. thread. 1" eye, two nuts and one lockwasher.

CABLE END FITTING
Secures protective cable to switch handle and supports.



SAFETY CABLE
3/32"x7x7 preformed, galvanized aircraft cable. Protective coating in either orange coated vinyl or nylon. 3/16" O.D.

CONDUIT PLUG
3/4" metal, socket head conduit plug.

CONVEYOR COMPONENTS COMPANY

130 Seltzer Road, PO Box 167 · Croswell, MI 48422 USA
PHONE: (810) 679-4211 · TOLL FREE (800) 233-3233 · FAX: (810) 679-4510
Email: info@conveyorcomponents.com · http://www.conveyorcomponents.com

MODEL RS: ROPE SAFETY CONTROL INSTALLATION INSTRUCTIONS

TECHNICAL INFORMATION

Raintight units (standard):

Enclosure type 1, 3, 3R, 4 and 4X dust-tight and raintight construction with corrosion resistance.
Gasket sealed for indoor/outdoor applications.
Aluminum or optional cast iron housing with 3 conduit openings in base casting.

Dual Rated Units:

Enclosure type 1, 3, 3R, 4 and 4X dust-tight and raintight construction, also for use in Class II, Groups E, F & G and Class III Hazardous Locations.
Aluminum or optional cast iron housing with 1 conduit opening in base casting.

Explosion Proof units:

Enclosure for use in Class I, Groups C & D; and Class II, Groups E, F & G, and Class III Hazardous Locations.
Aluminum or optional cast iron housing with 1 conduit opening in base casting.

Electrical Ratings:

SPDT switches:	DPDT switches:
20 Amps, 125/250/480 VAC	15 Amps, 125/250 VAC
10 Amps, 125 VAC Inductive	N/A
1 hp, 125 VAC	3/4 hp, 125 VAC
2 hp, 250 VAC	1 1/2 hp, 250 VAC
½ Amp, 24 VDC	N/A
½ Amp, 125 VDC	N/A
¼ Amp, 250 VDC	N/A

Micro-switch(es) may be wired for single throw operation, either normally open or normally closed as required. See figure 1.

Figure 1: Contacts

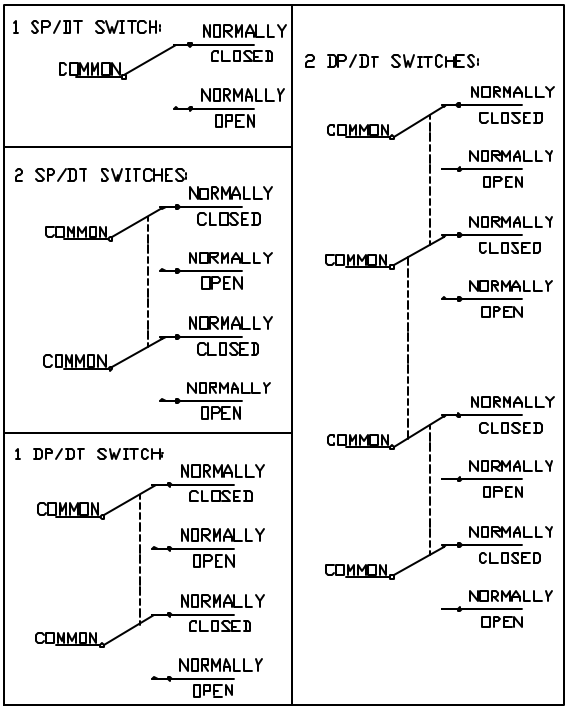
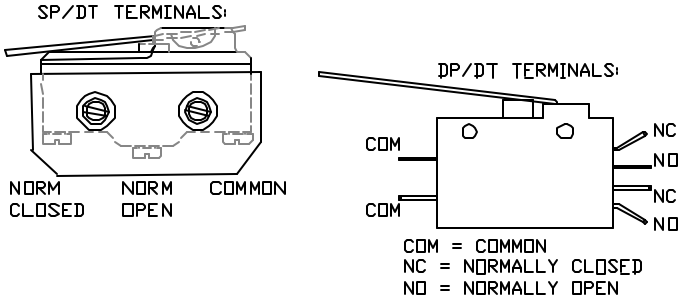


Figure 2: Electrical Terminals



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INSTALLATION INSTRUCTIONS

1. The base should be mounted on a flat surface using the three (3) mounting holes in the base casting (see figure 3). The holes in the base are manufactured for 3/8" bolts.

2. Each unit can cover a maximum of 200 feet of conveyor – 100 feet in each direction. Safety considerations dictate that not more than 100 feet of cable should be attached to each side.

3. The eyebolts supporting the cable should be placed at intervals from 8' – 10'. Care must be taken that the cable does not become too slack. However, if the cable is too tight, false actuation of the unit may occur.

4. This unit is designed for pilot duty. The control circuit should be wired through the motor starter circuit of the conveyor or other equipment to be controlled. Do not wire the unit directly into a heavy duty motor circuit. See "Switch" information on front page.

5. The control should be tested after installation by actuation of the cable. The protected equipment should stop and alarms should sound as required with a minimum effort on the cable. Cable tension can be adjusted as necessary by changing the location of the cable on the handle (see figure 4).

Figure 4: Cable Positions

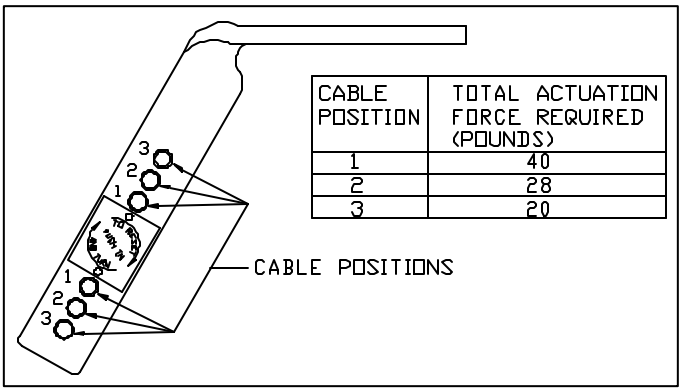
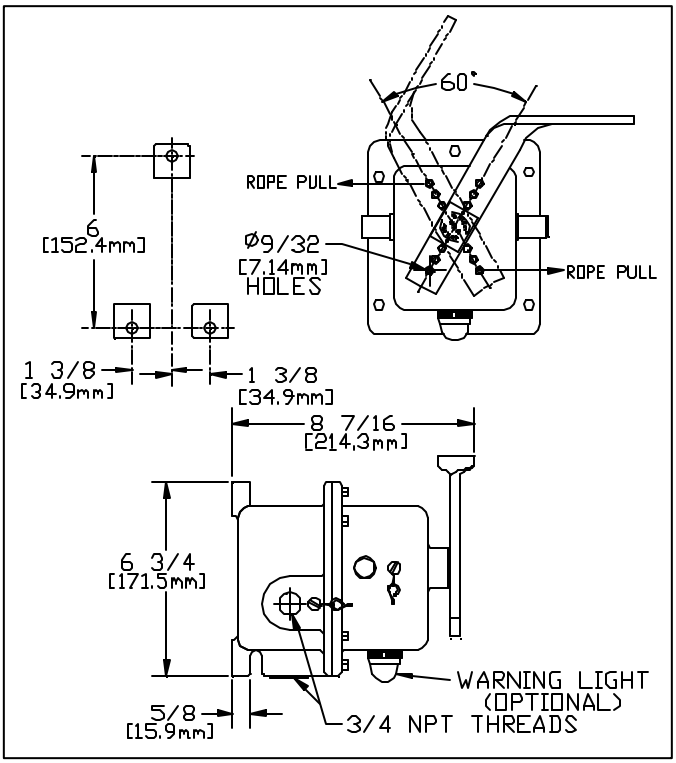


Figure 3: Control Dimensions



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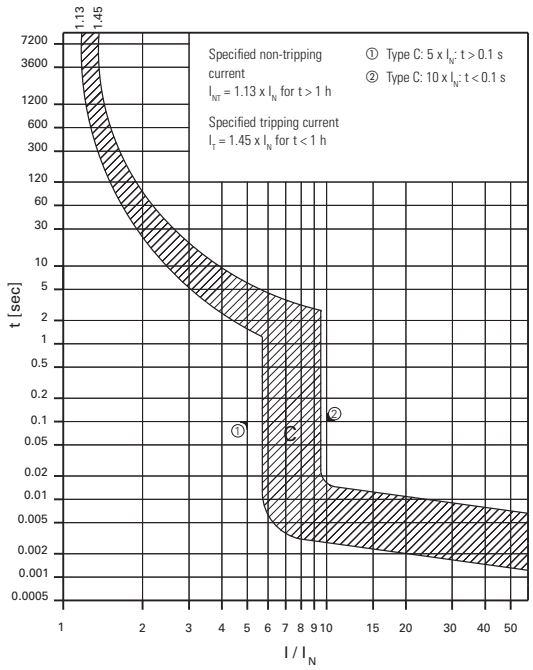
FAZ-NA C Curve 277/480 Vac Rated Offering

- UL approved (UL 489) and CSA Certified (CSA C22.2 No.5-02) as branch circuit breakers
- Interrupting capacity: 10 kA UL/CSA; 15 kA IEC 60947-2
- Current limiting device
- UL file number E235139



Single-Pole

Two-Pole

Three-Pole

Four-Pole

FAZ-NA UL 489 Circuit Breakers at 277/480 Vac—10 kAIC, 14 kAIC C Curve (15–25A)

Amps	Single-Pole ① Catalog Number	Two-Pole Catalog Number	Three-Pole Catalog Number	Four-Pole Catalog Number
C Curve (5–10X I_n Current Rating)				
0.5	**FAZ-C0.5/1-NA-SP**	**FAZ-C0.5/2-NA**	**FAZ-C0.5/3-NA**	**FAZ-C0.5/4-NA**
1	**FAZ-C1/1-NA-SP**	**FAZ-C1/2-NA**	**FAZ-C1/3-NA**	**FAZ-C1/4-NA**
1.5	**FAZ-C1.5/1-NA-SP**	**FAZ-C1.5/2-NA**	**FAZ-C1.5/3-NA**	**FAZ-C1.5/4-NA**
2	**FAZ-C2/1-NA-SP**	**FAZ-C2/2-NA**	**FAZ-C2/3-NA**	**FAZ-C2/4-NA**
3	**FAZ-C3/1-NA-SP**	**FAZ-C3/2-NA**	**FAZ-C3/3-NA**	**FAZ-C3/4-NA**
4	**FAZ-C4/1-NA-SP**	**FAZ-C4/2-NA**	**FAZ-C4/3-NA**	**FAZ-C4/4-NA**
5	**FAZ-C5/1-NA-SP**	**FAZ-C5/2-NA**	**FAZ-C5/3-NA**	**FAZ-C5/4-NA**
6	**FAZ-C6/1-NA-SP**	**FAZ-C6/2-NA**	**FAZ-C6/3-NA**	**FAZ-C6/4-NA**
7	**FAZ-C7/1-NA-SP**	**FAZ-C7/2-NA**	**FAZ-C7/3-NA**	**FAZ-C7/4-NA**
8	**FAZ-C8/1-NA-SP**	**FAZ-C8/2-NA**	**FAZ-C8/3-NA**	**FAZ-C8/4-NA**
10	**FAZ-C10/1-NA-SP**	**FAZ-C10/2-NA**	**FAZ-C10/3-NA**	**FAZ-C10/4-NA**
13	**FAZ-C13/1-NA-SP**	**FAZ-C13/2-NA**	**FAZ-C13/3-NA**	**FAZ-C13/4-NA**
15	**FAZ-C15/1-NA-SP**	**FAZ-C15/2-NA**	**FAZ-C15/3-NA**	**FAZ-C15/4-NA**
16	**FAZ-C16/1-NA-SP**	**FAZ-C16/2-NA**	**FAZ-C16/3-NA**	**FAZ-C16/4-NA**
20	**FAZ-C20/1-NA-SP**	**FAZ-C20/2-NA**	**FAZ-C20/3-NA**	**FAZ-C20/4-NA**
25	**FAZ-C25/1-NA-SP**	**FAZ-C25/2-NA**	**FAZ-C25/3-NA**	**FAZ-C25/4-NA**
30	**FAZ-C30/1-NA-SP**	**FAZ-C30/2-NA**	**FAZ-C30/3-NA**	**FAZ-C30/4-NA**
32	**FAZ-C32/1-NA-SP**	**FAZ-C32/2-NA**	**FAZ-C32/3-NA**	**FAZ-C32/4-NA**

Note

① Option for single packaging on single-pole C and D curves only; add suffix SP when ordering.

EG-Frame (15–125 Amperes)

Contents

EG-Frame (15–125 Amperes)

Product Description

EG breaker is HACR rated.

Catalog Number Selection

This information is presented only as an aid to understanding catalog numbers.
It is not to be used to build catalog numbers for circuit breakers or trip units.

Series G—EG-Frame (15–125 Amperes)

E G H 3 015 FF G

Frame
E

Standard/Application
G = IEC/CE/UL/CSA

Performance				
	600Y/347	**480**	**415**	**240**
B	—	18	18	25
E	18	25	25	35
S	22	35	40	85
H	25	65	70	100
C	25	100	100	200
K	Molded case switch ②			

Number of Poles
1 = One
2 = Two
3 = Three
4 = Four—neutral 0% protected
7 = Four—neutral 100% protected

Amperes
016 ①
015
020
025
030
032 ①
035
040
045
050
060
063 ①
070
080
090
100
110
125
160 ①

Terminations/Hardware	
Terminals	**Mounting Hardware**
M = Metric end caps	Metric
E = Imperial end caps	Imperial
G = Line/load standard	Metric
B = Bolt-on	—

Trip Unit
FF = Fixed fixed
AF = Adjustable thermal fixed magnetic
KS = Molded case switch

Notes

① Cannot be UL rated.
② Available only as 125 and 160 A sizes.

Product Selection

Complete Breaker (Includes Frame, Trip Unit, Standard Terminals and Mounting Hardware) IC Rating at 415/480 Volts

2

EG-Frame

EG-Frame—18/18

Maximum Continuous Amps at 40 °C ①	Single-Pole Fixed Thermal, Fixed Magnetic Catalog Number	Two-Pole Fixed Thermal, Fixed Magnetic Catalog Number	Three-Pole Fixed Thermal, Fixed Magnetic Catalog Number	Three-Pole Adjustable ② Thermal, Fixed Magnetic Catalog Number	Four-Pole ③ Fixed Thermal, Fixed Magnetic Catalog Number	Four-Pole ③ Adjustable ② Thermal, Fixed Magnetic Catalog Number
15	**EGB1015FFG**	**EGB2015FFG**	**EGB3015FFG**	—	**EGB4015FFG**	—
16	**EGB1016FFG**	**EGB2016FFG**	**EGB3016FFG**	—	**EGB4016FFG**	—
20	**EGB1020FFG**	**EGB2020FFG**	**EGB3020FFG**	—	**EGB4020FFG**	**EGB4020AFG**
25	**EGB1025FFG**	**EGB2025FFG**	**EGB3025FFG**	**EGB3025AFG**	**EGB4025FFG**	**EGB4025AFG**
30	**EGB1030FFG**	**EGB2030FFG**	**EGB3030FFG**	—	**EGB4030FFG**	—
32	**EGB1032FFG**	**EGB2032FFG**	**EGB3032FFG**	**EGB3032AFG**	**EGB4032FFG**	**EGB4032AFG**
35	**EGB1035FFG**	**EGB2035FFG**	**EGB3035FFG**	—	**EGB4035FFG**	—
40	**EGB1040FFG**	**EGB2040FFG**	**EGB3040FFG**	**EGB3040AFG**	**EGB4040FFG**	**EGB4040AFG**
45	**EGB1045FFG**	**EGB2045FFG**	**EGB3045FFG**	—	**EGB4045FFG**	—
50	**EGB1050FFG**	**EGB2050FFG**	**EGB3050FFG**	**EGB3050AFG**	**EGB4050FFG**	**EGB4050AFG**
60	**EGB1060FFG**	**EGB2060FFG**	**EGB3060FFG**	—	**EGB4060FFG**	—
63	**EGB1063FFG**	**EGB2063FFG**	**EGB3063FFG**	**EGB3063AFG**	**EGB4063FFG**	**EGB4063AFG**
70	**EGB1070FFG**	**EGB2070FFG**	**EGB3070FFG**	—	**EGB4070FFG**	—
80	**EGB1080FFG**	**EGB2080FFG**	**EGB3080FFG**	**EGB3080AFG**	**EGB4080FFG**	**EGB4080AFG**
90	**EGB1090FFG**	**EGB2090FFG**	**EGB3090FFG**	—	**EGB4090FFG**	—
100	**EGB1100FFG**	**EGB2100FFG**	**EGB3100FFG**	**EGB3100AFG**	**EGB4100FFG**	**EGB4100AFG**
110	**EGB1110FFG**	**EGB2110FFG**	**EGB3110FFG**	—	**EGB4110FFG**	—
125	**EGB1125FFG**	**EGB2125FFG**	**EGB3125FFG**	**EGB3125AFG**	**EGB4125FFG**	**EGB4125AFG**
160	—	—	**EGB3160FFG**	**EGB3160AFG**	**EGB4160FFG**	**EGB4160AFG**

Notes

① 16, 32, 63 and 160 A are not UL listed ratings.
② Adjustable thermal are not UL listed.
③ Change the fourth digit to 7 for 100% neutral protection. Neutral is on the LH side.

EG-Frame—25/25 Single-Pole Unavailable

EG-Frame

EG-Frame—25/25

	Two-Pole	Three-Pole		Four-Pole ③	
	Fixed Thermal, Fixed Magnetic	Fixed Thermal, Fixed Magnetic	Adjustable ② Thermal, Fixed Magnetic	Fixed Thermal, Fixed Magnetic	Adjustable ② Thermal, Fixed Magnetic
Maximum Continuous Amps at 40 °C ①	Catalog Number	Catalog Number	Catalog Number	Catalog Number	Catalog Number
15	**EGE2015FFG**	**EGE3015FFG**	—	**EGE4015FFG**	—
16	**EGE2016FFG**	**EGE3016FFG**	—	**EGE4016FFG**	—
20	**EGE2020FFG**	**EGE3020FFG**	—	**EGE4020FFG**	**EGE4020AFG**
25	**EGE2025FFG**	**EGE3025FFG**	**EGE3025AFG**	**EGE4025FFG**	**EGE4025AFG**
30	**EGE2030FFG**	**EGE3030FFG**	—	**EGE4030FFG**	—
32	**EGE2032FFG**	**EGE3032FFG**	**EGE3032AFG**	**EGE4032FFG**	**EGE4032AFG**
35	**EGE2035FFG**	**EGE3035FFG**	—	**EGE4035FFG**	—
40	**EGE2040FFG**	**EGE3040FFG**	**EGE3040AFG**	**EGE4040FFG**	**EGE4040AFG**
45	**EGE2045FFG**	**EGE3045FFG**	**EGE3050AFG**	**EGE4045FFG**	—
50	**EGE2050FFG**	**EGE3050FFG**	—	**EGE4050FFG**	**EGE4050AFG**
60	**EGE2060FFG**	**EGE3060FFG**	—	**EGE4060FFG**	—
63	**EGE2063FFG**	**EGE3063FFG**	**EGE3063AFG**	**EGE4063FFG**	**EGE4063AFG**
70	**EGE2070FFG**	**EGE3070FFG**	—	**EGE4070FFG**	—
80	**EGE2080FFG**	**EGE3080FFG**	**EGE3080AFG**	**EGE4080FFG**	**EGE4080AFG**
90	**EGE2090FFG**	**EGE3090FFG**	—	**EGE4090FFG**	—
100	**EGE2100FFG**	**EGE3100FFG**	**EGE3100AFG**	**EGE4100FFG**	**EGE4100AFG**
125	**EGE2125FFG**	**EGE3125FFG**	**EGE3125AFG**	**EGE4125FFG**	**EGE4125AFG**
160	—	**EGE3160FFG**	**EGE3160AFG**	**EGE4160FFG**	**EGE4160AFG**

Notes

① 16, 32, 63 and 160 A are not UL listed ratings.
② Adjustable thermal are not UL listed.
③ Change the fourth digit to 7 for 100% neutral protection. Neutral is on the LH side.

EG-Frame

EG-Frame—40/35

Maximum Continuous Amps at 40 °C ①	Single-Pole Fixed Thermal, Fixed Magnetic Catalog Number	Two-Pole Fixed Thermal, Fixed Magnetic Catalog Number	Three-Pole Fixed Thermal, Fixed Magnetic Catalog Number	Three-Pole Adjustable ② Thermal, Fixed Magnetic Catalog Number	Four-Pole ③ Fixed Thermal, Fixed Magnetic Catalog Number	Four-Pole ③ Adjustable ② Thermal, Fixed Magnetic Catalog Number
15	**EGS1015FFG**	**EGS2015FFG**	**EGS3015FFG**	—	**EGS4015FFG**	—
16	**EGS1016FFG**	**EGS2016FFG**	**EGS3016FFG**	—	**EGS4016FFG**	—
20	**EGS1020FFG**	**EGS2020FFG**	**EGS3020FFG**	—	**EGS4020FFG**	**EGS4020AFG**
25	**EGS1025FFG**	**EGS2025FFG**	**EGS3025FFG**	**EGS3025AFG**	**EGS4025FFG**	**EGS4025AFG**
30	**EGS1030FFG**	**EGS2030FFG**	**EGS3030FFG**	—	**EGS4030FFG**	—
32	**EGS1032FFG**	**EGS2032FFG**	**EGS3032FFG**	**EGS3032AFG**	**EGS4032FFG**	**EGS4032AFG**
35	**EGS1035FFG**	**EGS2035FFG**	**EGS3035FFG**	—	**EGS4035FFG**	—
40	**EGS1040FFG**	**EGS2040FFG**	**EGS3040FFG**	**EGS3040AFG**	**EGS4040FFG**	**EGS4040AFG**
45	**EGS1045FFG**	**EGS2045FFG**	**EGS3045FFG**	—	**EGS4045FFG**	—
50	**EGS1050FFG**	**EGS2050FFG**	**EGS3050FFG**	**EGS3050AFG**	**EGS4050FFG**	**EGS4050AFG**
60	**EGS1060FFG**	**EGS2060FFG**	**EGS3060FFG**	—	**EGS4060FFG**	—
63	**EGS1063FFG**	**EGS2063FFG**	**EGS3063FFG**	**EGS3063AFG**	**EGS4063FFG**	**EGS4063AFG**
70	**EGS1070FFG**	**EGS2070FFG**	**EGS3070FFG**	—	**EGS4070FFG**	—
80	**EGS1080FFG**	**EGS2080FFG**	**EGS3080FFG**	**EGS3080AFG**	**EGS4080FFG**	**EGS4080AFG**
90	**EGS1090FFG**	**EGS2090FFG**	**EGS3090FFG**	—	**EGS4090FFG**	—
100	**EGS1100FFG**	**EGS2100FFG**	**EGS3100FFG**	**EGS3100AFG**	**EGS4100FFG**	**EGS4100AFG**
125	**EGS1125FFG**	**EGS2125FFG**	**EGS3125FFG**	**EGS3125AFG**	**EGS4125FFG**	**EGS4125AFG**
160	—	—	**EGS3160FFG**	**EGS3160AFG**	**EGS4160FFG**	**EGS4160AFG**

Notes

① 16, 32, 63 and 160 A are not UL listed ratings.
② Adjustable thermal are not UL listed.
③ Change the fourth digit to 7 for 100% neutral protection. Neutral is on the LH side.

EG-Frame

EG-Frame—70/65

Maximum Continuous Amps at 40 °C ①	Single-Pole Fixed Thermal, Fixed Magnetic Catalog Number	Two-Pole Fixed Thermal, Fixed Magnetic Catalog Number	Three-Pole Fixed Thermal, Fixed Magnetic Catalog Number	Three-Pole Adjustable ② Thermal, Fixed Magnetic Catalog Number	Four-Pole ③ Fixed Thermal, Fixed Magnetic Catalog Number	Four-Pole ③ Adjustable ② Thermal, Fixed Magnetic Catalog Number
15	EGH1015FFG	EGH2015FFG	EGH3015FFG	—	EGH4015FFG	—
16	EGH1016FFG	EGH2016FFG	EGH3016FFG	—	EGH4016FFG	—
20	EGH1020FFG	EGH2020FFG	EGH3020FFG	EGH3020AFG	EGH4020FFG	EGH4020AFG
25	EGH1025FFG	EGH2025FFG	EGH3025FFG	EGH3025AFG	EGH4025FFG	EGH4025AFG
30	EGH1030FFG	EGH2030FFG	EGH3030FFG	—	EGH4030FFG	—
32	EGH1032FFG	EGH2032FFG	EGH3032FFG	EGH3032AFG	EGH4032FFG	EGH4032AFG
35	EGH1035FFG	EGH2035FFG	EGH3035FFG	—	EGH4035FFG	—
40	EGH1040FFG	EGH2040FFG	EGH3040FFG	EGH3040AFG	EGH4040FFG	EGH4040AFG
45	EGH1045FFG	EGH2045FFG	EGH3045FFG	—	EGH4045FFG	EGH4050AFG
50	EGH1050FFG	EGH2050FFG	EGH3050FFG	EGH3050AFG	EGH4050FFG	—
60	EGH1060FFG	EGH2060FFG	EGH3060FFG	—	EGH4060FFG	—
63	EGH1063FFG	EGH2063FFG	EGH3063FFG	EGH3063AFG	EGH4063FFG	EGH4063AFG
70	EGH1070FFG	EGH2070FFG	EGH3070FFG	—	EGH4070FFG	—
80	EGH1080FFG	EGH2080FFG	EGH3080FFG	EGH3080AFG	EGH4080FFG	EGH4080AFG
90	EGH1090FFG	EGH2090FFG	EGH3090FFG	—	EGH4090FFG	—
100	EGH1100FFG	EGH2100FFG	EGH3100FFG	EGH3100AFG	EGH4100FFG	EGH4100AFG
125	EGH1125FFG	EGH2125FFG	EGH3125FFG	EGH3125AFG	EGH4125FFG	EGH4125AFG

Notes

① 16, 32, 63 A are not UL listed ratings.
② Adjustable thermal are not UL listed.
③ Change the fourth digit to 7 for 100% neutral protection. Neutral is on the LH side.

Product specifications

Eaton EGH2015FFG

Catalog Number: EGH2015FFG

Eaton Series G molded case circuit breaker, EG-frame, EG, Fixed thermal, fixed magnetic trip, Two-pole, 15A, 600Y/347 Vac, 100 kAIC at 240 Vac, 65 kAIC at 480 Vac, 35 kAIC at 600Y/347 Vac, Line and load, 50/60 Hz

General specifications

Product Name
Eaton Series G complete molded case circuit breaker

Catalog Number
EGH2015FFG

UPC
786685018942

Product Length/Depth
2.99 in

Product Height
3 in

Product Width
2 in

Product Weight
1.9 lb

Warranty
Eaton Selling Policy 25-000, one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.

Compliances
CE Marked

Certifications
IEC Rated
CSA Certified
UL Listed

Product specifications

Series

Series G

Interrupt rating

100 kAIC at 240 Vac
65 kAIC at 480 Vac
35 kAIC at 600Y/347 Vac

Type

Complete breaker

Frame

EG

Circuit breaker type

EG

Frequency rating

50/60 Hz

Circuit breaker frame type

Complete breaker

Terminals

Line and load

Voltage rating

600Y/347 Vac

Amperage Rating

15 A

Trip Type

Fixed thermal, fixed magnetic

Number of poles

Two-pole

Resources

Application notes

Application of Tap Rules to Molded Case Breaker Terminals

Application of Multi-Wire Terminals for Molded Case Circuit Breakers

Brochures

Series G MCCB quick selector

Motor protection circuit breakers product aid

Comprehensive circuit protection for control panel applications

High performance operating handles for Series G circuit breakers product aid

Multi-wire lugs product aid

Power metering and monitoring with Modbus RTU product aid

StrandAble terminals product aid

Circuit breaker motor operators product aid

Current limiting molded case circuit breaker module product aid

Molded case circuit breakers providing higher levels of selective coordination product aid

Plug-in adapters for molded case circuit breakers product aid

Current limiting molded case circuit breaker module for series G, JG and CL

Breaker service centers

Catalogs

Eaton's Volume 4—Circuit Protection

Molded case circuit breakers catalog

Specifications and datasheets

MOEM MCCB product selection guide

NG and ND-Frame molded case circuit breakers

Eaton Specification Sheet - EGH2015FFG

Product specifications

Eaton EGH3015FFG

Catalog Number: EGH3015FFG

Eaton Series G molded case circuit breaker, EG-frame, EG, Fixed thermal, Fixed magnetic trip, Three-pole, 15 A, 600Y/347 Vac, 100 kAIC at 240 Vac, 65 kAIC at 480 Vac, 35 kAIC at 600Y/347 Vac, Line and load, 50/60 Hz

General specifications

Product Name
Eaton Series G complete molded case circuit breaker

Catalog Number
EGH3015FFG

UPC
782116131204

Product Length/Depth
2.99 in

Product Height
5.5 in

Product Width
3 in

Product Weight
3 lb

Warranty
Eaton Selling Policy 25-000, one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.

Compliances
CE Marked

Certifications
IEC Rated
CSA Certified
UL Listed

Product specifications

Series

Series G

Interrupt rating

35 kAIC at 600Y/347 Vac

65 kAIC at 480 Vac

100 kAIC at 240 Vac

Type

Complete breaker

Frame

EG

Circuit breaker type

EG

Frequency rating

50/60 Hz

Circuit breaker frame type

Complete breaker

Terminals

Line and load

Voltage rating

600Y/347 Vac

Amperage Rating

15 A

Trip Type

Fixed thermal, fixed magnetic

Number of poles

Three-pole

Resources

Application notes

Application of Multi-Wire Terminals for Molded Case Circuit Breakers

Application of Tap Rules to Molded Case Breaker Terminals

Brochures

Multi-wire lugs product aid

StrandAble terminals product aid

Series G Molded Case Circuit Breakers - Quick Selector

Current limiting molded case circuit breaker module for series G, JG and CL

Comprehensive circuit protection for control panel applications

Plug-in adapters for molded case circuit breakers product aid

Circuit breaker motor operators product aid

Power metering and monitoring with Modbus RTU product aid

Series G MCCB quick selector

High performance operating handles for Series G circuit breakers product aid

Molded case circuit breakers providing higher levels of selective coordination product aid

Current limiting molded case circuit breaker module product aid

Motor protection circuit breakers product aid

Breaker service centers

Catalogs

Eaton's Volume 4—Circuit Protection

Molded case circuit breakers catalog

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MOEM MCCB product selection guide

NG and ND-Frame molded case circuit breakers

Eaton Specification Sheet - EGH3015FFG

Warranty guides

Selling Policy 25-000 - Distribution and Control Products and Services

Product specifications

Eaton EGH3030FFG

Catalog Number: EGH3030FFG

Eaton Series G molded case circuit breaker, EG-frame, EG, Fixed thermal, Fixed magnetic trip, Three-pole, 30 A, 600Y/347 Vac, 100 kAIC at 240 Vac, 65 kAIC at 480 Vac, 35 kAIC at 600Y/347 Vac, Line and load, 50/60 Hz

General specifications

Product Name
Eaton Series G complete molded case circuit breaker

Catalog Number
EGH3030FFG

UPC
782114877517

Product Length/Depth
2.99 in

Product Height
5.5 in

Product Width
3 in

Product Weight
2.7 lb

Warranty
Eaton Selling Policy 25-000, one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.

Compliances
CE Marked

Certifications
UL Listed
CSA Certified
IEC Rated

Product specifications

Series

Series G

Interrupt rating

35 kAIC at 600Y/347 Vac

65 kAIC at 480 Vac

100 kAIC at 240 Vac

Type

Complete breaker

Frame

EG

Circuit breaker type

EG

Frequency rating

50/60 Hz

Circuit breaker frame type

Complete breaker

Terminals

Line and load

Voltage rating

600Y/347 Vac

Amperage Rating

30 A

Trip Type

Fixed thermal, fixed magnetic

Number of poles

Three-pole

Resources

Application notes

Application of Multi-Wire Terminals for Molded Case Circuit Breakers

Application of Tap Rules to Molded Case Breaker Terminals

Brochures

Current limiting molded case circuit breaker module for series G, JG and CL

Series G Molded Case Circuit Breakers - Quick Selector

StrandAble terminals product aid

High performance operating handles for Series G circuit breakers product aid

Series G MCCB quick selector

Power metering and monitoring with Modbus RTU product aid

Circuit breaker motor operators product aid

Multi-wire lugs product aid

Molded case circuit breakers providing higher levels of selective coordination product aid

Plug-in adapters for molded case circuit breakers product aid

Motor protection circuit breakers product aid

Comprehensive circuit protection for control panel applications

Current limiting molded case circuit breaker module product aid

Breaker service centers

Catalogs

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Molded case circuit breakers catalog

Specifications and datasheets

Eaton Specification Sheet - EGH3030FFG

NG and ND-Frame molded case circuit breakers

MOEM MCCB product selection guide

Product specifications

Eaton AN59DN0A5E005

Catalog Number: AN59DN0A5E005

Eaton Freedom NEMA Starter, Full voltage reversing, C440 electronic overload relay, NEMA Size 1 open enclosure - 27 A, Horizontal mounting, 120/60 or 110/50 coil voltage, C440 standard feature set - 1–5 A

General specifications

Product Name
Eaton Freedom NEMA motor control starter

Catalog Number
AN59DN0A5E005

UPC
786685413761

Product Length/Depth
9 in

Product Height
7 in

Product Width
7 in

Product Weight
7 lb

Warranty
1 year

Compliances
RoHS Compliant

Certifications
UL
CSA
CE
NEMA

Product specifications

Mounting
Horizontal

Overload relay
C440 electronic

Special features
With C440 EOLR standard feature set, SEL reset, SEL class (10a, 10, 20, 30)

Size
1

Coil voltage
120/60 or 110/50

NEMA frame size
NEMA Size 1

Relay
C440 electronic

Type
Starter

Configuration
Reversing

Amperage Rating
27 A

Resources

Catalogs
Eaton's Volume 5—Motor Control and Protection

Specifications and datasheets
Eaton Specification Sheet - AN59DN0A5E005

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Product specifications

Eaton AN59DN0A5E020

Catalog Number: AN59DN0A5E020

Eaton Freedom NEMA Starter, Full voltage reversing, C440 electronic overload relay, NEMA Size 1 open enclosure - 27 A, Horizontal mounting, 120/60 or 110/50 coil voltage, C440 standard feature set - 4–20 A

General specifications

Product Name
Eaton Freedom NEMA motor control starter

Catalog Number
AN59DN0A5E020

UPC
786685413808

Product Length/Depth
4.98 in

Product Height
7.1 in

Product Width
6.7 in

Product Weight
8.2 lb

Warranty
1 year

Compliances
RoHS Compliant

Certifications
UL
CSA
CE
NEMA

Product specifications

Mounting

Horizontal

Overload relay

C440 electronic

Special features

With C440 EOLR standard feature set, SEL reset, SEL class (10a, 10, 20, 30)

Size

1

Coil voltage

120/60 or 110/50

NEMA frame size

NEMA Size 1

Relay

C440 electronic

Type

Starter

Configuration

Reversing

Amperage Rating

27 A

Resources

Catalogs

Eaton's Volume 5—Motor Control and Protection

Specifications and datasheets

Eaton Specification Sheet - AN59DN0A5E020

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Product specifications

Eaton ZEB-XRR-120

Catalog Number: ZEB-XRR-120

C440 / XTOE Accessories, Remote reset module (120 Vac)

General specifications

Product Name
Eaton control product reset module

Catalog Number
ZEB-XRR-120

UPC
786685423630

Product Length/Depth
2.4 in

Product Height
3.2 in

Product Width
2.1 in

Product Weight
0.4 lb

Warranty
Eaton Selling Policy 25-000, one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.

Compliances
CE Marked

Certifications
UL Listed
CSA Certified

Catalog Notes
Remote reset module (120 Vac)

Product specifications

Special features

Used with Freedom NEMA Overloads

Type

Remote Reset Module (120V)

Resources

Catalogs

Counters, Panel Meters, Tachometers and Timers

Eaton's Volume 5—Motor Control and Protection

Drawings

ZEB-XRR-120 3D Inventor

ZEB-XRR-120 2D PDF

ZEB-XRR-120 AutoCAD 2D Footprint

ZEB-XRR-120 AutoCAD 2D Footprint (mm)

ZEB-XRR-120 3D Model Xchange

ZEB-XRR-120 2D Drawing Xchange

Specifications and datasheets

Eaton Specification Sheet - ZEB-XRR-120

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Product specifications

Eaton EHMFS03X

Catalog Number: EHMFS03X

Eaton molded case circuit breaker accessory handle mechanism, Flex shaft flange-mounted handle mechanism, EG-Frame, Series G, 3 in

General specifications

Product Name
Eaton molded case circuit breaker accessory handle mechanism

Catalog Number
EHMFS03X

UPC
782113681191

Product Length/Depth
20 in

Product Height
2.5 in

Product Width
19 in

Product Weight
6.1 lb

Warranty
Eaton Selling Policy 25-000, one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.

Compliances
Contact Manufacturer

Product specifications

Series

Series G

Type

Flex shaft flange-mounted handle mechanism

Used with

EG-frame

Shaft length

3 in

Resources

Application notes

Application of Multi-Wire Terminals for Molded Case Circuit Breakers

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Multi-wire lugs product aid

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StrandAble terminals product aid

Plug-in adapters for molded case circuit breakers product aid

Series G MCCB quick selector

Current limiting molded case circuit breaker module product aid

Series G Handle Mechanism

Breaker service centers

Catalogs

Molded case circuit breakers catalog

Installation instructions

Flex Shaft Handle Mechanism for Series G EG-Frame

Multimedia

Flex shaft handle installation tutorial

Specifications and datasheets

MOEM MCCB product selection guide

Eaton Specification Sheet - EHMFS03X

NG and ND-Frame molded case circuit breakers

Warranty guides

Selling Policy 25-000 - Distribution and Control Products and Services

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71492916
2020-08-17

Technical Information
Micropilot FMR20 HART

Free space radar

Level measurement for liquids

Application

- Ingress protection: IP66/68 / NEMA 4X/6P
- Measuring range: up to 20 m (66 ft)
- Process temperature: –40 to 80 °C (–40 to 176 °F)
- Process pressure: –1 to 3 bar (–14 to 43 psi)
- Accuracy: up to ± 2 mm (0.08 in)
- International explosion protection certificates

Your benefits

- Level measurement for liquids in storage tanks, open basins, pump shafts and canal systems
- Radar measuring device with *Bluetooth*® wireless technology and HART communication
- Simple, safe and secure wireless remote access – ideal for installation in hazardous areas or places difficult to reach
- Commissioning, operation and maintenance via free iOS / Android app SmartBlue – saves time and reduces costs
- Full PVDF body - for a long sensor lifetime
- Hermetically sealed wiring and fully potted electronics – eliminates water ingress and allows operation under harsh environmental conditions
- Most compact radar due to unique radar chip design – fits in limited space installations
- Best price-performance-ratio radar

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Radar Element Configuration

QTY		Order code Description
1	PC	Micropilot FMR20 Model no.: FMR20-3A36/0 (FMR20-CBPBNVCERSF3)
		Level, radar, contactless and maintenance-free. Economic device. Application: water based liquids (DC >4). :: Reliable measuring: for changing medias, pressure, temperatures, gas phases. :: Floodable sensor design: IP68/NEMA6P.
	CB	Approval: CSA C/US IS Cl.I Div.1 Gr.A-D, AEx/Ex ia IIC T4
	P	Power Supply; Output; Operation: 2-wire; 4-20mA HART; HART/Bluetooth (App) configuration
	BN	Antenna; Max. Measuring Range: 80mm/3”; 20m liquid -40oC...80oC/-40…176oF
	VCE	Process Connection Rear Side; Material: Thread ASME MNPT1; PVDF; FNPT1/2 conduit connection
	RSF	Process Connection Front Side; Material: UNI slip on flange 6”/DN150/150; PP max 4bar abs./58psia, suitable for 6” 150lbs/DN150 PN16/10K 150
	3	Cable Length: 20m/65ft

Technical Information
Barrier RB223

One or two-channel barrier

Loop-powered barrier for the safe separation of 4 to 20 mA standard signal circuits

Application

- Separation of active 0/4 to 20 mA signals from transmitters, valves and adjusters

Your benefits

- Compact side-by-side housing
- Space-saving one-channel and two-channel version
- No power supply necessary
- International Ex approvals
  ATEX, FM, CSA
- Can be used up to SIL3
- Bidirectional HART® transmission
- Communication sockets for HART® + integrated HART® resistor for sensor configuration

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Function and system design

Measuring principle

The passive barrier is used for galvanic isolation of active signal loops (0/4 to 20 mA) in three applications:

- Transmission from non-Ex-areas to Ex-areas, e.g. for active actuators, controllers or indicators
- Transmission from Ex-areas to non-Ex-areas for the linking of active, intrinsically safe loops in the Ex-area to a PLC
- Transmission of signals (0/4 to 20 mA) from the Ex-area to the non-Ex-area when an intrinsically safe transmitter in the Ex-area is supplied by a not intrinsically safe loop power supply in the non-Ex-area

The device has an analog input and an intrinsically safe analog output or an output and an intrinsically safe input. As an option the device is available as a 2-channel version. The barrier is used for intrinsically safe operation of sensors, valves and actuators.
The device is supplied from the current loop without a separate power supply.

Measuring system

The standard instrument has one analog input and one analog output. A two-channel instrument with two analog inputs and two analog outputs is available as an option.

Ex to nonEx:

Active 4-wire sensor, e.g. Promag 50

Passive current input, e.g. RIA15

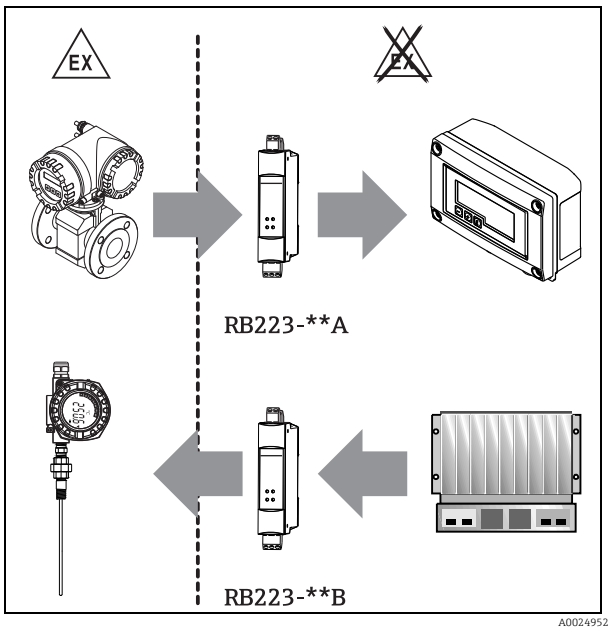
RB223-**A

NonEx to Ex:

Passive 2-wire sensor, e.g. TMT162

Active current input, e.g. SPS

RB223-**B



Input

Direction of power transmission nonEx → Ex

- 0/4 to 22 mA, (for specified accuracy)
- 0 to 40 mA operating range
- Max. effective voltage < 26 V for specified accuracy
- I_{max} = 100 mA (short-circuit current of protective diode in event of overvoltage)
- U_{max} = 30 V (limiting voltage of protective diode)
- Reverse polarity protection
- R_i < 400 Ω (without HART® resistor 232 Ω)

Direction of power transmission Ex → nonEx

- 0/4 to 22 mA, (for specified accuracy)
- Intrinsically safe [Ex ia] as per ATEX, FM, CSA
- 0 to 40 mA operating range
- Reverse polarity protection
- R_i < 120 Ω (without HART® resistor 232 Ω)
- Max. effective voltage < 26 V

Output

Direction of power transmission nonEx → Ex

- 0/4 to 22 mA, (for specified accuracy)
- 0 to 40 mA operating range (max. current depends on the load)
- Max. load (load resistance) = 0 to 600 Ω
- Intrinsically safe [Ex ia] as per ATEX, FM, CSA

Direction of power transmission Ex → nonEx

- 0/4 to 22 mA (for specified accuracy)
- 0 to 40 mA operating range (max. current depends on the load)
- Max. load (load resistance) = 0 to 600 Ω

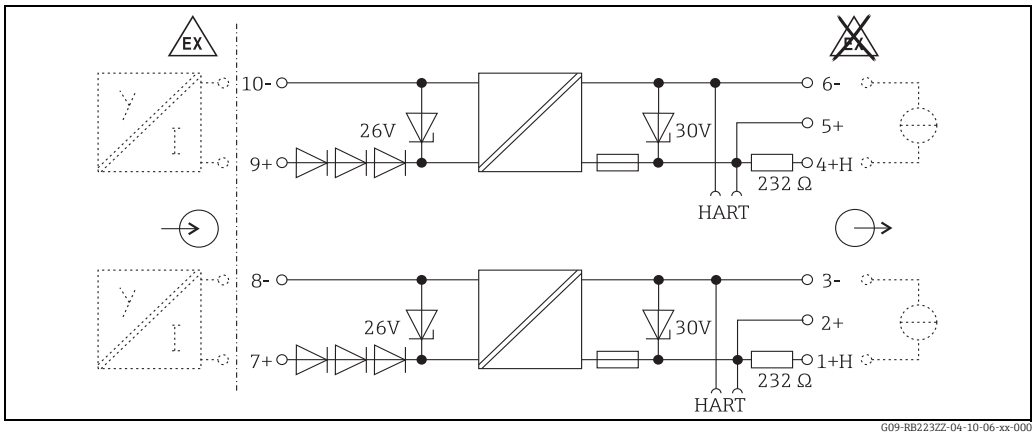
Galvanic isolation

Testing voltage

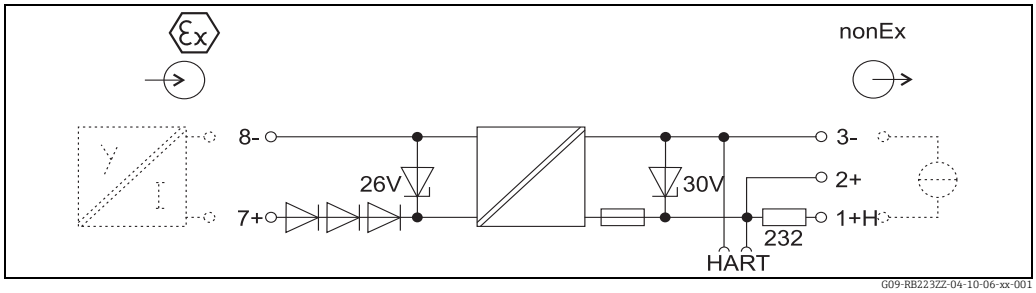
> 1.5 kV AC between input and output
> 1.5 kV AC between the channels

Power supply

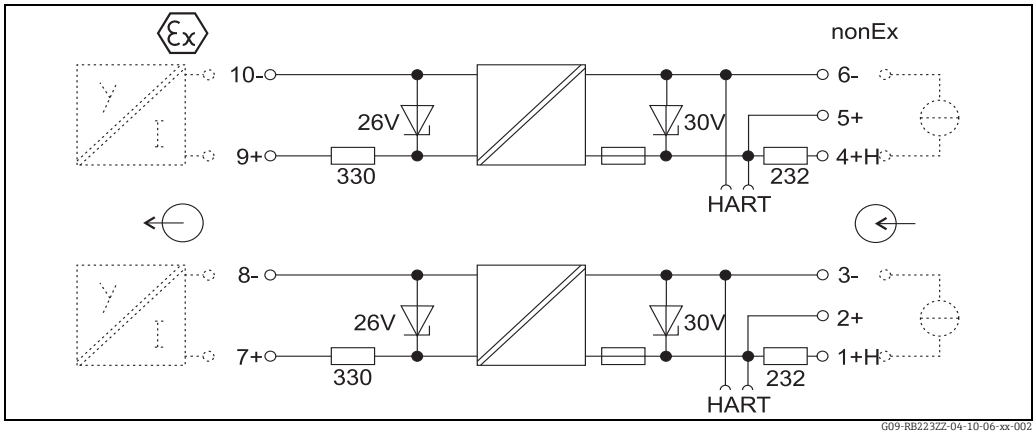
Electrical connection



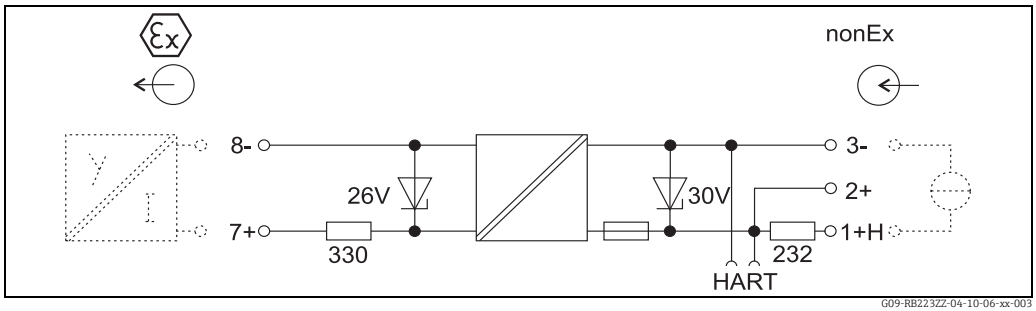
*Connection RB223-**A, Ex -> nonEx, two-channel*



*Connection RB223-**A, Ex -> nonEx, one-channel*



*Connection RB223-**B, nonEx -> Ex, two-channel*



*Connection RB223-**B, nonEx -> Ex, one-channel*

Supply voltage	The device is powered from the standard 0/4 to 20 mA current loop.
Starting current (intrinsic consumption)	< 50 µA
Voltage drop	< (1.9 V + 400 Ω x current loop) for nonEx → Ex < (3.9 V + 120 Ω x current loop) for Ex → nonEx
Power loss	< 0.2 W for 20 mA (per channel) without HART® resistor < 0.3 W for 20 mA (per channel) with HART® resistor

Performance characteristics

Current transmission	< ± (10 μA + 0.15% of measured value)
Load error	≤ 0.02 % of measured value/100 Ω
Formula for load calculation	Load = (transmitter supply [V] / loop current [A]) - load resistance [R]
Temperature drift	≤ ± 0.01 %/10 K (0.0056 %/10 °F)
Residual ripple at output	< 30 mV_{eff} for 20 mA loop current and 600 Ω load

Transmission behavior

HART® protocol	Bidirectional transmission possible

Step-function response

Settling time (10 to 90 % of full scale value)	< 0.5 ms for 500 Ω load for nonEx → Ex < 0.3 ms for 500 Ω load for Ex → nonEx

Frequency response

Large signal limit frequency	650 Hz for 500 Ω load for nonEx → Ex 1300 Hz for 500 Ω load for Ex → nonEx

Installation

Mounting	Mounting in a cabinet on a mounting rail TS 35 as per IEC 60715.
Orientation	No restrictions
Installation instructions	Installation and setup conditions as per IEC 60715.

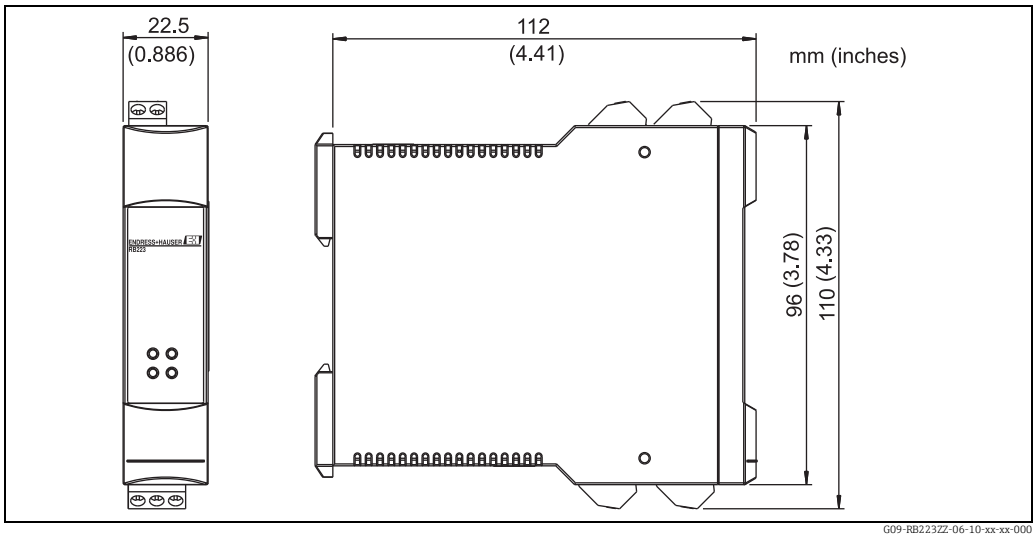
Environment

Ambient temperature range	-20 to +60 °C (-4 to +140 °F)
Storage temperature	-20 to +80 °C (-4 to 176 °F)
Installation height	As per IEC 61010-1: < 3000 m above MSL
Climate class	As per IEC 60654-1 Class B2
Degree of protection	IP 20
Relative humidity	< 95 % (without condensation)
Electrical safety	Protection class III, pollution degree 2, overvoltage protection category II
Electromagnetic compatibility (EMC)	Interference immunity as per EN 61326 - series (industry) and NAMUR NE21

Mechanical construction

Design, dimensions

Housing for top-hat rail as per IEC 60715 TH35:



Dimensions of RB223 in mm (in)

Weight	Approx. 150 g (5.29 oz.)
Material	Housing: plastic PC, UL 940
Terminals	▪ Coded, pluggable screw terminal, core size 1.5 mm^2 solid, or 1.0 mm^2 strand with ferrule ▪ Communication socket on the front via 2 mm jack plug

Human interface

Remote operation

HART® communication:
Communication signals are transmitted bidirectionally.
Communication resistor:
Resistor for HART® communication 232 Ω installed.
Communication sockets:
Access for HART® communicator, e.g. DXR-275

Pay attention to voltage drop!

Certificates and approvals

CE mark

Directive 2004/108/EC and 2006/95/EC

Ex approval

ATEX, FM and CSA approved associated apparatus

SIL

Can be used up to SIL3

Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser web site: **www.endress.com/rb223**
- From your Endress+Hauser Sales Center: www.addresses.endress.com

Product Configurator - the tool for individual product configuration

- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Accessories

Accessories

The following accessories are available:

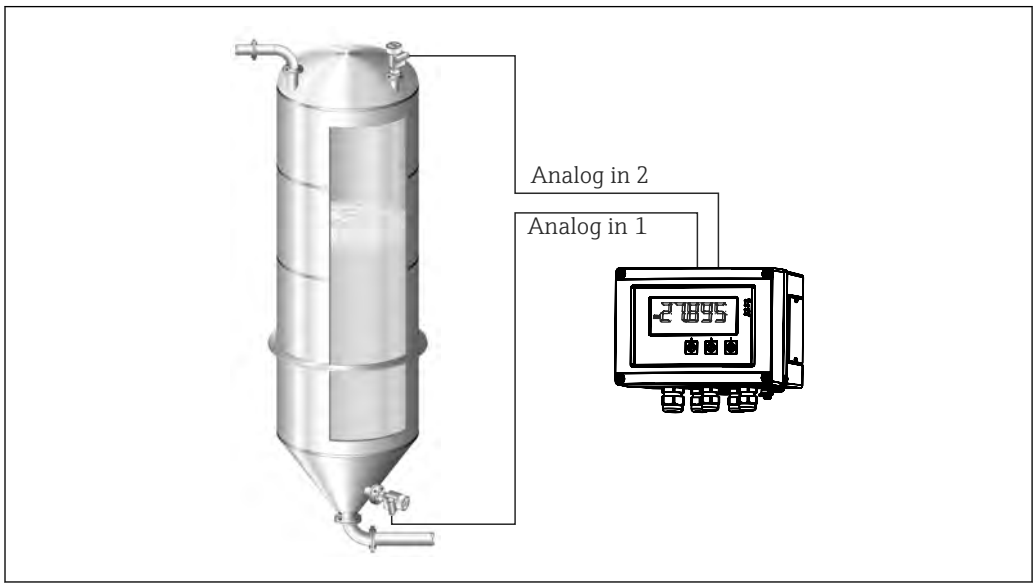
Order code	Accessory
51002468	Protective housing IP66 for field mounting

Documentation

- Operating Instructions RB223 (BA00239R)
- ATEX Safety Instructions (XA00068R)
- Brochure "System Products and Data Manager" (FA00016K)
- SIL Safety Manual (SD00022R)
- Additional Ex approvals, FM/CSA Control Drawings

Function and system design

Application



1 Example for "differential pressure" application

The RIA46 field meter powers the transmitter and processes analog signals from transmitters, particularly from the area of process instrumentation. These signals are monitored, evaluated, calculated, saved, separated, linked, converted and displayed. The signals, intermediate values and the results of calculations and analysis are transmitted by digital or analog means.

Measuring system

The RIA46 is a process transmitter, which is controlled by a microcontroller, and exhibits a display, analog inputs for process and status signals, analog and digital outputs, as well as an interface for configuration.

Connected sensors (e.g. temperature, pressure) can be powered by the integrated transmitter power supply system. The signals to be measured are converted from analog to digital signals, processed digitally in the device, and then converted from digital to analog signals and made available to the various outputs. All measured values, and values calculated in any way, are available as a signal source for the display, all outputs, relays and the interface. It is possible to make multiple use of the signals and results (e.g. a signal source as an analog output signal and limit value for a relay).

Mathematics functions

The following mathematics functions are available in RIA46:
- Sum
- Difference
- Multiplication
- Mean
- Linearization

Linearization function

Up to 32 user-definable points are available in the device per calculated value to linearize the input, e.g. for tank linearization. In the case of the two-channel device (option), mathematics channel M2 can be used to linearize mathematics channel M1.

Linearization is also available in the FieldCare configuration software.

Input

Measured variable

Current, voltage, resistance, resistance thermometer, thermocouples

Measuring ranges

Current:
- 0/4 to 20 mA +10% overrange
- Short-circuit current: max. 150 mA
- Load: 10 Ω

Voltage:
- 0 to 10 V, 2 to 10 V, 0 to 5 V, 0 to 1 V, 1 to 5 V, ±1 V, ±10 V, ±30 V, ±100 mV
- Max. permitted input voltage:
  Voltage ≥ 1 V: ±35 V
  Voltage < 1 V: ±12 V
- Input impedance: > 1 000 kΩ

Resistance:
30 to 3 000 Ω

Resistance thermometer:
- Pt100 as per IEC60751, GOST, JIS1604
- Pt500 and Pt1000 as per IEC60751
- Cu100, Cu50, Pt50, Pt46, Cu53 as per GOST
- Ni100, Ni1000 as per DIN 43760

Thermocouple types:
- Typ J, K, T, N, B, S, R as per IEC60584
- Typ U as per DIN 43710
- Typ L as per DIN 43710, GOST
- Typ C, D as per ASTM E998

Number of inputs

One or two universal inputs

Update time

200 ms

Galvanic isolation

Towards all other circuits

Output

Output signal

One or two analog outputs, galvanically isolated

Current/voltage output

Current output:
- 0/4 to 20 mA
- Overrange up to 22 mA

Voltage:
- 0 to 10 V, 2 to 10 V, 0 to 5 V, 1 to 5 V
- Overrange: up to 11 V, short-circuit proof, I_{max} < 25 mA

HART®

HART® signals are not affected

Loop power supply

- Open-circuit voltage: 24 V_{DC} (+15% /-5%)
  Ex version: > 14 V at 22 mA
  Non-hazardous operation: > 16 V at 22 mA
- Maximum 30 mA short-circuit-proof and overload-proof
- Galvanically isolated from system and outputs

Switching output

Open Collector for monitoring of the device state and alarm notification. The OC output is closed in normal state. In error state, the OC output is opened.

- I_{max} = 200 mA
- U_{max} = 28 V
- $U_{on/max}$ = 2 V at 200 mA

Galvanic isolation towards all other circuits; test voltage 500 V

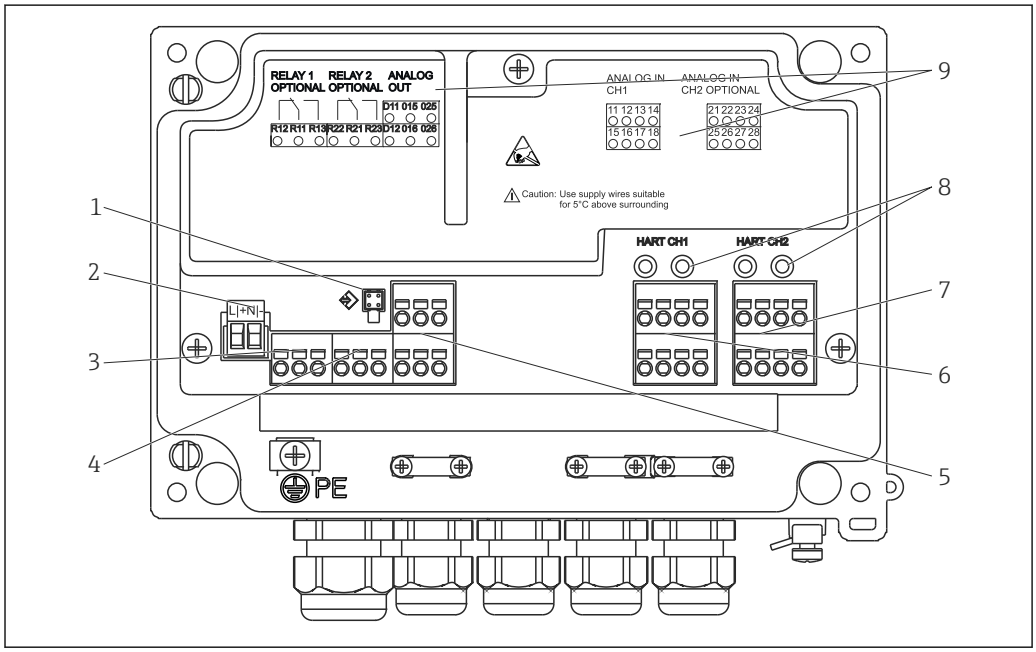
Relay output

Relay output for limit function

Relay contact	Changeover
Maximum contact burden DC	30 V / 3 A (permanent state, without destruction of the input)
Maximum contact burden AC	250 V / 3 A (permanent state, without destruction of the input)
Minimum contact load	500 mW (12 V/10 mA)
Galvanic isolation towards all other circuits	Test voltage 1 500 V_{AC}
Switching cycles	> 1 million

Power supply

Terminal assignment



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2 Inside view and terminal assignment of the process display

1 Connection socket for interface cable
2 Connection supply voltage
3 Connection relay 1 (optional)
4 Connection relay 2 (optional)
5 Connection analog and status output
6 Connection analog input 1
7 Connection analog input 2 (optional)
8 HART® connection sockets
9 Laser labelling of terminal assignment

Supply voltage

Wide-area power supply unit 24 to 230 V AC/DC (-20 % / +10 %) 50/60 Hz

Power consumption

Max. 21.5 VA / 6.9 W

Connection data interface

Commubox FXA291 PC USB interface

- Connection: 4-pin connector
- Transmission protocol: FieldCare
- Transmission rate: 38,400 Baud

Interface cable TXU10-AC PC USB interface

- Connection: 4-pin connection
- Transmission protocol: FieldCare
- Delivery scope: Interface cable incl. FieldCare Device Setup DVD with all Comm DTMs and Device DTMs

Performance characteristics

Reference operating conditions

Power supply: 230 V_{AC}, 50/60 Hz

Ambient temperature: 25 °C (77 °F) ± 5 °C (9 °F)

Humidity: 20 %...60 % rel. humidity

Maximum measured error

Universal input:

Accuracy	Input:	Range:	Maximum measured error of measuring range (oMR):
	Current	0 to 20 mA, 0 to 5 mA, 4 to 20 mA; Overrange: up to 22 mA	±0.05%
	Voltage ≥ 1 V	0 to 10 V, 2 to 10 V, 0 to 5 V, 1 to 5 V, 0 to 1 V, ±1 V, ±10 V, ±30 V	±0.1%
	Voltage < 1 V	±100 mV	±0.05%
	Resistance measurement	30 to 3 000 Ω	4-wire: ± (0.10% oMR + 0.8 Ω) 3-wire: ± (0.10% oMR + 1.6 Ω) 2-wire: ± (0.10% oMR + 3 Ω)
	RTD	Pt100, −200 to 850 °C (−328 to 1 562 °F) (IEC60751, α=0.00385) Pt100, −200 to 850 °C (−328 to 1 562 °F) (JIS1604, w=1.391) Pt100, −200 to 649 °C (−328 to 1 200 °F) (GOST, α=0.003916) Pt500, −200 to 850 °C (−328 to 1 562 °F) (IEC60751, α=0.00385) Pt1000, −200 to 600 °C (−328 to 1 112 °F) (IEC60751, α=0.00385)	4-wire: ± (0.10% oMR + 0.3 K (0.54 °F)) 3-wire: ± (0.10% oMR + 0.8 K (1.44 °F)) 2-wire: ± (0.10% oMR + 1.5 K (2.7 °F))
		Cu100, −200 to 200 °C (−328 to 392 °F) (GOST, w=1.428) Cu50, −200 to 200 °C (−328 to 392 °F) (GOST, w=1.428) Pt50, −200 to 1 100 °C (−328 to 2 012 °F) (GOST, w=1.391) Pt46, −200 to 850 °C (−328 to 1 562 °F) (GOST, w=1.391) Ni100, −60 to 250 °C (−76 to 482 °F) (DIN43760, α=0.00617) Ni1000, −60 to 250 °C (−76 to 482 °F) (DIN43760, α=0.00617)	4-wire: ± (0.10% oMR + 0.3 K (0.54 °F)) 3-wire: ± (0.10% oMR + 0.8 K (1.44 °F)) 2-wire: ± (0.10% oMR + 1.5 K (2.7 °F))
		Cu53, −50 to 200 °C (−58 to 392 °F) (GOST, w=1.426)	4-wire: ± (0.10% oMR + 0.3 K (0.54 °F)) 3-wire: ± (0.10% oMR + 0.8 K (1.44 °F)) 2-wire: ± (0.10% oMR + 1.5 K (2.7 °F))
	Thermocouples	Typ J (Fe-CuNi), −210 to 1 200 °C (−346 to 2 192 °F) (IEC60584)	± (0.10% oMR +0.5 K (0.9 °F)) from −100 °C (−148 °F)
		Typ K (NiCr-Ni), −200 to 1 372 °C (−328 to 2 502 °F) (IEC60584)	± (0.10% oMR +0.5 K (0.9 °F)) from −130 °C (−202 °F)

Accuracy	Input:	Range:	Maximum measured error of measuring range (oMR):
		Typ T (Cu-CuNi), −270 to 400 °C (−454 to 752 °F) (IEC60584)	± (0.10% oMR +0.5 K (0.9 °F)) from −200 °C (−328 °F)
		Typ N (NiCrSi-NiSi), −270 to 1 300 °C (−454 to 2 372 °F) (IEC60584)	± (0.10% oMR +0.5 K (0.9 °F)) from −100 °C (−148 °F)
		Typ L (Fe-CuNi), −200 to 900 °C (−328 to 1 652 °F) (DIN43710, GOST)	± (0.10% oMR +0.5 K (0.9 °F)) from −100 °C (−148 °F)
		Typ D (W3Re/W25Re), 0 to 2 495 °C (32 to 4 523 °F) (ASTME998)	± (0.15% oMR +1.5 K (2.7 °F)) from 500 °C (932 °F)
		Typ C (W5Re/W26Re), 0 to 2 320 °C (32 to 4 208 °F) (ASTME998)	± (0.15% oMR +1.5 K (2.7 °F)) from 500 °C (932 °F)
		Typ B (Pt30Rh-Pt6Rh), 0 to 1 820 °C (32 to 3 308 °F) (IEC60584)	± (0.15% oMR +1.5 K (2.7 °F)) from 600 °C (1 112 °F)
		Typ S (Pt10Rh-Pt), −50 to 1 768 °C (−58 to 3 214 °F) (IEC60584)	± (0.15% oMR +3.5 K (6.3 °F)) for −50 to 100 °C (−58 to 212 °F) ± (0.15% oMR +1.5 K (2.7 °F)) from 100 °C (212 °F)
		Typ U (Cu-CuNi), −200 to 600 °C (−328 to 1 112 °F) (DIN 43710)	± (0.15% oMR +1.5 K (2.7 °F)) from 100 °C (212 °F)
AD converter resolution		16 bit	
Temperature drift		Temperature drift: ≤ 0.01%/K (0.1%/18 °F) oMR ≤ 0.02%/ K (0.2%/18 °F) oMR for Cu100, Cu50, Cu53, Pt50 and Pt46	

Analog output:

Current	0/4 to 20 mA, overrange up to 22 mA	±0.05% of measuring range
	Max. load	500 Ω
	Max. inductivity	10 mH
	Max. capacity	10 µF
	Max. ripple	10 mVpp at 500 Ω, frequency < 50 kHz
Voltage	0 to 10 V, 2 to 10 V 0 to 5 V, 1 to 5 V Overrange: up to 11 V, shortcircuit proof, I_{max} < 25 mA	±0.05% of measuring range ±0.1 % of measuring range
	Max. ripple	10 mVpp at 1 000 Ω, frequency < 50 kHz
Resolution	13 bit	
Temperature drift	≤ 0.01%/K (0.1%/18 °F) of measuring range	
Galvanic isolation	Testing voltage of 500 V towards all other circuits	

Installation

Mounting location

Field, direct wall mounting and wall or pipe mounting [1] using the optional mounting plate.

Orientation

No restrictions.

The orientation is determined by the readability of the display.

Max. viewing angle range +/- 45° from the central display axis in every direction.

1) According to UL approval panel or surface mounting only.

Environment

Ambient temperature range

NOTICE

The life-time of the display is shortened when operated in the upper temperature range.

► To avoid heat accumulation, always make sure the device is sufficiently cooled.

Non-Ex/Ex devices: −40 to 60 °C (−40 to 140 °F)

UL devices: −40 to 50 °C (−40 to 122 °F)

At temperatures below −30 °C (−22 °F) the readability of the display can no longer be guaranteed.

Storage temperature

−40 to 85 °C (−40 to 185 °F)

Operating height

< 2 000 m (6 560 ft) above MSL

Climate class

As per IEC 60654-1, Class B2

Degree of protection

Front IP 67 / NEMA 4x (not evaluated by UL)

Shock and vibration

3g at 2…150 Hz as per IEC 60068-2-6

Electrical safety

Protection class I, overvoltage category II, pollution degree 2 for aluminum housing

Protection class II, overvoltage category II, pollution degree 2 for plastic housing

Condensation

Permitted

Electromagnetic compatibility (EMC)

CE compliance

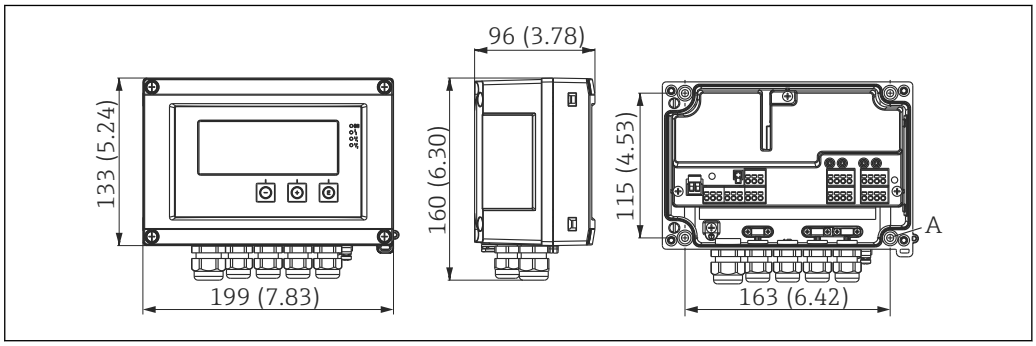
Electromagnetic compatibility in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE21). For details refer to the EU Declaration of Conformity.

Interference immunity as per IEC/EN 61326 series, industrial requirements.

Interference emission as per IEC/EN 61326 series, Class B equipment.

Mechanical construction

Design, dimensions



3 Dimensions of the field meter in mm (in)

A Drill-hole for direct wall mounting or on optional mounting plate with 4 screws Φ5 mm (2 in)

Weight

- Plastic housing: approx. 600 g (1.32 lb)
- Aluminum housing: approx. 1 700 g (3.75 lb)

Material

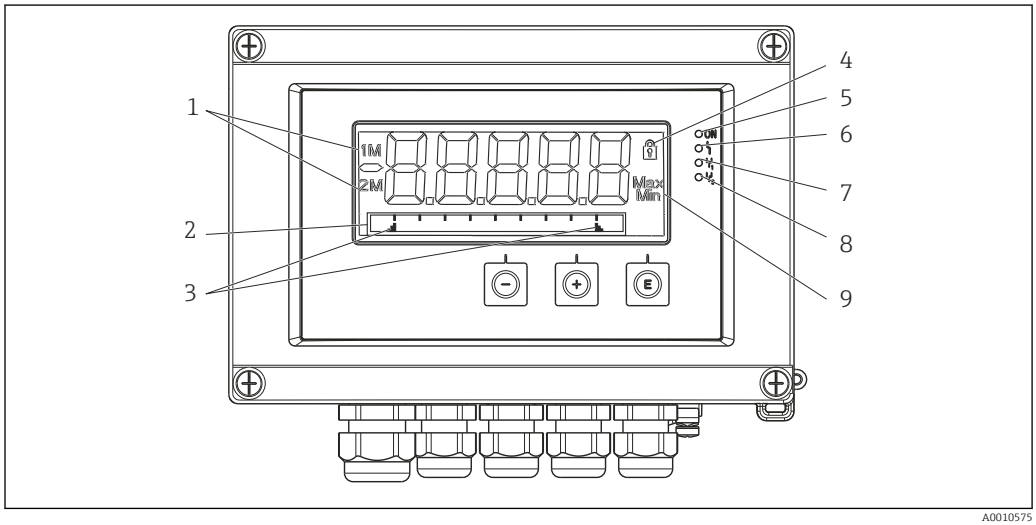
Housing	Nameplate
Fiber-glass reinforced plastic PBT-GF30	Laser marking
Optional: Aluminum (AlSi12, AC-44100 or AlSi10Mg(Fe), AC-43400)	Laser-writable foil, polyester

Terminals

Spring terminals, 2.5 mm² (14 AWG); auxiliary voltage with plug-in screw terminals 0.1 to 4 mm² (30 to 12 AWG), torque 0.5 to 0.6 Nm (0.37 to 0.44 lbf ft).

Operability

Local operation



4 *Display of the field meter*

1 Channel display: 1: analog input 1; 2: analog input 2; 1M: calculated value 1; 2M: calculated value 2
2 Dot matrix display for TAG, bar graph and unit
3 Limit value indicators in the bar graph
4 "Operation locked" indicator
5 Green LED; measuring device operational
6 Red LED; error/alarm
7 Yellow LED; status of relay 1
8 Yellow LED; status of relay 2
9 Minimum/maximum value indicator

- Display
  5-digit, 7-segment backlit LC display
  Dot matrix for text/bar graph
- Display range
  -99999 to +99999 for measured values
- Signaling
  – Setup security locking (lock)
  – Measuring range overshoot/undershoot
  – 2 x status relay (only if relay option was selected)

Operating elements

3 keys: -, +, E

Remote operation

Configuration

The device can be configured with the PC software or on site using the operating keys. FieldCare Device Setup is delivered together with the Commubox FXA291 or TXU10-AC (see 'Accessories') or can be downloaded free of charge from www.endress.com.

Interface

4-pin socket for the connection with a PC via Commubox FXA291 or TXU10-AC interface cable (see 'Accessories')

Certificates and approvals

CE mark	The measuring system meets the legal requirements of the applicable EC guidelines. These are listed in the corresponding EC Declaration of Conformity together with the standards applied. Endress +Hauser confirms successful testing of the device by affixing to it the CE mark.
EAC mark	The product meets the legal requirements of the EEU guidelines. The manufacturer confirms the successful testing of the product by affixing the EAC mark.
Ex approval	Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your E+H Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request.
Overfill prevention	WHG-compliant limit signal transmitter (optional)
Functional safety	SIL2 (optional)
UL	UL recognized component (see www.ul.com/database, search by keyword "E225237")
Other standards and guidelines	▪ IEC 60529: Degrees of protection provided by enclosures (IP code) ▪ IEC 61010-1: Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use ▪ EN 60079-11: Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "I" (optional)

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.
- From your Endress+Hauser Sales Center: www.addresses.endress.com

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Device-specific accessories

Cable glands and adapters

Adapter set NPT

1x M20x1.5 (outer) - NPT1/2" (inner) 4x M16x1.5 (outer) - NPT1/2" (inner)	RIA46X-GI

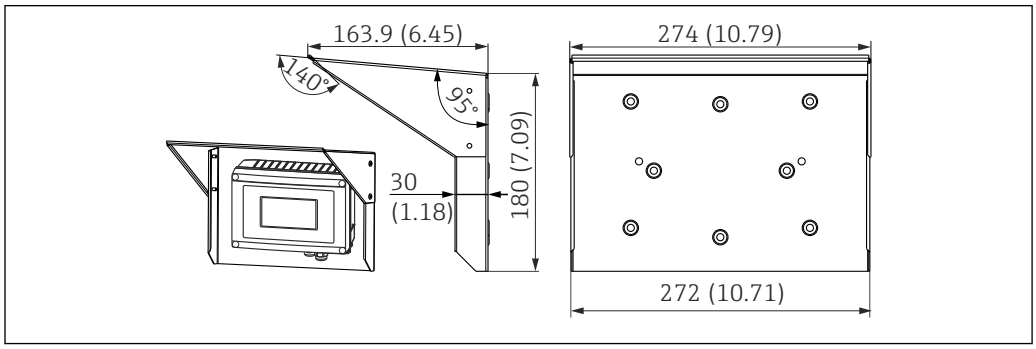
Cable gland set plastic

4x M16x1.5 + 1x M20x1.5	RIA46X-GH

Housing

Weather protection cover

Ordering:
- as an additional option in the product structure for RIA46
- separately via order code: RK01-AR



5 Dimensions in mm (in)

Mounting kit for wall/pipe mounting

Ordering:
- as an additional option in the product structure for RIA46
- separately via order code: RK01-AH

Pipe mounting set

Install. kit stainl. steel housing W08	71091611

Communication-specific accessories

Designation
Interface cable
Commubox TXU10 incl. FieldCare Device Setup and DTM Library
Commubox FXA291 incl. FieldCare Device Setup and DTM Library

Supplementary documentation

- System components and data manager - solutions to complete your measuring point: FA00016K/09
- Operating Instructions for process display unit RIA46: BA00274R/09
- Ex-related additional documentation: ATEX II(1) GD [Ex ia] IIC: XA00079R/09
- SIL Safety Manual: SD00023R/09

TI00150R/09/EN/06.19
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2019-07-31

Technical Information
RMA42

Process transmitter with control unit

Universal process transmitter for monitoring and displaying analog measured values

Application

- Plant and apparatus engineering and construction
- Control rooms and cabinets
- Laboratories
- Process recording and supervision
- Process control
- Signal adjustment and signal conversion
- WHG compliant limit signal transmitter

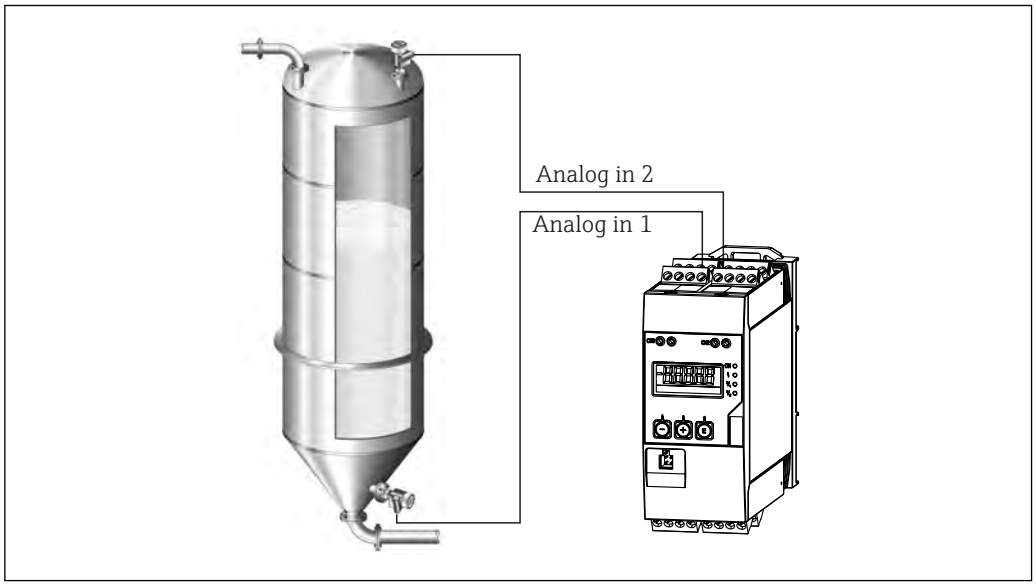
Your benefits

- 5-digit, 7-segment backlit LC display
- User-configurable dot matrix display range for bar graph, units and tag name
- 1 or 2 universal inputs
- 2 relays (optional)
- Min./max. value saved
- 1 or 2 calculated values
- One linearization table with 32 points for each calculated value
- 1 or 2 analog outputs
- Digital status output (open collector)
- Operation using 3 keys
- Configuration via interface and FieldCare or DeviceCare software

Endress+Hauser

Function and system design

Measuring principle



1 *Example of a "differential pressure" application*

The RMA42 process transmitter powers the transmitter and processes analog signals from transmitters, particularly from the area of process instrumentation. These signals are monitored, evaluated, calculated, saved, separated, linked, converted and displayed. The signals and results of calculations are communicated by analog means, as a switch output and displayed digitally.

Measuring system

The RMA42 is a process transmitter that is controlled by a microcontroller and features a display, analog inputs for process and status signals, analog and digital outputs, as well as a configuration interface.

Connected sensors (e.g. temperature, pressure) can be powered by the integrated transmitter power supply system. These signals are monitored, evaluated, calculated, saved (min/max values) and provided at the various outputs. All measured values, and values calculated in any way, are available as a signal source for the display, all outputs, relays and the interface. It is possible to make multiple use of the signals and results (e.g. a signal source is used as an analog output signal and as a limit value for a relay).

Mathematics functions

The following mathematics functions are available in the RMA42:
- Total
- Difference
- Multiplication
- Average
- Linearization

Linearization function

Up to 32 user-definable linearization points are available in the device per calculated value for the linearization of the input, e.g. for tank linearization. In two-channel devices (optional), the mathematics channel M2 can be used to linearize the mathematics channel M1.

Linearization is also provided in the FieldCare configuration software.

Input

Measured variable	Current, voltage, resistance, resistance thermometer, thermocouples
Measuring ranges	Current: ▪ 0/4 to 20 mA +10% overrange ▪ Short-circuit current: max. 150 mA ▪ Load: 10 Ω Voltage: ▪ 0 to 10 V, 2 to 10 V, 0 to 5 V, 0 to 1 V, 1 to 5 V, ±1 V, ±10 V, ±30 V, ±100 mV ▪ Max. permitted input voltage: Voltage ≥ 1 V: ±35 V Voltage < 1 V: ±12 V ▪ Input impedance: > 1 000 kΩ Resistance: 30 to 3 000 Ω Resistance thermometer: ▪ Pt100 as per IEC60751, GOST, JIS1604 ▪ Pt500 and Pt1000 as per IEC60751 ▪ Cu100, Cu50, Pt50, Pt46, Cu53 as per GOST ▪ Ni100, Ni1000 as per DIN 43760 Thermocouple types: ▪ Typ J, K, T, N, B, S, R as per IEC60584 ▪ Typ U as per DIN 43710 ▪ Typ L as per DIN 43710, GOST ▪ Typ C, D as per ASTM E998
Number of inputs	One or two universal inputs
Update time	200 ms
Galvanic isolation	Towards all other circuits

Output

Output signal

One or two analog outputs, galvanically isolated

Current/voltage output

Current output:
- 0/4 to 20 mA
- Overrange up to 22 mA

Voltage:
- 0 to 10 V, 2 to 10 V, 0 to 5 V, 1 to 5 V
- Overrange: up to 11 V, short-circuit proof, I_{max} < 25 mA

HART®

HART® signals are not affected

Loop power supply

- Open-circuit voltage: 24 V_{DC} (+15% /-5%)
- Ex version: > 14 V at 22 mA
- Non-Ex version with SIL: > 14 V at 22 mA
- Non-Ex version without SIL: > 16 V at 22 mA
- Maximum 30 mA short-circuit-proof and overload-proof
- Galvanically isolated from system and outputs

Switching output

Open Collector for monitoring of the device state and alarm notification. The OC output is closed in normal state. In error state, the OC output is opened.

- I_{max} = 200 mA
- U_{max} = 28 V
- $U_{on/max}$ = 2 V at 200 mA

Galvanic isolation towards all other circuits; test voltage 500 V

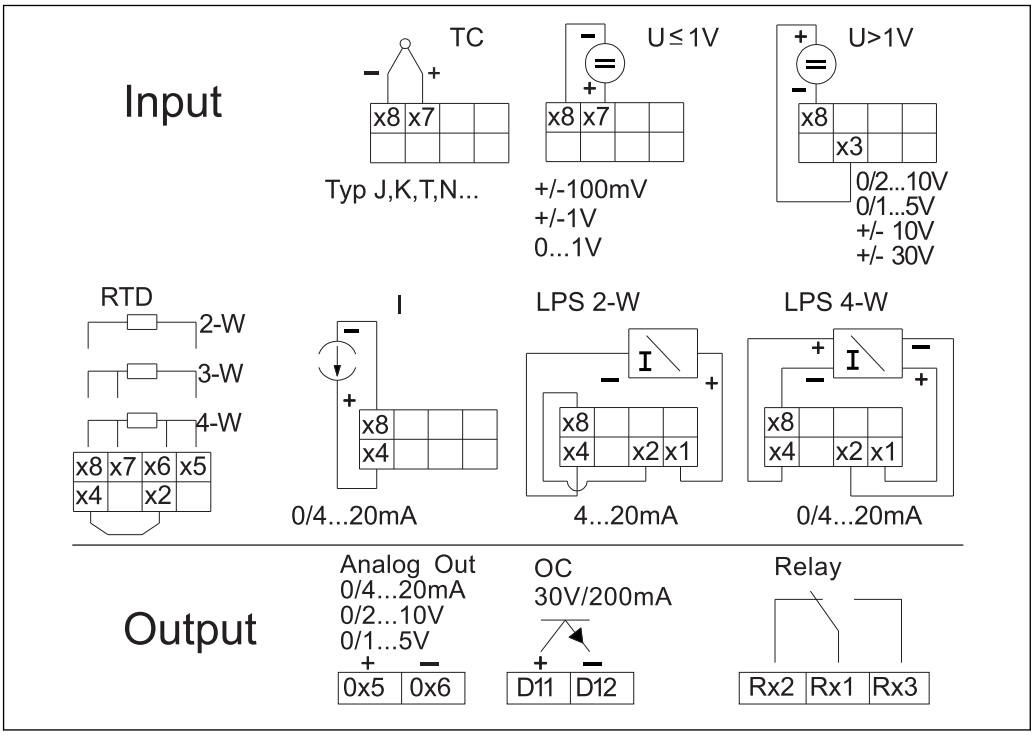
Relay output

Relay output for limit function

Relay contact	Changeover
Maximum contact burden DC	30 V / 3 A (permanent state, without destruction of the input)
Maximum contact burden AC	250 V / 3 A (permanent state, without destruction of the input)
Minimum contact load	500 mW (12 V/10 mA)
Galvanic isolation towards all other circuits	Test voltage 1 500 V_{AC}
Switching cycles	> 1 million

Power supply

Terminal assignment



2 *Terminal assignment of the process transmitter (relays (terminals Rx1-Rx3) and channel 2 (terminals 21-28 and O25/O26) optional)*

Supply voltage

Wide-area power supply unit 24 to 230 V AC/DC (-20 % / +10 %) 50/60 Hz

Power consumption

Max. 21.5 VA / 6.9 W

Connection data interface

Commubox FXA291 PC USB interface

- Connection: 4-pin connector
- Transmission protocol: FieldCare
- Transmission rate: 38,400 Baud

Interface cable TXU10-AC PC USB interface

- Connection: 4-pin connection
- Transmission protocol: FieldCare
- Delivery scope: Interface cable incl. FieldCare Device Setup DVD with all Comm DTMs and Device DTMs

Performance characteristics

Reference operating conditions

Power supply: 230 V_{AC}, 50/60 Hz

Ambient temperature: 25 °C (77 °F) ± 5 °C (9 °F)

Humidity: 20 %...60 % rel. humidity

Maximum measured error

Universal input:

Accuracy	Input:	Range:	Maximum measured error of measuring range (oMR):
	Current	0 to 20 mA, 0 to 5 mA, 4 to 20 mA; Overrange: up to 22 mA	±0.05%
	Voltage ≥ 1 V	0 to 10 V, 2 to 10 V, 0 to 5 V, 1 to 5 V, 0 to 1 V, ±1 V, ±10 V, ±30 V	±0.1%
	Voltage < 1 V	±100 mV	±0.05%
	Resistance measurement	30 to 3 000 Ω	4-wire: ± (0.10% oMR + 0.8 Ω) 3-wire: ± (0.10% oMR + 1.6 Ω) 2-wire: ± (0.10% oMR + 3 Ω)
	RTD	Pt100, −200 to 850 °C (−328 to 1 562 °F) (IEC60751, α=0.00385) Pt100, −200 to 850 °C (−328 to 1 562 °F) (JIS1604, w=1.391) Pt100, −200 to 649 °C (−328 to 1 200 °F) (GOST, α=0.003916) Pt500, −200 to 850 °C (−328 to 1 562 °F) (IEC60751, α=0.00385) Pt1000, −200 to 600 °C (−328 to 1 112 °F) (IEC60751, α=0.00385)	4-wire: ± (0.10% oMR + 0.3 K (0.54 °F)) 3-wire: ± (0.10% oMR + 0.8 K (1.44 °F)) 2-wire: ± (0.10% oMR + 1.5 K (2.7 °F))
		Cu100, −200 to 200 °C (−328 to 392 °F) (GOST, w=1.428) Cu50, −200 to 200 °C (−328 to 392 °F) (GOST, w=1.428) Pt50, −200 to 1 100 °C (−328 to 2 012 °F) (GOST, w=1.391) Pt46, −200 to 850 °C (−328 to 1 562 °F) (GOST, w=1.391) Ni100, −60 to 250 °C (−76 to 482 °F) (DIN43760, α=0.00617) Ni1000, −60 to 250 °C (−76 to 482 °F) (DIN43760, α=0.00617)	4-wire: ± (0.10% oMR + 0.3 K (0.54 °F)) 3-wire: ± (0.10% oMR + 0.8 K (1.44 °F)) 2-wire: ± (0.10% oMR + 1.5 K (2.7 °F))
		Cu53, −50 to 200 °C (−58 to 392 °F) (GOST, w=1.426)	4-wire: ± (0.10% oMR + 0.3 K (0.54 °F)) 3-wire: ± (0.10% oMR + 0.8 K (1.44 °F)) 2-wire: ± (0.10% oMR + 1.5 K (2.7 °F))
	Thermocouples	Typ J (Fe-CuNi), −210 to 1 200 °C (−346 to 2 192 °F) (IEC60584)	± (0.10% oMR +0.5 K (0.9 °F)) from −100 °C (−148 °F)
		Typ K (NiCr-Ni), −200 to 1 372 °C (−328 to 2 502 °F) (IEC60584)	± (0.10% oMR +0.5 K (0.9 °F)) from −130 °C (−202 °F)
		Typ T (Cu-CuNi), −270 to 400 °C (−454 to 752 °F) (IEC60584)	± (0.10% oMR +0.5 K (0.9 °F)) from −200 °C (−328 °F)
		Typ N (NiCrSi-NiSi), −270 to 1 300 °C (−454 to 2 372 °F) (IEC60584)	± (0.10% oMR +0.5 K (0.9 °F)) from −100 °C (−148 °F)
		Typ L (Fe-CuNi), −200 to 900 °C (−328 to 1 652 °F) (DIN43710, GOST)	± (0.10% oMR +0.5 K (0.9 °F)) from −100 °C (−148 °F)
		Typ D (W3Re/W25Re), 0 to 2 495 °C (32 to 4 523 °F)(ASTME998)	± (0.15% oMR +1.5 K (2.7 °F)) from 500 °C (932 °F)
		Typ C (W5Re/W26Re), 0 to 2 320 °C (32 to 4 208 °F) (ASTME998)	± (0.15% oMR +1.5 K (2.7 °F)) from 500 °C (932 °F)

Accuracy	Input:	Range:	Maximum measured error of measuring range (oMR):
		Typ B (Pt30Rh-Pt6Rh), 0 to 1 820 °C (32 to 3 308 °F) (IEC60584)	± (0.15% oMR +1.5 K (2.7 °F)) from 600 °C (1 112 °F)
		Typ S (Pt10Rh-Pt), −50 to 1 768 °C (−58 to 3 214 °F) (IEC60584)	± (0.15% oMR +3.5 K (6.3 °F)) for −50 to 100 °C (−58 to 212 °F) ± (0.15% oMR +1.5 K (2.7 °F)) from 100 °C (212 °F)
		Typ U (Cu-CuNi), −200 to 600 °C (−328 to 1 112 °F) (DIN 43710)	± (0.15% oMR +1.5 K (2.7 °F)) from 100 °C (212 °F)
AD converter resolution		16 bit	
Temperature drift		Temperature drift: ≤ 0.01%/K (0.1%/18 °F) oMR ≤ 0.02%/ K (0.2%/18 °F) oMR for Cu100, Cu50, Cu53, Pt50 and Pt46	

Analog output:

Current	0/4 to 20 mA, overrange up to 22 mA	±0.05% of measuring range
	Max. load	500 Ω
	Max. inductivity	10 mH
	Max. capacity	10 µF
	Max. ripple	10 mVpp at 500 Ω, frequency < 50 kHz
Voltage	0 to 10 V, 2 to 10 V 0 to 5 V, 1 to 5 V Overrange: up to 11 V, shortcircuit proof, I_{max} < 25 mA	±0.05% of measuring range ±0.1 % of measuring range
	Max. ripple	10 mVpp at 1 000 Ω, frequency < 50 kHz
Resolution	13 bit	
Temperature drift	≤ 0.01%/K (0.1%/18 °F) of measuring range	
Galvanic isolation	Testing voltage of 500 V towards all other circuits	

Installation

Mounting location

Mounting on top-hat rail as per IEC 60715.

Orientation

Vertical or horizontal.

NOTICE

Heat accumulation when installing several devices on a vertically mounted top-hat rail

▶ Keep sufficient gaps between the individual devices.

Environment

Ambient temperature range

NOTICE

The life-time of the display is shortened when operated in the upper temperature range.

▶ To avoid heat accumulation, always make sure the device is sufficiently cooled.

Non-Ex/Ex devices: −20 to 60 °C (−4 to 140 °F)

UL devices: −20 to 50 °C (−4 to 122 °F)

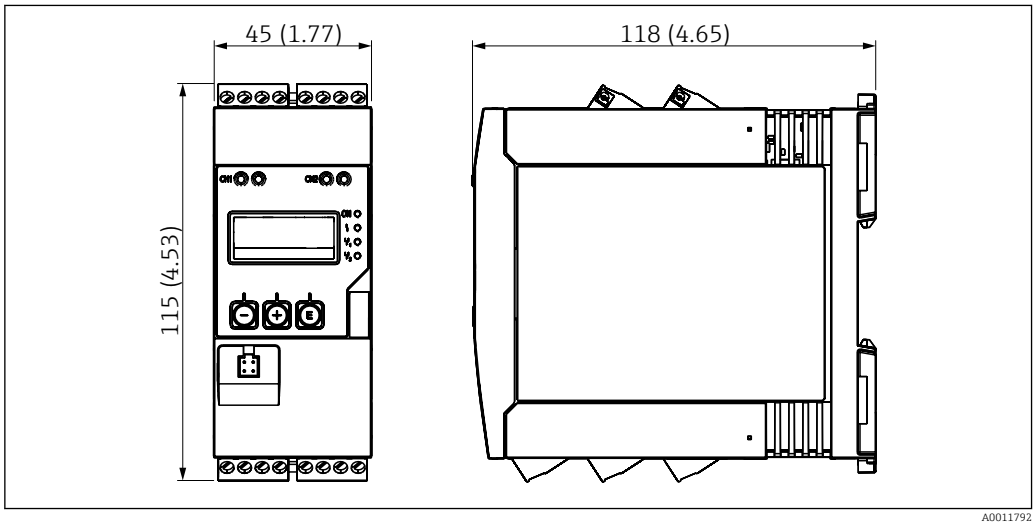
Storage temperature

−40 to 85 °C (−40 to 185 °F)

Operating height	< 2 000 m (6 560 ft) above MSL
Climate class	As per IEC 60654-1, Class B2
Degree of protection	Top-hat rail housing IP 20
Electrical safety	Protection class II, overvoltage category II, pollution degree 2
Condensation	Not permitted
Electromagnetic compatibility (EMC)	**CE compliance** Electromagnetic compatibility in accordance with all the relevant requirements of the IEC/EN 61326 series. For details refer to the EU Declaration of Conformity. Interference immunity as per IEC/EN 61326 series, industrial requirements. Interference emission as per IEC/EN 61326 series, Class B equipment.

Mechanical construction

Design, dimensions

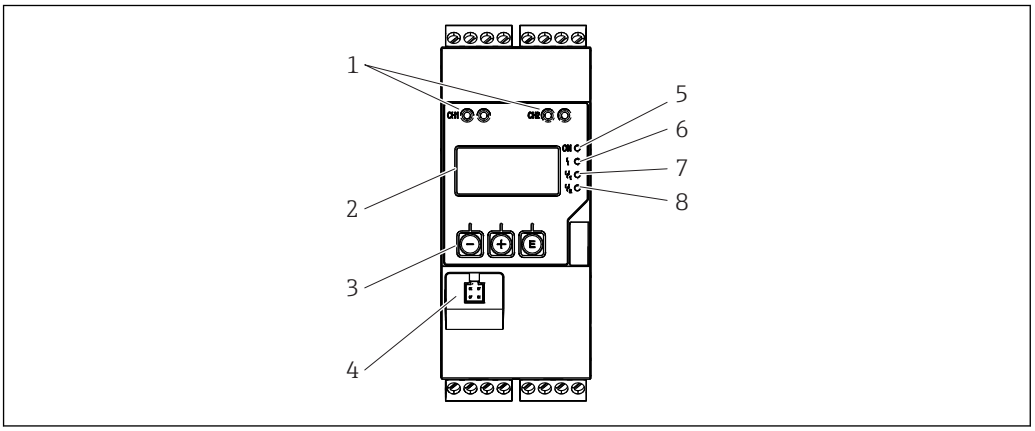


3 Dimensions of the process transmitter in mm (in)

Weight	Approximately 300 g (10.6 oz)
Material	Housing: plastic PC-GF10
Terminals	Screw terminals, plug-in, 2.5 mm^2 (14 AWG), 0.1 to 4 mm^2 (30 to 12 AWG), torque 0.5 to 0.6 Nm (0.37 to 0.44 lbf ft)

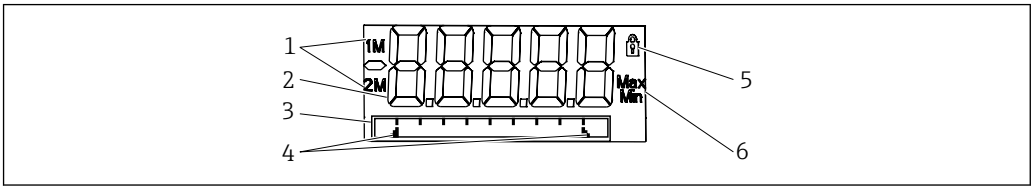
Operability

Local operation



4 *Display and operating elements of the process transmitter*

1 *HART® connection sockets*
2 *Display*
3 *Operating keys*
4 *PC interface connection port*
5 *Green LED; on = supply voltage applied*
6 *Red LED; on = error/alarm*
7 *Yellow LED; on = relay 1 energized*
8 *Yellow LED; on = relay 2 energized*



5 *Display of the process transmitter*

1 *Channel display: 1: analog input 1; 2: analog input 2; 1M: calculated value 1; 2M: calculated value 2*
2 *Measured value display*
3 *Dot matrix display for TAG, bar graph and unit*
4 *Limit value indicators in the bar graph*
5 *"Operation locked" indicator*
6 *Minimum/maximum value indicator*

- Display
  5-digit, 7-segment backlit LC display
  Dot matrix for text/bar graph
- Display range
  -99999 to +99999 for measured values
- Signaling
  - Setup security locking (lock)
  - Measuring range overshoot/undershoot
  - 2 x status relay (only if relay option was selected)

Operating elements

3 keys: -, +, E

Remote operation

Configuration

The device can be configured with the PC software or on site using the operating keys. FieldCare Device Setup is delivered together with the Commubox FXA291 or TXU10-AC (see 'Accessories') or can be downloaded free of charge from www.endress.com.

Interface

4-pin socket for the connection with a PC via Commubox FXA291 or TXU10-AC interface cable (see 'Accessories')

Certificates and approvals

CE mark	The measuring system meets the legal requirements of the applicable EC guidelines. These are listed in the corresponding EC Declaration of Conformity together with the standards applied. The manufacturer confirms successful testing of the device by affixing to it the CE mark.
EAC mark	The product meets the legal requirements of the EEU guidelines. The manufacturer confirms the successful testing of the product by affixing the EAC mark.
Ex approval	Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your E+H Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request.
Overfill prevention	WHG-compliant limit signal transmitter (optional)
Functional safety	SIL2 (optional)
Marine approvals	German Lloyd (GL, optional)
UL	UL recognized component (see www.ul.com/database, search by keyword "E225237")
CSA	CSA General Purpose (CSA GP)
Power station	Seismic test according to KTA3505 (optional)
Other standards and guidelines	▪ IEC 60529: Degrees of protection provided by enclosures (IP code) ▪ IEC 61010-1: Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use ▪ EN 60079-11: Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "I" (optional)

Ordering information

Detailed ordering information is available for your nearest sales organization www.addresses.endress.com or in the Product Configurator under www.endress.com :

1. Click Corporate
2. Select the country
3. Click Products
4. Select the product using the filters and search field
5. Open the product page

The Configuration button to the right of the product image opens the Product Configurator.

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Communication-specific accessories

Designation
Interface cable
Commubox TXU10 incl. FieldCare Device Setup and DTM Library
Commubox FXA291 incl. FieldCare Device Setup and DTM Library

Supplementary documentation

- System components and data manager - solutions to complete your measuring point: FA00016K/09
- Operating Instructions for process transmitter RMA42: BA00287R/09
- Ex-related additional documentation: ATEX II (1)G [Ex ia] IIC, ATEX II (1)D [Ex ia] IIIC: XA00095R/09
- SIL Safety Manual: SD00025R/09

Configuration summary

Mat. no.	Description Order code	Quantity	Unit
71099241	Process Transmitter + Control Unit RMA42 RMA42-AAA	1	ST

010	Approval:	AA	Non-hazardous area
020	Input; Output:	A	1x universal; 1x analog

FEDERAL SIGNAL CORPORATION

Vibratone® Horns

Models 350TR and ~~450TR~~

DESIGNED FOR ROUTINE SIGNALING

- Effective range of 200 feet (61m)
- Coded or sustained tones
- Model 350TR – 24 and 120VAC
  Model 450TR – 24VDC
- Model 350TR produces 100dB at 10' (110dB at 1m)
  Model 450TR produces 99dB at 10' (109db at 1m)
- UL Listed, cUL Listed*,
  CSA Certified, FM Approved
- Type 4X and Type 12 enclosure

The Models 350TR and 450TR Vibratone Horns produce a very loud horn tone by the electro-mechanical vibration of a diaphragm. Capable of reproducing coded blasts or sustained tones, Federal Signal's Vibratone horn is excellent for general alarm, start and dismissal, coded paging, and process control signaling in areas of high ambient noise levels.

Well suited to the requirements of panel builders and other OEM customers, the 350TR and 450TR offer the benefits of quick and simple surface mount installation. Each horn is supplied with a gasketed trim ring. The trim ring is streamlined but durable, constructed of 18-gauge aluminum with Neoprene™ gaskets between the mounting surface and trim ring and between the trim ring and horn. The trim ring is sealed with gray powder coat paint for long life and corrosion resistance.

The Vibratone Model 350TR is available in 24VAC and 120VAC operating voltages. The Model 350TR produces 100dB at ten feet (110dB at 1 meter).

The Vibratone Model 450TR is available 24VDC. The Model 450TR produces 99dB at ten feet (109dB at 1 meter).

Vibratone horns are UL Listed, cUL Listed, CSA Certified and FM Approved. The Models 350TR and 450TR are approved for Type 4X and Type 12 applications.

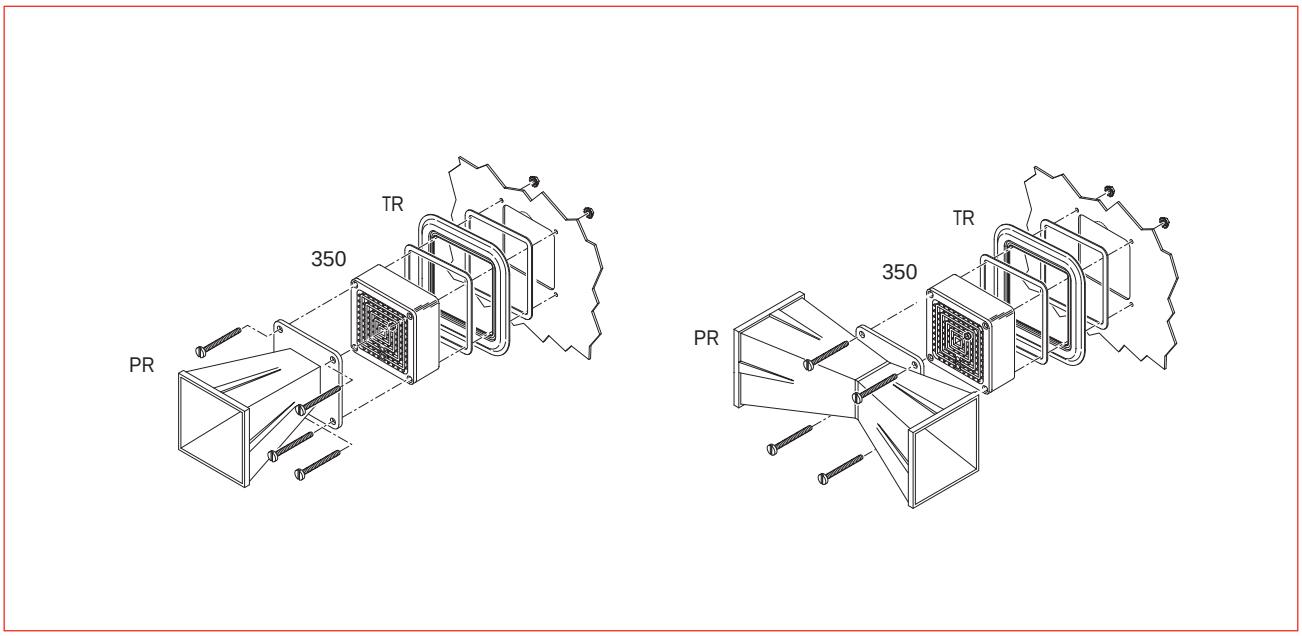
Each Vibratone horn is enclosed in a zinc die-cast housing and sealed with powder-coat paint. The Model 350TR features a stainless steel diaphragm. The Model 450TR utilizes an aluminum alloy diaphragm and heavy duty contacts. The rugged construction of the Vibratone horns resists vandalism and the effects of harsh industrial environments.

Compact size, loud output and heavy-duty construction make the VibraTone horns ideal for industrial and institutional signaling applications.

Model	Voltage	Operating Current	Decibels @ 10'	1m
~~350TR~~	24VAC 50/60Hz	0.90 amps	100	110
350TR	120VAC 50/60Hz	0.18 amps	100	110
450TR	24VDC	0.25 amps	99	109

*Only 350TR is cUL Listed

VIBRATONE® HORNS (350TR/450TR)



OPTIONS

PR	Projector which concentrates sound into a basic area when attached to the basic model 350/450 units; 4" H x 4" W x 6" D; shipping weight 1 lb. (0.45 kg)
PR2	Double projector directs sounds to both sides when attached to the basic model 350/450 units; ideal for use in hallways; 4" H x 11½" W x 4" D; shipping weight 2 lbs. (0,91 kg)
TR	Gasketed trim ring allowing surface mount installations of 350/450 units while maintaining Type12 and Type4X rating of enclosure.

SPECIFICATIONS

Operating Temp.:	°-65F to 150°F	°-54C to 66°C
Net Weight:	1.7 lbs.	0.77 kg
Shipping Weight:	1.8 lbs.	0.81 kg
Height:	5.6"	142.2 mm
Width:	5.6"	142.2 mm
Depth:	2.5"	64 mm

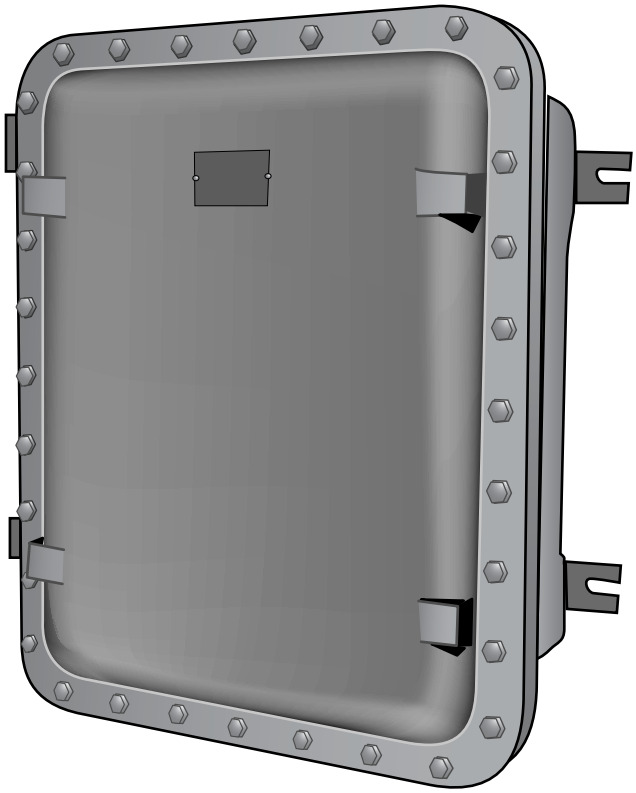
HOW TO ORDER

- Specify model and voltage
- Specify options from list
- Please refer to Model Number Index 350TR/450TR beginning on page 378

REPLACEMENT PARTS

Description	***Part Number***
Coil (120VAC only)	KFC1516C
Volume Control Kit	K8435663B

NJBEW Cast Junction Boxes



Use:

Explosionproof junction boxes are used where hazardous materials are handled or stored. These enclosures may be used to house control stations, starters, breakers, relays, meters, terminals for splicing wires, pull box, bus box or custom panel.

Features:

- Sand cast copper-free aluminum.
- Precision machined flame path between box and cover.
- Bolt on stainless steel slotted mounting feet for horizontal or vertical mounting.
- Flexible hinge mounting either left or right side, (hinges standard on 121206 & above).
- External flange maximizes internal space.
- Wall thickness suitable for minimum of five full threads.
- Provision for mounting pan.
- Wide range of drilled and tapped outlets.
- Ground lug package and installation instructions for termination of ground wires enclosed.
- O-ring gasket insures watertight integrity.

Materials:

- Bodies and covers: copper-free aluminum.
- Cover bolts: stainless steel
- O-Ring: Neoprene
- Hinges: Stainless Steel

Finishes:

- Bodies and covers: Shot blast finish standard.

Options:

- Grey epoxy powder coat available to provide NEMA 4X rating. (-G2 Suffix)
- Drilling and Tapping.
- See page V4 for comprehensive list of options.

Applicable Third Party Standards:

UL Standard 886

CSA Standard C22.2, No. 30

Third Party Certification:

UL Listed

CSA Certified

Compliances:

Class I, Div. 1, 2, Groups B◊, C◊, D
Class I, Zone 1, 2, Groups IIA, IIB◊+H2◊
Class II, Div. 1, 2, Groups E, F, G
Class III
NEMA 4, 7B◊C◊D, 9EFG

◊ For Groups B and C (Div. 1) and Groups IIB+H2 (Zone 1), all conduits must be sealed within 2" of the enclosures

Effective February, 2002
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EGS Electrical Group O-Z/GEDNEY

7770 N. Frontage Road
Skokie, Illinois 60077

NJBEW Cast Junction Boxes

Class I, Div. 1, 2, Groups B◊, C◊, D; Class I, Zone 1, 2, Groups IIA, IIB◊+H2◊; Class II, Div. 1, 2, Groups E, F, G; Class III; NEMA 4, 7B◊C◊D, 9EFG

Ordering Information:

	Overall Dimensions			Mounting Dimensions				Inside Dimensions					Max. Conduit	Ship Wt.	Mtg. Hrdw.
Catalog No.	F	E	G	A	A*	B	B*	W	H	Db	Dc	K	Size (In)	(lbs)	Cat. No.
NJBEW050903	8.94	13.50	6.13	4.00	n/a	11.00	n/a	5.06	9.50	3.50	1.13	2.00	1.50	20	NMH2
NJBEW060804	10.40	12.50	6.50	4.56	9.13	10.56	4.50	6.00	8.00	3.75	0.75	2.50	2.00	20	NMH2
NJBEW061004	10.63	15.25	6.75	5.50	n/a	13.13	n/a	6.13	10.75	3.81	1.44	2.00	1.50	27	NMH2
NJBEW061204	10.63	16.63	6.38	n/a	9.13	n/a	8.50	6.13	12.13	4.06	1.00	2.25	2.00	25	NMH2
NJBEW061604	11.00	20.50	6.88	6.00	n/a	18.00	n/a	6.50	16.00	4.13	1.38	2.31	1.50	32	NMH2
NJBEW071106	12.25	15.88	10.00	6.38	n/a	13.50	n/a	7.38	11.00	5.88	2.50	3.38	2.00	35	NMH2
NJBEW080808	12.25	12.25	8.25	4.50	n/a	10.75	n/a	8.00	8.00	5.75	0.75	3.25	2.00	30	NMH2
NJBEW081006	12.50	14.50	8.50	7.00	10.75	12.50	6.50	8.00	10.00	5.75	0.75	3.50	2.00	36	NMH4
NJBEW081307	12.50	17.44	10.38	n/a	10.00	n/a	8.50	8.00	13.06	3.50	3.50	2.75	2.00	30	NMH2
NJBEW091105	13.88	15.50	8.69	7.25	11.82	13.13	8.56	9.38	11.13	4.81	1.88	3.25	2.00	22	NMH2
NJBEW091504	14.25	20.44	8.50	7.25	11.81	17.88	13.31	9.50	15.56	4.75	1.75	3.00	2.00	33	NMH2
NJBEW101004	14.81	14.81	7.13	6.50	n/a	13.00	n/a	10.25	10.25	3.50	1.50	2.25	2.00	45	NMH2
NJBEW101006	14.81	14.81	9.13	6.50	n/a	13.00	n/a	10.25	10.25	5.75	1.50	3.38	2.00	44	NMH2
NJBEW101406	14.50	18.50	8.44	7.00	13.00	16.63	10.63	10.00	14.00	5.88	0.75	3.13	2.00	55	NMH4
NJBEW101408	14.50	18.50	9.63	n/a	13.00	n/a	10.63	10.00	14.00	7.75	0.75	4.44	4.00	60	NMH2
NJBEW112005	16.38	25.13	7.50	10.25	14.50	22.63	16.88	11.38	20.00	4.88	1.50	3.50	3.00	85	NMH8
NJBEW112406	15.75	29.38	10.19	8.50	14.13	27.13	20.00	10.75	24.38	6.00	1.63	4.00	3.00	72	NMH8
NJBEW113006	16.38	35.00	10.25	9.50	15.13	32.88	27.25	11.25	29.88	6.19	1.88	4.19	3.00	113	NMH8
NJBEW121206	17.38	17.38	9.25	8.63	15.63	15.63	8.63	12.25	12.25	5.75	1.50	3.75	3.00	65	NMH8
NJBEW121208	17.38	14.38	11.50	8.63	15.63	15.63	8.63	12.25	12.25	7.75	1.50	4.75	3.50	70	NMH8
NJBEW121806	17.00	23.00	9.13	n/a	15.75	n/a	14.13	12.25	18.25	5.75	1.50	3.50	4.00	90	NMH5
NJBEW121808	17.00	23.00	11.13	n/a	15.75	n/a	14.13	12.25	18.25	8.75	1.50	4.25	4.00	101	NMH5
NJBEW122408	16.75	28.75	11.13	n/a	15.75	n/a	18.38	12.00	24.00	7.75	1.00	4.25	4.00	138	NMH4
NJBEW123608	16.75	40.75	11.88	n/a	15.75	n/a	29.00	12.00	36.00	7.75	1.50	4.56	4.00	218	NMH5
NJBEW133806	18.00	42.50	10.44	16.13	11.88	40.75	33.75	13.63	37.88	6.13	1.50	4.31	3.50	190	NMH8
NJBEW141406	19.38	19.38	9.56	9.75	17.75	17.75	9.75	14.75	14.75	5.75	1.38	3.88	3.50	98	NMH8
NJBEW141408	19.38	19.38	11.56	9.75	17.75	17.75	9.75	14.75	14.75	7.75	1.38	4.00	3.00	105	NMH8
NJBEW142408	19.63	29.00	12.00	13.13	n/a	27.50	n/a	14.88	24.25	8.00	1.50	4.00	4.00	131	NMH6
NJBEW153707	21.25	43.00	12.06	13.75	20.00	41.63	32.00	15.63	37.25	7.44	1.50	5.25	4.00	250	NMH8
NJBEW161606	21.00	21.00	9.81	11.00	19.75	19.75	11.00	16.50	16.50	5.75	1.50	3.88	3.50	132	NMH8
NJBEW161608	21.00	21.00	12.39	11.00	19.75	19.75	11.00	16.50	16.50	8.38	1.50	4.88	4.00	140	NMH8
NJBEW161812	21.38	23.38	15.06	12.00	19.00	21.00	14.00	16.25	18.25	11.88	0.38	7.00	4.00	150	NMH8
NJBEW162206	21.50	27.31	9.06	13.00	19.88	25.25	15.50	16.44	22.50	5.75	1.25	3.31	3.00	130	NMH8
NJBEW162408	21.00	28.00	12.13	n/a	19.75	n/a	18.38	16.25	24.25	8.25	1.50	5.31	4.00	180	NMH6
NJBEW162806	20.75	32.75	8.63	13.00	n/a	30.75	n/a	16.25	28.25	5.75	1.50	3.13	3.00	150	NMH5
NJBEW181806	23.38	23.38	9.94	13.00	21.75	21.75	13.00	18.25	18.25	5.75	1.50	4.13	3.50	188	NMH8
NJBEW181808	23.38	23.38	11.94	13.00	21.75	21.75	13.00	18.25	18.25	7.75	1.50	4.50	4.00	198	NMH8
NJBEW182408	23.94	30.00	12.18	16.13	21.75	27.75	18.38	18.25	24.19	7.75	1.50	5.06	4.00	224	NMH8
NJBEW182410	23.94	30.00	14.18	16.13	21.75	27.75	18.38	18.25	24.19	9.75	1.50	5.75	4.00	235	NMH8
NJBEW183008	22.63	34.63	12.13	n/a	21.75	n/a	23.00	18.25	30.25	7.75	1.50	4.75	4.00	265	NMH5
NJBEW183608	23.50	41.75	12.31	11.00	21.75	39.50	29.00	18.25	36.50	7.75	1.50	4.75	4.00	250	NMH8
NJBEW183610	23.50	41.75	14.31	11.00	21.75	39.50	29.00	18.25	36.50	9.75	1.50	5.50	4.00	270	NMH8
NJBEW184207	23.88	47.88	11.88	16.00	23.00	45.38	38.38	18.63	42.25	7.00	1.50	5.00	4.00	310	NMH8
NJBEW205610	26.00	56.00	17.63	n/a	21.56	n/a	38.63	20.00	56.00	5.00	5.00	4.50	4.00	225	NMH8
NJBEW206008	25.00	65.00	12.75	n/a	23.50	n/a	5.00	20.00	60.00	6.88	1.50	4.75	4.00	521	NMH5
NJBEW242408	29.38	29.38	12.31	18.38	28.00	28.00	18.38	24.50	24.50	7.75	1.50	5.00	4.00	225	NMH8
NJBEW242410	29.38	29.38	14.31	18.38	28.00	28.00	18.38	24.50	24.50	9.75	1.50	6.13	4.00	240	NMH8
NJBEW243008	29.00	35.00	13.00	18.00	28.00	34.00	23.00	24.00	30.00	8.00	1.94	5.25	4.00	420	NMH8
NJBEW243608	30.75	43.00	13.06	n/a	28.00	n/a	29.00	24.25	36.25	7.75	1.63	5.13	4.00	420	NMH5
NJBEW243610	30.75	43.00	13.06	n/a	28.00	n/a	29.00	24.25	36.25	9.75	1.63	6.00	4.00	450	NMH5
NJBEW303808	36.00	44.00	13.75	n/a	35.00	n/a	29.00	30.00	38.00	7.75	2.00	6.13	4.00	600	NMH6
NJBEW303816	36.00	44.00	20.06	n/a	35.00	n/a	29.00	30.00	38.00	7.75	7.75	6.13	4.00	800	NMH6

Dimensions (in inches) are nominal. ◊ For Groups B and C, all conduits must be sealed within 2" of the enclosure.
Refer to page V3 for Dimensional Drawing. Refer to page V5 for drill and tap schedule to accompany order.

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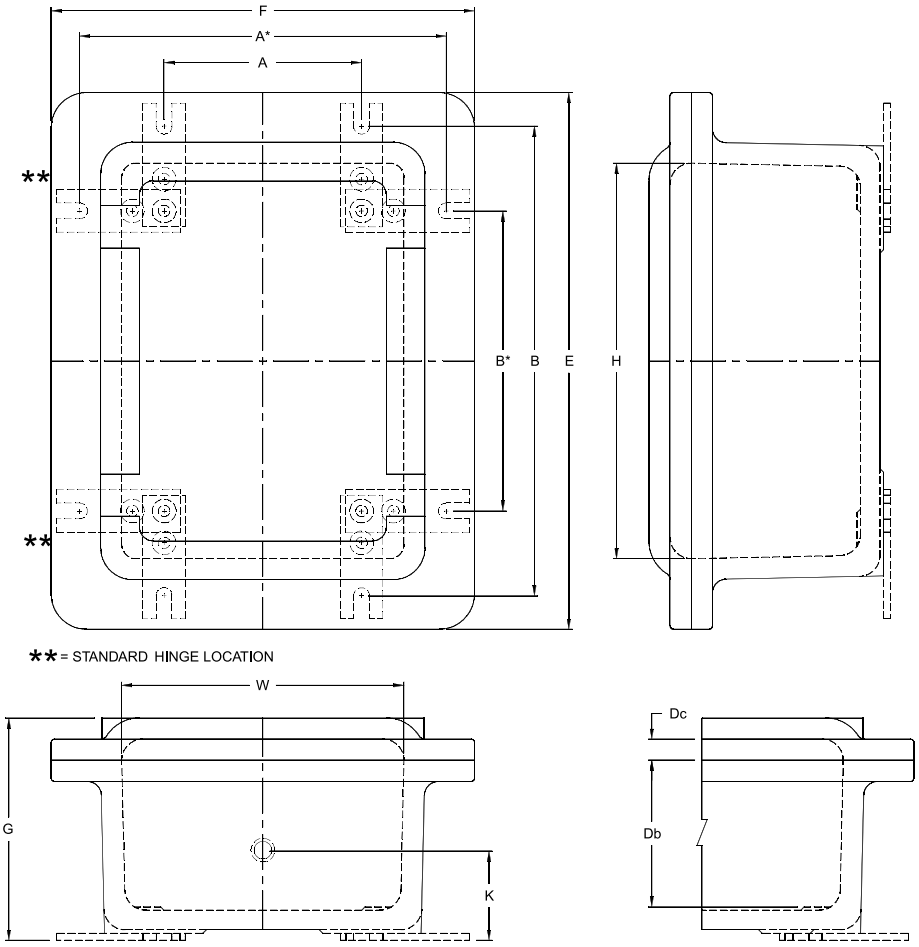
NJBEW Cast Junction Boxes

Dimensional Data (Refer to Page V2 for Dimensional Labels):



DRILLING AND TAPPING GUIDELINES:

Conduit	Minimum Spacing For Conduit Centers (Inches)									
Size (NPT)	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4
½	2.13	2.13	2.25	2.63	2.81	3.13	3.63	4.00	4.50	4.50
¾	2.13	2.13	2.25	2.63	2.81	3.13	3.63	4.00	4.50	4.50
1	2.25	2.25	2.38	2.81	3.00	3.25	3.75	4.13	4.50	4.63
1¼	2.63	2.63	2.81	3.13	3.31	3.63	4.13	4.50	4.75	5.00
1½	2.81	2.81	3.00	3.31	3.50	3.81	4.31	4.63	4.94	5.25
2	3.13	3.13	3.25	3.63	3.81	4.13	4.63	5.00	5.83	5.75
2½	3.63	3.63	3.75	4.13	4.31	4.63	5.13	3.31	5.75	6.13
3	4.00	4.00	4.13	4.50	4.63	5.00	3.31	5.75	6.00	6.25
3½	4.50	4.50	4.50	4.75	4.94	5.38	5.75	6.00	6.25	6.50
4	4.50	4.50	4.63	5.00	5.25	5.75	6.13	6.25	6.50	6.75

Note: Dimensions (in inches) are nominal.

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O-Z/GEDNEY
7770 N. Frontage Road
Skokie, Illinois 60077

NJBEW and NCSEW Series Drill and Tap Schedule

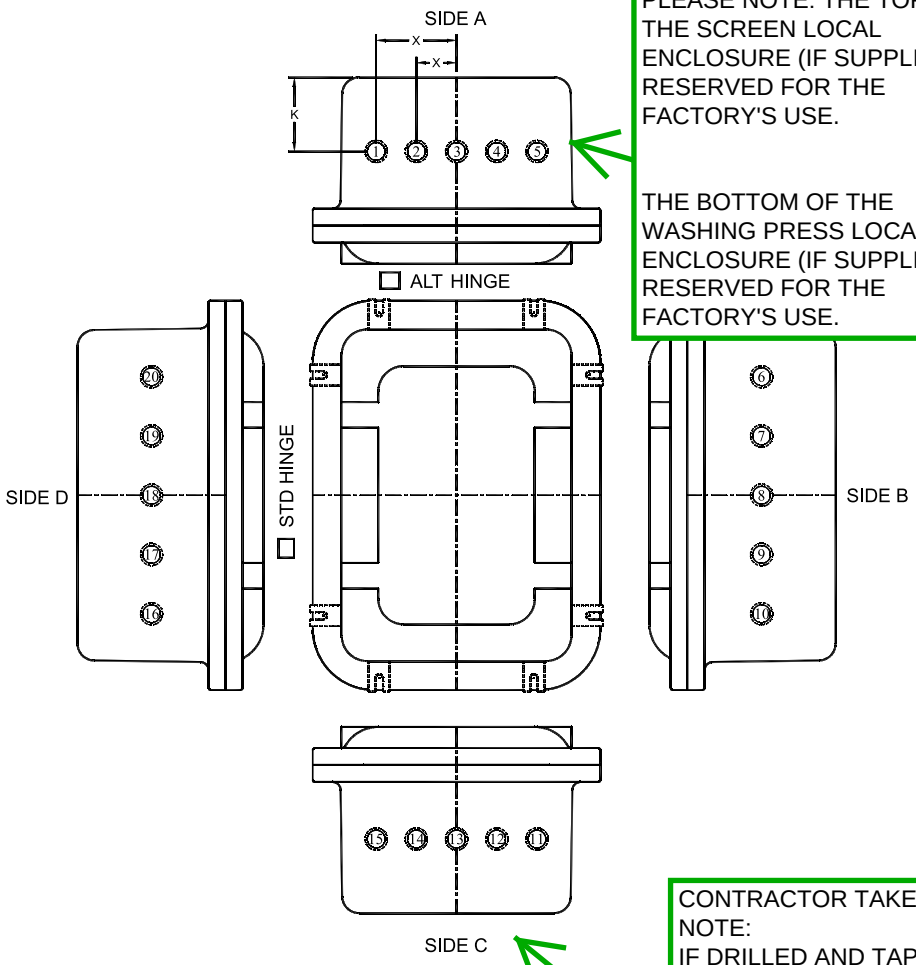
For factory installed conduit entries complete this schedule and fax with your purchase order.

CHECK ONLY IF SHOP IS TO LOCATE.

❒ Drain Only, Side_____

❒ Breather/Drain Sides ____&____

Position	Conduit Size	Dimension "X"	Dimension "K"
1			
2			
3 CL			
4			
5			
6			
7			
8 CL			
9			
10			
11			
12			
13 CL			
14			
15			
16			
17			
18 CL			
19			
20			



PLEASE NOTE: THE TOP OF THE SCREEN LOCAL ENCLOSURE (IF SUPPLIED) IS RESERVED FOR THE FACTORY'S USE.

THE BOTTOM OF THE WASHING PRESS LOCAL ENCLOSURE (IF SUPPLIED) IS RESERVED FOR THE FACTORY'S USE.

CONTRACTOR TAKE NOTE:
IF DRILLED AND TAPPED CONDUIT PROVISIONS ARE WANTED DONE AT THE FACTORY, PLEASE INDICATE LOCATION, NUMBER OF AND SIZE OF EACH CONDUIT ENTRANCE.

Check List

❒ Assign Drawing no.

❒ Select correct figure no.

❒ If breather and drain are required, are they clearly marked at desired positions or is box checked?

❒ Are indicated conduit sizes within the catalog published maximum on pages V2 and V35.

❒ Check for minimum spacing between conduit to conduit per spacing table on page V3.

❒ For NCSEW cover layout, submit separate drawing and allow min. 2½" spacing between consecutive ¾ - 14 NPS openings in cover.

❒ Sign name to drawing.

Name_____

Date_____

Catalog Number	Dwg No.

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O-Z/GEDNEY
7770 N. Frontage Road
Skokie, Illinois 60077

NJBEW Cast Junction Boxes

OPTIONS

Factory Installed Suffix	Field Installed Cat. No.	Description
AB	n/a	Set of 4 standoffs ½" high
BR		Breather, NEMA 4X (includes outlets & installation)
DN		Drain, NEMA 4X (includes outlets & installation)
DP1	NWG13/1CT	Desiccate package
EGS	n/a	External grounding stud ⅜"-16
G1	n/a	Grey Powder Coat Epoxy (outside)
G2	n/a	Grey Powder Coat Epoxy (inside & outside)
H		Hinges stainless steel
	NHOF12SS	Hinge Kit, 2 light duty SS hinges
	NHOF22SS	Hinge Kit, 2 heavy duty SS hinges
	NHOF23SS	Hinge Kit, 3 heavy duty SS hinges
*K	n/a	Terminal blocks 600V, 30A (* indicate # of points) (example: 5 points = 5K)
NP	n/a	Plastic nameplate, 2" x 4", ⅛" black letters on white surface, 3 lines max, specify legend.
Q	n/a	SS captive Quad-Lead bolts
Z	See table below	Mounting pan

MOUNTING HARDWARE†

Factory Installed Suffix	Field Installed Cat. No.	Description
MH1	NMH1	¼" - 20 X 1¼" Bolt, ¼" - 20 Hex Nut, ¼" Washers
MH2	NMH2	⅜" -16 X 1¼" Bolt, ⅜" -16 Hex Nut, ⅜" Washers
MH3	NMH3	7/16" - 14 X 1¾" Bolt, 7/16" - 14 Hex Nut, 7/16" Washers
MH4	NMH4	½" - 13 x 1¾" Bolt, ½" - 13 Hex Nut, ½" Washers
MH5	NMH5	½" - 13 X 2" Bolt, ½" - 13 Hex Nut, ½" Washers
MH6	NMH6	⅝" - 11 X 2" Bolt, ⅝" - 11 Hex Nut, ⅝" Washers
MH7	NMH7	½" - 13 X 1¼" Bolt, ½" - 13 Hex Nut, ½" Washers
MH8	NMH8	⅝" - 11 X 1¼" Bolt, ⅝" - 11 Hex Nut, ⅝" Washers

†Refer to page V3 for Enclosure-Mounting Hardware Correlation.

DRILL & TAP OPTIONS (For drill and tap schedule, refer to page V5)

Symbol	Conduit Size (NPT)	Symbol	Conduit Size (NPT)
A	1/2"	F	2"
B	3/4"	G	2-1/2"
C	1"	H	3"
D	1-1/4"	J	3-1/2"
E	1-1/2"	K	4"

Blind Tapped Holes

Suffix	Screw Size
BT1	#6 - 1/4"
BT2	5/16" - 1/2"

Mounting Pans

Mounting Pan Catalog No.	Junction Box Catalog No.	Overall Dimension W	H
NZ-593	NJBEW050903	4.00	8.50
NZ-684	NJBEW060804	4.50	6.50
NZ-6104	NJBEW061004	5.00	10.00
NZ-6124	NJBEW061204	5.50	11.00
NZ-6164	NJBEW061604	5.25	15.00
NZ-7116	NJBEW071106	6.50	10.00
NZ-886	NJBEW080806	6.50	6.50
NZ-8106	NJBEW081006	6.50	8.50
NZ-8137	NJBEW081307	6.00	11.00
NZ-9115	NJBEW091105	8.25	10.00
NZ-9154	NJBEW091504	8.13	14.75
NZ-10104/6	NJBEW101004	7.50	7.50
NZ-10104/6	NJBEW101006	7.50	7.50
NZ-10146/8	NJBEW101408	9.00	13.00
NZ-10146/8	NJBEW101408	9.00	13.00
NZ-11205	NJBEW112005	10.50	19.00
NZ-11246	NJBEW112406	9.88	23.25
NZ-11306	NJBEW113006	9.88	28.50
NZ-12126/8	NJBEW121206	10.50	10.50
NZ-12126/8	NJBEW121208	10.50	10.50
NZ-12186/8	NJBEW121806	10.50	16.50
NZ-12186/8	NJBEW121808	10.50	16.50
NZ-12248	NJBEW122408	10.75	22.63
NZ-12368	NJBEW123608	10.00	34.00
NZ-13386	NJBEW133806	11.50	36.38
NZ-14146/8	NJBEW141406	12.25	12.25
NZ-14146/8	NJBEW141408	12.25	12.25
NZ-14248	NJBEW142408	14.00	22.38
NZ-15377	NJBEW153707	14.50	35.50
NZ-16166/8	NJBEW161606	15.00	15.00
NZ-16166/8	NJBEW161608	15.00	15.00
NZ-161812	NJBEW161812	15.00	16.00
NZ-16226	NJBEW162206	14.00	20.00
NZ-16248	NJBEW162408	14.75	22.75
NZ-16286	NJBEW162806	14.00	26.00
NZ-18186/8	NJBEW181806	16.00	16.00
NZ-18186/8	NJBEW181808	16.00	16.00
NZ-18248/10	NJBEW182408	16.00	22.00
NZ-18248/10	NJBEW182410	16.00	22.00
NZ-18308	NJBEW183008	16.00	28.00
NZ-18368/10	NJBEW183608	17.00	34.75
NZ-18368/10	NJBEW183610	17.00	34.75
NZ-18427	NJBEW184207	17.00	40.00
NZ-205610	NJBEW205610	17.00	54.00
NZ-20608	NJBEW206008	18.00	57.50
NZ-24248/10	NJBEW242408	22.00	22.00
NZ-24248/10	NJBEW242410	22.00	22.00
NZ-24308	NJBEW243008	22.50	28.00
NZ-24368/10	NJBEW243608	22.00	34.00
NZ-24368/10	NJBEW243610	22.00	34.00
NZ-30388	NJBEW303808	28.00	36.00
NZ-30388	NJBEW303816	28.00	36.00

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GO™ SWITCH

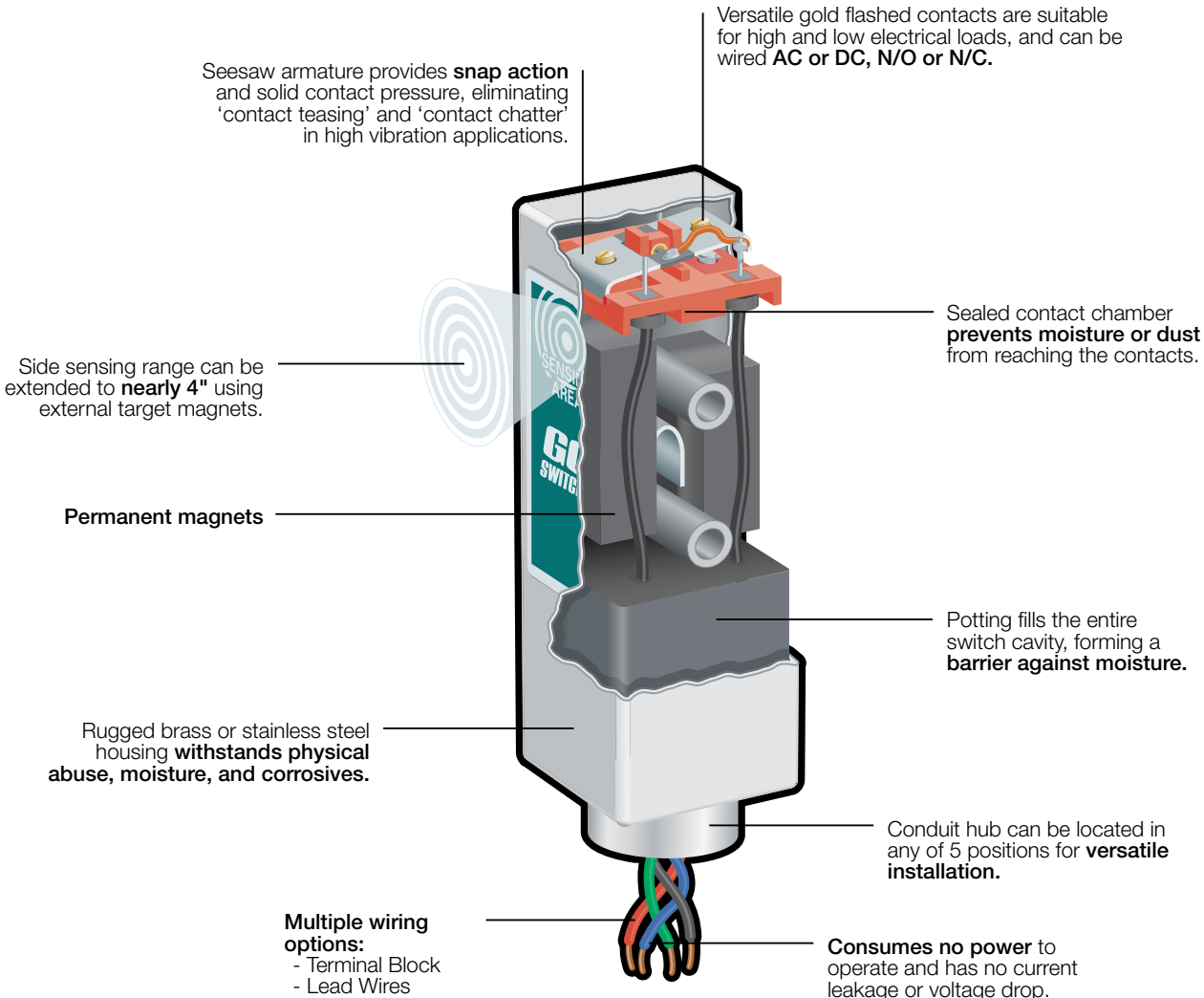
THE ALL IN ONE PROXIMITY SENSOR AND LIMIT SWITCH.
GO Gets It.

GO Switch is the most versatile sensing solution. It detects like a proximity switch and functions like a limit switch, providing higher reliability when conventional switches fail.

EMERSON™
Process Management

GO™ SWITCH - EXTENDED SENSING
Built to last in the most demanding conditions

GO Switch models 11, 21, 31 and 81 are the ideal replacements for traditional mechanical limit switches. Sealed contacts, rugged housings, non-contact detection of ferrous metal & magnetic targets, and snap action response make these switches the ultimate problem solvers for troublesome mechanical limit switch applications.



MODEL 11

Models 11, 21, 31, and 81 were the world's original GO™ Switches. Their simple design, rugged housings, long sensing ranges, and global approvals make these switches the ideal choice wherever reliable proximity sensing is needed. Some features common to all these models include a standard operating temperature range of -58°F to 221°F (-50°C to 105°C) and gold-plated SPDT dry contacts.

Model 11

Features

- Single Pole Double Throw (SPDT) 5A/240VAC, 10A/120VAC, 3A/24VDC
- AC/DC, NO/NC Wiring Flexibility
- -58°F to 221°F (-50°C to 105°C) operating temperature
- 3/8'' (10mm) sensing distance (ferrous metal)
- Dry Contact
- Intrinsically Safe
- Side sensing
- Gold Plated Contacts

Options

- High Temperature: -58°F to +350°F (-50°C to +176°C)
- Brass or Stainless Steel 304 Housings
- Extended Sensing: 9/16'' (14mm)
- Terminal Block, Lead Wires, or Cables
- Latching Contacts
- SubSea Connectors
- Quick Disconnects - Micro or Mini
- Global Hazardous Area Approvals

Model 81

Features

- Double Pole Double Throw (DPDT) 5A/240VAC, 10A/120VAC, 3A/24VDC
- AC/DC, NO/NC Wiring Flexibility
- -58°F to 221°F (-50°C to 105°C) operating temperature
- 1/4" (6mm) Sensing Distance (Ferrous metal)
- Dry Contact
- Intrinsically Safe
- End Sensing
- Gold Plated Contacts

Options

- High temperature: -58°F to 350°F (-50°C to 176°C)
- Single Pole Double Throw (SPDT) 10A/120VAC, 3A/24VDC
- Brass or Stainless Steel 304 Housings
- Lead Wires or Cables
- SubSea Connectors
- Quick Disconnects – Mini
- CSA/UL Hazardous Area Approvals

Model 21

Features

- Single Pole Double Throw (SPDT) 5A/240VAC, 10A/120VAC, 3A/24VDC
- AC/DC, NO/NC Wiring Flexibility
- -58°F to 221°F (-50°C to 105°C) operating temperature
- 3/8'' (10mm) Sensing Distance (Ferrous Metal)
- Dry Contact
- Intrinsically Safe
- Side sensing
- Gold Plated Contacts

Options

- Brass or Stainless Steel 304 Housings
- Terminal Block, Lead Wires, or Cables
- Latching Contacts
- SubSea Connectors
- Quick Disconnects - Micro or Mini
- Global Hazardous Area Approvals

Model 31

Features

- Single Pole Double Throw (SPDT) 3A/240VAC, 6A/120VAC, 2A/24VDC
- AC/DC, NO/NC Wiring Flexibility
- -58ºF to 221ºF (-50ºC to 105ºC) operating temperature
- 1/4" (6mm) Sensing Distance (Ferrous metal)
- Dry Contact
- Intrinsically Safe
- End sensing
- Gold Plated Contacts

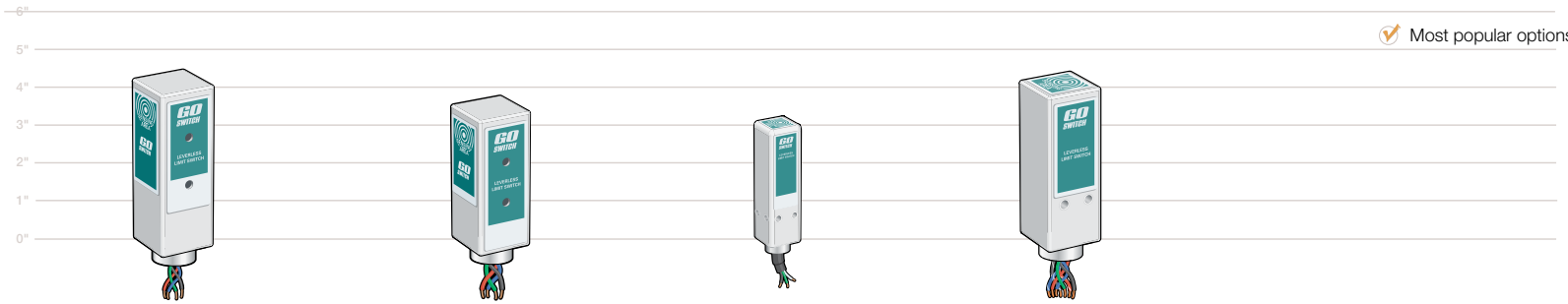
Options

- Lead Wires or Cables
- Quick Disconnects - Micro or Mini
- CSA/FM Hazardous Area Approvals

GO™ SWITCH ORDERING GUIDE - EXTENDED SENSING

Choose one option from each category to build a complete model number.

☑ Most popular options



Model 11
Long Range

Model 21
Side Sensing

Models 31
End Sensing

Model 81
DPDT

Model

Models 11, 21 & 81

☑ **11** 1 1/2" square x 4 9/16" overall. (Add 1/2" for bottom conduit outlet)

☑ **21** 1 1/2" square x 3 13/16" overall. (Add 1/2" for bottom conduit outlet)

31 1" square x 3 1/4" overall

81 1 1/2" square x 4 3/8" overall. (Add 1/2" for bottom conduit outlet)

Ordering Guide
Fill in each box to create a complete model number.

Model

Contact Form

☑ **1** Single Pole Double Throw (Form C)

☑ **2** Double Pole Double Throw (Form CC) (Model 81 Only)

3 Single Pole Double Throw (Form C) Latching (Maintained contact) (Models 11 & 21 only) (Outlet 2, 4 or 5 only)

Contact Form

Sensing Range

☑ **0** 1/4" end sensing (Model 81 only)

☑ **1** Standard sensing - 3/8" side sensing (Model 11 & 21 only)

☑ **2** Extended sensing - 9/16" side sensing (Contact form must be 1 or 3) (Model 11 only)

7 Precision sensing - 1/4" side sensing (Minimal differential) (Models 11, 21 & 31 only)

Sensing Range

Outlet Position

1 Behind sensing area (Models 11, 21 & 81 only)

2 Left of sensing area (Models 11 & 21 only)

3 Right of sensing area (Models 11 & 21 only)

4 Same side as sensing area (Models 11 & 21 only)

5 Bottom of enclosure

Outlet Position

Enclosure Materials

☑ **1** Brass with flat black lacquer coating (Models 11, 21 & 81 only)

☑ **2** Stainless steel*

3 Brass with corrosion resistant coating (Models 11, 21 & 81 only)

4 Stainless steel - corrosion resistant coating (polyurethane)*

* All-welded stainless steel switches are recommended for wet or harsh environments.

Enclosure Materials

Approvals

☑ **0** CSA / FM Cl I, Div 2, Grps A-D; Cl II, Div 2, Grps F & G, Cl III Terminal Block (Contact form must be 1 or 3) (Wiring must be 00) (Models 11 & 21 only)

2 High temperature to 350°F (Models 11 & 81; Contact Form 1 or 3 (1 or 2 for Model 81) (Sensing 1; Enclosure 2; Wiring F only) (Models 11, 21 and 81 only)

3 UL Cl I, Div 1 & 2; Grps A-D; Cl II, Div 1 & 2, Grps E-G; Cl III (Enclosure must be 2 or 4) (Lead seal required) (Wiring A, B, and F only)

☑ **4** CSA / FM Cl I, Div 1; Grps A-D; Cl II, Div 1; Grps E-G; Cl III. (Enclosure must be 2 or 4) (Lead seal required) (Wiring A, B, and F only)

5 MSHA approved "Explosion Proof" (Enclosure 2 only) (Wiring B3 or longer) (Models 11 & 21 only) (Wiring A, B, and F only)

☑ **6** CSA / FM Cl I, Div 2; Grps A-D; Cl II, Div 2; Grps E-G; Cl III. (Lead seal required)

7 CSA General Purpose

☑ **8** UL General Purpose

Approvals

Wiring Options

☑ **Terminal Block**
00 (Models 11 & 21 only)

☑ **Lead Wires** - 18 Gauge
A2 36"
A3 72"
A4 144"
A_ _ _ Greater than 144" - specify length in 5ft increments

Cable - 16 Gauge (Model 81 contact form 1 only)
B2 36"
B3 72"
B4 144"
B_ _ _ Greater than 144" - specify length in 5ft increments

Mini Change Connector (Models 11, 21, 31, 81)
(Approval 7 or 8 only; 3 pin is 8 only)
DCA 3 pin
DCD 4 pin
DCG 5 pin
DCH 7 pin (Model 81 only)

Micro Change Connector (Models 11, 21, 31, 81)
(Approval 7 or 8 only; 3 pin is 8 only)
DBA 3 pin
DBD 4 pin
DBG 5 pin

SubSea Connector
(Models 11, 21, 81) (Enclosure 2 or 4 only)
(Approval 7 or 8 only; 3 pin is 8 only)
3DD 3 pin
4DD 4 pin
8DD 8 pin (Model 81 only)
3DE 3 pin 90°
4DE 4 pin 90°

Hi-Temp™ Leads (Teflon insulated) 18 Gauge
F2 36"
F3 72"
F4 144"
F_ _ _ Greater than 144" - specify length in 5ft Increments

Wiring Options

TARGET MAGNETS
Increase the Sensing Range of GO Switches

Standard magnets are available to increase the sensing distance of any GO Switch model. This feature gives the customer the flexibility of using the magnet as the target and increasing the sensing distance up to 10 times that of ferrous metal targets.

AMP3 MAGNET/RESIN COVER
AMC3 magnet in plastic molded bracket with mounting holes. 7/8" (22 mm) x 29/16" (65 mm) x 17/32" (13 mm) thick with 7/32" (6 mm) holes.

For all GO Switches

AMS7 MAGNET/STAINLESS
Magnet assembly. 2" (50 mm) x 1/2" (13mm) 7/16-20 UNC threads.

For 70 Series GO Switches

AMS4 MAGNET/STAINLESS COVER
AMC4 magnet molded into stainless steel cover, with mounting holes. 11/4" (32 mm) x 17/16" (37 mm) x 1" (25 mm) thick with 3/16" (5 mm) holes.

For all GO Switches

AMS12 MAGNET
Magnet assembly.
2 3/5" (66mm) x 7/8" (22mm)
7/16-20 UNF threads.

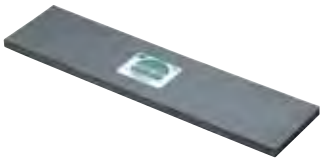
For 70 Series GO Switches

AMC5 MAGNET/STAINLESS COVER
AMC1 magnet molded into stainless cover with mounting holes. 7/8" (22 mm) x 29/16" (65 mm) x 17/32" (13 mm) thick with 7/32" (6 mm) holes.

For all square GO Switches

AMF6 MAGNET (MACHINABLE)
Flexible sensing amplifier/external magnet. 3" (76 mm) x 12" (305 mm) x 3/8" (10 mm) thick.

For all square GO Switches



DISCONNECT ENCLOSURE WITH CLAMPS, TYPE 4X

SPECIFICATIONS

- 14 gauge Type 304 or Type 316L stainless steel
- Seams continuously welded and ground smooth
- External mounting brackets
- External-formed flange around all sides of enclosure opening
- Stainless steel door clamps on three sides of door
- Door removed by pulling stainless steel continuous hinge pin
- Data pocket is high-impact thermoplastic
- Seamless foam-in-place gasket
- Collar studs provided for mounting optional panels
- Holes provided in body for mounting disconnect operating handle and operating mechanism
- Bonding provision on door; ground stud on body
- All exterior hardware on Type 316L enclosures matches the enclosure material
- Adjustable door interlock bracket fastened to door
- Includes instructions for installing disconnect switches, circuit breakers and operating mechanisms

FINISH

Sides and body have smooth #4 brushed finish.

ACCESSORIES

Panels for Type 3R, 4, 4X, 12 and 13 Enclosures
Blank Adapter Plates, Stainless Steel
Industrial Corrosion Inhibitors
Electric Heater
PANELITE Enclosure Lights
Terminal Block Kit Assembly for Type 4, 12 and 13 Enclosures
Steel and Stainless Steel Window Kits

MODIFICATION AND CUSTOMIZATION

Hoffman excels at modifying and customizing products to your specifications. Contact your local Hoffman sales office or distributor for complete information.

BULLETIN: A19S

INDUSTRY STANDARDS

UL 508A Listed; Type 3R, 4, 4X, 12; File No. E61997
cUL Listed per CSA C22.2 No. 94; Type 3R, 4, 4X, 12; File No. E61997

NEMA/EEMAC Type 3, 3R, 4, 4X, 12, 13
CSA File No. 42186: Type 4, 4X, 12
IEC 60529, IP66
Meets NEMA Type 3RX requirements

APPLICATION

For disconnect applications in which a clamp-secured door is preferred, this enclosure features clamps on three sides to keep liquids and contaminants from entering and a preferred cutout that accepts major brand disconnect switches and circuit breakers.

Furnished with Enclosure

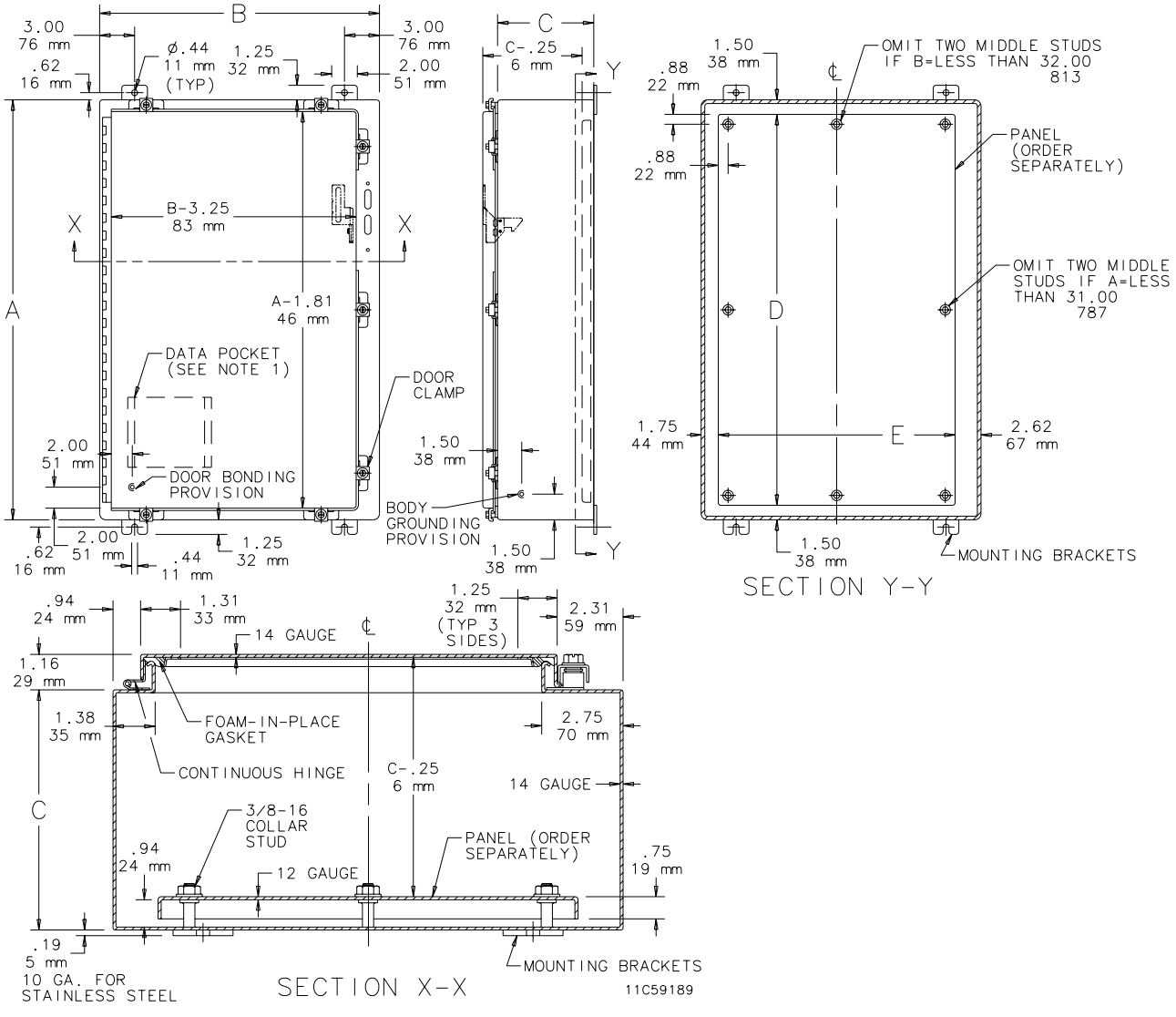
1. Adjustable door interlock bracket fastened to door
2. Instructions to locate and install disconnect switches, circuit breakers and operating mechanisms

Standard Product

Catalog Number	AxBxC in.	AxBxC mm	Stainless Steel Type	Panel	Conductive Panel	Panel Size D x E (in.)	Panel Size D x E (mm)	Data Pocket Size (in.)	Data Pocket Size (mm)	Number of Clamps
A24HS2108SSLP	24.00 x 21.38 x 8.00	610 x 543 x 203	304	A24P20	A24P20G	21.00 x 17.00	533 x 432	6.00 x 6.00	152 x 152	5
A24HS2108SS6LP	24.00 x 21.38 x 8.00	610 x 543 x 203	316L	A24P20	A24P20G	21.00 x 17.00	533 x 432	6.00 x 6.00	152 x 152	5
A24HS2508SSLP	24.00 x 25.38 x 8.00	610 x 645 x 203	304	A24P24	A24P24G	21.00 x 21.00	533 x 533	6.00 x 6.00	152 x 152	5
A24HS2508SS6LP	24.00 x 25.38 x 8.00	610 x 645 x 203	316L	A24P24	A24P24G	21.00 x 21.00	533 x 533	6.00 x 6.00	152 x 152	5
A30HS2508SSLP	30.00 x 25.38 x 8.00	762 x 645 x 203	304	A30P24	A30P24G	27.00 x 21.00	686 x 533	12.00 x 12.00	305 x 305	5
A30HS2508SS6LP	30.00 x 25.38 x 8.00	762 x 645 x 203	316L	A30P24	A30P24G	27.00 x 21.00	686 x 533	12.00 x 12.00	305 x 305	5
A36HS2508SSLP	36.00 x 25.38 x 8.00	914 x 645 x 203	304	A36P24	A36P24G	33.00 x 21.00	838 x 533	12.00 x 12.00	305 x 305	5
A36HS2508SS6LP	36.00 x 25.38 x 8.00	914 x 645 x 203	316L	A36P24	A36P24G	33.00 x 21.00	838 x 533	12.00 x 12.00	305 x 305	5
A36HS3108SSLP	36.00 x 31.38 x 8.00	914 x 797 x 203	304	A36P30	A36P30G	33.00 x 27.00	838 x 686	12.00 x 12.00	305 x 305	7
A36HS3108SS6LP	36.00 x 31.38 x 8.00	914 x 797 x 203	316L	A36P30	A36P30G	33.00 x 27.00	838 x 686	12.00 x 12.00	305 x 305	7
A42HS3112SSLP	42.00 x 31.38 x 12.00	1067 x 797 x 305	304	A42P30	A42P30G	39.00 x 27.00	991 x 686	12.00 x 12.00	305 x 305	10
A42HS3112SS6LP	42.00 x 31.38 x 12.00	1067 x 797 x 305	316L	A42P30	A42P30G	39.00 x 27.00	991 x 686	12.00 x 12.00	305 x 305	10
A42HS3712SSLP	42.00 x 37.38 x 12.00	1067 x 949 x 305	304	A42P36	A42P36G	39.00 x 33.00	991 x 838	12.00 x 12.00	305 x 305	10
A42HS3712SS6LP	42.00 x 37.38 x 12.00	1067 x 949 x 305	316L	A42P36	A42P36G	39.00 x 33.00	991 x 838	12.00 x 12.00	305 x 305	10
A48HS3712SSLP	48.00 x 37.38 x 12.00	1219 x 949 x 305	304	A48P36	A48P36G	45.00 x 33.00	1143 x 838	12.00 x 12.00	305 x 305	10
A48HS3712SS6LP	48.00 x 37.38 x 12.00	1219 x 949 x 305	316L	A48P36	A48P36G	45.00 x 33.00	1143 x 838	12.00 x 12.00	305 x 305	10
A60HS3712SSLP	60.00 x 37.38 x 12.00	1524 x 949 x 305	304	A60P36	A60P36G	57.00 x 33.00	1448 x 838	12.00 x 12.00	305 x 305	11
A60HS3712SS6LP	60.00 x 37.38 x 12.00	1524 x 949 x 305	316L	A60P36	A60P36G	57.00 x 33.00	1448 x 838	12.00 x 12.00	305 x 305	11

Purchase panels separately. Optional stainless steel, composite or aluminum panels are available for most sizes

NOTE: nVent HOFFMAN cannot guarantee compatibility of disconnect configurations with third-party latching. Please work with your local nVent HOFFMAN distributor or contact nVent HOFFMAN Technical Support, 763-422-2175, TechAppSupport@nVent.com.



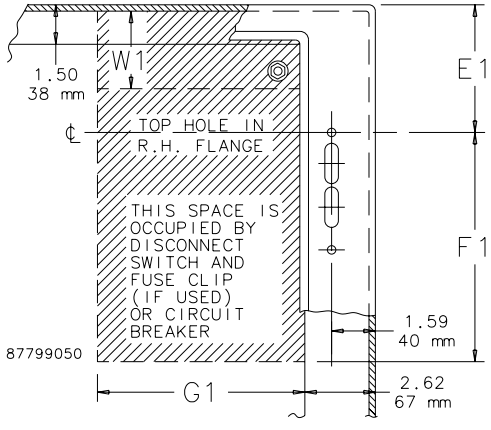
DISCONNECT MOUNTING SPACE

Disconnects will occupy space on panel shown by dimensions E1, F1, and G1. Wiring space W1 is available when disconnect is installed in the enclosure.
E1 = 8.62 in. (219 mm) when C = 8.00 in. (203 mm)
E1 = 11.62 in. (294 mm) when C = 12.00 in. (305 mm)
W1 = Wiring Space

Refer to ***NATIONAL ELECTRICAL CODE, 2005*** article 430-10(b) for wiring space required for line side conductors to be connected to disconnect.

Verify your application to determine whether wiring space is adequate.

Consult Space Occupied by Disconnect drawing to determine whether the disconnect device you are using will fit the enclosure size you have selected.



Consult disconnect manufacturer for F1 and G1 dimensions.

PREFERRED-CUTOUT OVERVIEW

APPLICATION

Enclosures having the preferred cutout are sized for use with up to 200A disconnect switches and up to 400A circuit breakers unless otherwise specified. The preferred cutout accepts the smaller operating handle whose mounting hole centers are 4.688 in. apart. Preferred cutouts are standard in mild steel wall-mount enclosures, modular enclosures and some select large mild steel enclosures. They are also present on all standard stainless steel offerings. Mild steel operator adapter plates with brand specific preferred cutouts are available for enclosures with a rectangular universal cutout.

Preferred cutouts are designed to house the following:

Allen-Bradley

- Bulletin 1494U universal disconnect switches with flange-mount handles for either variable-depth, cable-operated mechanisms
- Bulletin 1494V disconnect switches with flange-mount variable-depth operating mechanisms and Bulletin 1494V flange-mount variable-depth operating mechanisms for circuit breakers
- Bulletin 140U flexible cable operating mechanisms for 140U molded case circuit breakers
- Bulletin 140G flexible cable and variable-depth, flange-mount, molded case circuit breakers
- Bulletin 1494C cable-operated disconnect switches with flange-mount handles
- Bulletin 194RC cable-operated flange-mount handles for use with the NFPA 79 compliant 194R IEC rotary disconnect switches

Allen-Bradley Bulletin 1494V-R1, -R2 and -W2 operating handles and Allen-Bradley Bulletin 1494F disconnect devices or Bulletin 1494D circuit breaker operators will NOT fit these enclosures.

ABB Controls flange-mount variable-depth operating mechanisms for disconnect switches and circuit breakers. Also the cable version for circuit breakers.

Eaton Cutler-Hammer Type C361 flange-mount variable-depth operating mechanisms with disconnect switches and Type C371 flange-mount variable-depth operating mechanisms for circuit breakers.

General Electric Type STDA flange handles and variable-depth operating mechanisms for disconnect switches and circuit breakers. Also SPECTRAFLEX cable operators for circuit breakers.

Siemens ITE MAX FLEX® flange-mount variable-depth operating handles for circuit breakers.

Schneider Square D® Class 9422 disconnect switches with flange-mount variable-depth operating mechanisms or cable mechanisms and Class 9422 flange-mount variable-depth operating mechanisms or cable mechanisms for circuit breakers.
These enclosures will NOT accept Square D Class 9422 bracket-mounted disconnect devices, Class 9422TG1 or TG2 devices.

ORDERING

The disconnect switch, operating handle, and operating mechanism must be ordered from disconnect equipment supplier. See Technical Information in the nVent HOFFMAN Specifier's Guide for wire bend space available when various manufacturers' disconnect switches are installed. Check the enclosure dimension drawings to verify the chosen disconnect switch will fit in the enclosure.

PROAIR HARSH ENVIRONMENT

CR23
1600 BTU/Hr.
469 Watt

CR29
2700 and 4000 BTU/Hr.
791 and 1172 Watts

CR43
6000 & 8000 BTU/Hr.
1758 and 2344 Watts

INDUSTRY STANDARDS

UL/cUL Listed; Type 12, 3R, 4; 4X optional; File No. SA6453
UR/cUR Recognized

UR/cUR Recognized on select models, reference performance data tables.
CE
EAC

APPLICATION

- Industrial automation
- Package handling equipment
- Food and beverage
- Wastewater treatment
- Security and defense systems
- And more

FEATURES

- Robust reciprocating compressor
- Easy maintenance: hinged front cover allows quick access to all components; condenser coil can be cleaned while unit is still mounted to the cabinet
- R134a or R407c earth-friendly refrigerant
- Models for 115, 230 and 460 single phase VAC power input
- UL Listed or Recognized to save customers time and money with agency approvals
- Operating temperature range from -40 F/-40 C to 131 F/55 C (with optional low-ambient package)
- Attractive industrial design with minimal use of visible fasteners
- Reliable mechanical thermostat located behind the filter of the unit
- Low-carbon mild-steel sheet-metal cover for rugged factory and outdoor environments
- Easy-mount flanges for simple installation
- Cleanable reusable aluminum mesh filter protects coils for maximum cooling performance
- Mounting hardware, gaskets and user manual furnished with the unit
- Every unit functionally tested before shipping
- High-performance fans and blowers designed for densely packed enclosures
- Standard Indoor Air Conditioner models also include:
  - Electro-Mechanical Thermostat
  - Surge Suppressor

FINISH

- RAL 7035 light-gray, semi-textured powder-coat paint standard
- Stainless steel Type 304 or 316 finishes available on Type 4X models
- Other colors and textures available

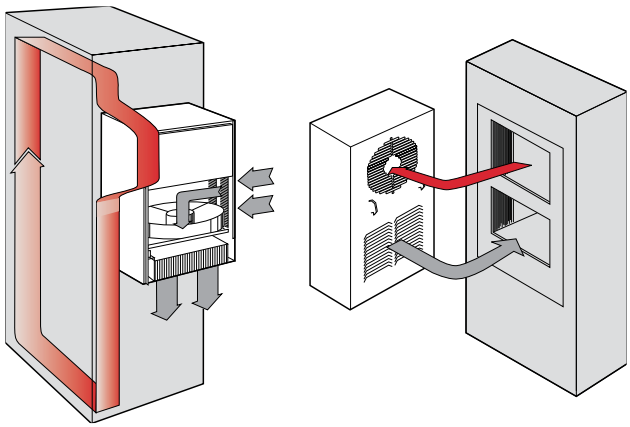
OPTIONS

- Thermostat Malfunction Package
- Special Voltage Package
- Outdoor Package*
- Harsh Environment Package*
- Stainless Steel Package*
- Heater Package*

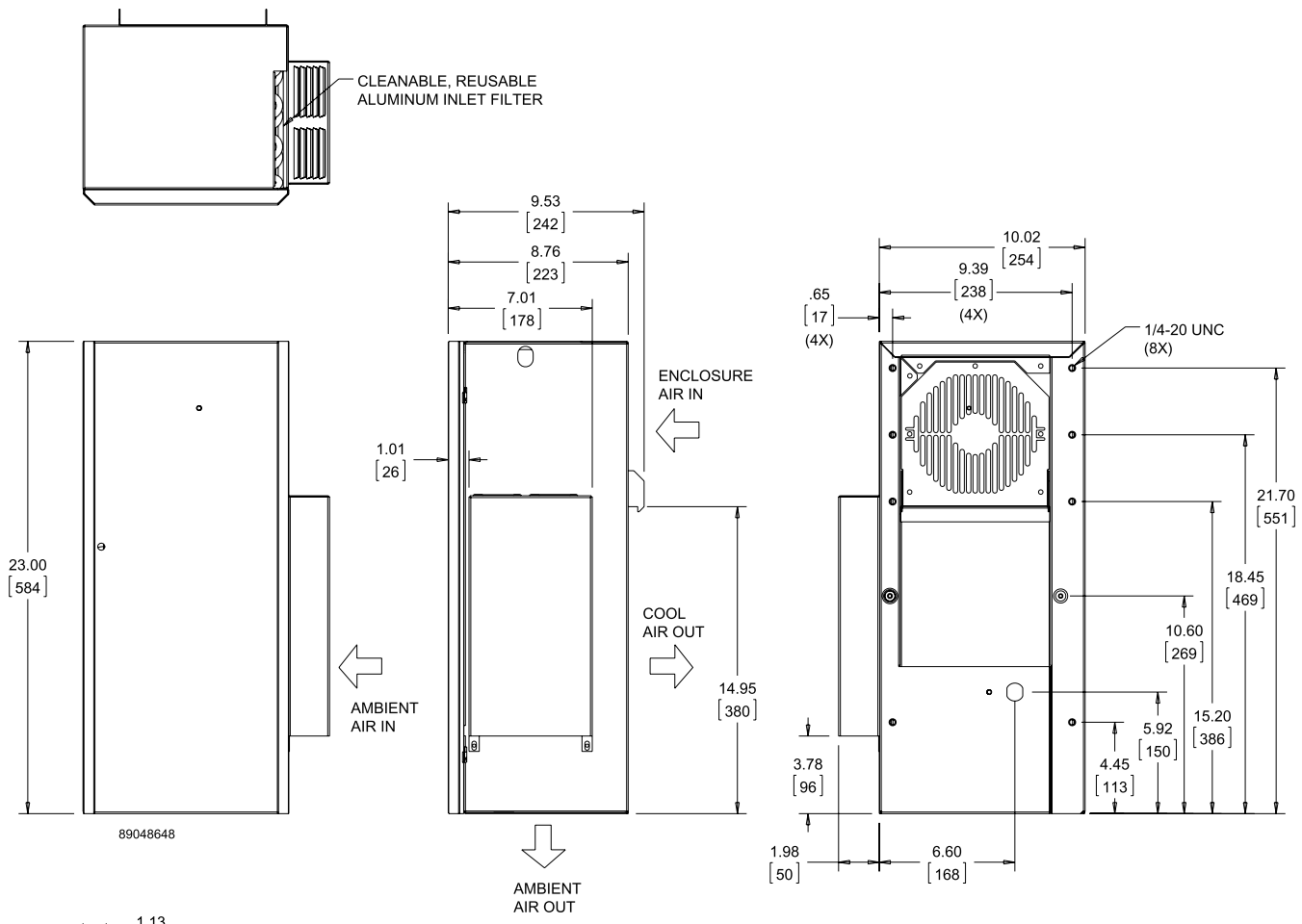
* T-Series may be more appropriate. Refer to T-Series A/C section. Consult the factory for availability and catalog number.

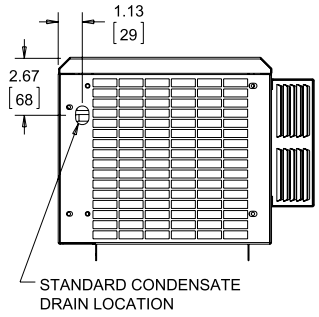
Performance Data **CR23 Models 1600 BTU/Hr. (469 Watt)**

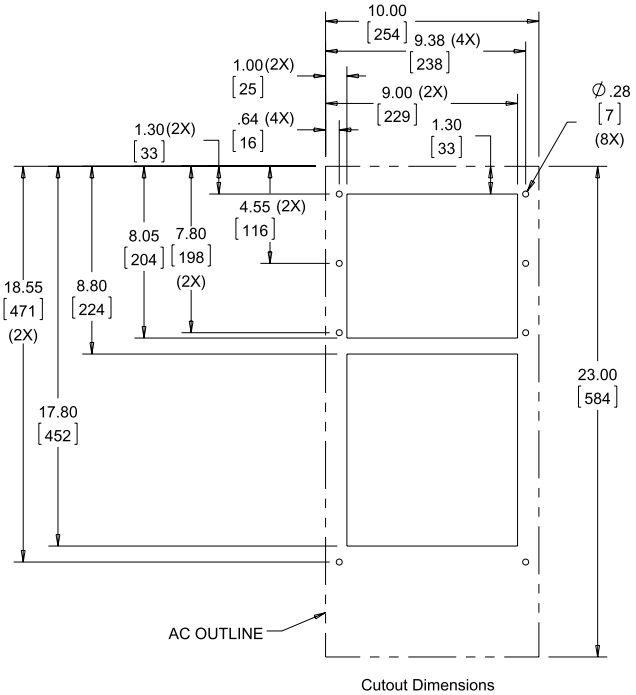
CATALOG NUMBER			
Indoor Model	CR230216G002	CR230226G002	CR230246G400
Indoor Level 2 Controller	CR230216G016	–	–
Outdoor Type 3R	CR230216G013	CR230226G030	–
Outdoor/SST/Corrosion Type 3R	CR230216G007	CR230226G009	–
Outdoor/SST/Level 2 Type 3R	CR230216G017	CR230226G016	–
Indoor/Outdoor/SST/Corrosion Type 4X	CR230216G015	CR230226G014	CR230226G037
COOLING PERFORMANCE			
Nominal:			
BTU/Hr.	**1400/1600**	**1400/1600**	**1400/1600**
Watts	**410/469**	**410/469**	**410/469**
Refrigerant	R-134A	R-134A	R-134A
Refrigerant Charge (ounces/grams)	10/284	10/284	10/284
Operating Temperature Range:			
Maximum (°F/°C)	131/55	131/55	131/55
Minimum (°F/°C) (Low Ambient Pkg)	-40/-40	-40/-40	-40/-40
Airflow at 0 Static Pressure:			
Internal loop 50 Hz (CFM / m^3/hr.)	117/199	117/199	117/199
External loop 50 Hz (CFM / m^3/hr.)	86/146	86/146	86/146
Internal loop 60 Hz (CFM / m^3/hr.)	130/221	130/221	130/221
External loop 60 Hz (CFM / m^3/hr.)	95/161	95/161	95/161
ELECTRICAL DATA			
Rated Voltage	**115**	**230**	**460V 1PH**
Frequency (Hz)	50/60	50/60	50/60
Operating Range	+/- 10%	+/- 10%	+/- 10%
Max. Power Consumption (W at 50/60 Hz)	471.5/517.5	506	552
Max. Nominal Current (A at 50/60 Hz)	4.1/4.0	2.7/2.5	1.4/1.3
Starting Current (A)	18	13.2	7.7
Agency Approvals	UL/cUL Listed CE EAC		cUR Recognized CE EAC
Power Input Description	6-ft. cord with NEMA 5-15 plug	6-ft. cord with NEMA 6-15 plug	6-ft. cord with wire leads
ENCLOSURE PROTECTION			
UL Type	Type 12, 3R standard Type 4, 4X Stainless steel optional		
CONTROLLER			
Description	Basic mechanical thermostat		
Thermostat Location	Behind cover		
Factory Thermostat Setting (°F/°C)	80/27		
SOUND LEVEL			
At 1.5 Meters	62 dB(A)		
UNIT CONSTRUCTION			
Material	Mild steel sheet metal standard Stainless steel optional		
Finish	RAL 7035 light-gray, semi-textured powder-coat paint standard		
UNIT DIMENSIONS			
Height (in./mm)	23/584		23/584
Width (in./mm)	10/254		10/254
Depth (in./mm)	8.75/222		8.75/222
Weight (lb./kg)	57/26		67/30



CR23 Models 1600 BTU/Hr. (469 Watt) With Type 4X Hood





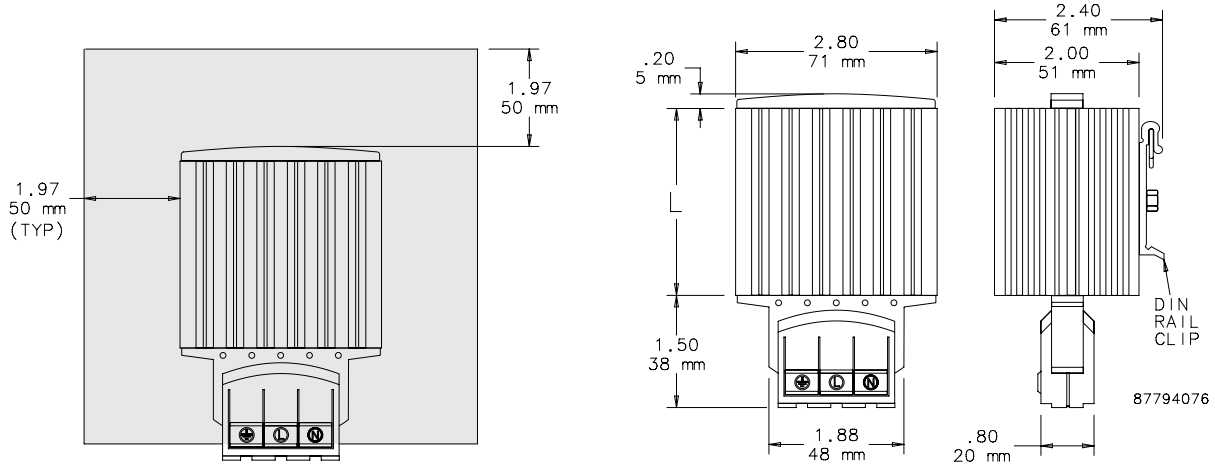


Cutout Dimensions

NOTE:
1. MOUNTING GASKET SUPPLIED (NOT SHOWN)
2. UNITS: in. [mm]

Visit nVent.com/HOFFMAN to download 2D and 3D CAD drawings into the overall design of your electrical system.

Clearance Range for DAH601



ELECTRIC HEATERS

115/230 Volt
100/200 Watt

115/230 Volt
400/800 Watt

115/230 Volt
1300 Watt

INDUSTRY STANDARDS

UL 508A Component Recognized; File No. E61997

CSA Certified, CSA File No. LR42186
CE

APPLICATION

Protect mechanical, electrical and electronic equipment from low temperatures, condensation and corrosion with this thermostatically controlled, fan-driven heater that maintains a stable enclosure temperature.
Fan draws cool air from the bottom of the enclosure and passes this air across the thermostat and heating element before being released into enclosure cavity. Heated air is discharged through the top of the heater unit.

SPECIFICATIONS

- Aluminum housing
- Thermostat range adjustable from 0 F to 100 F (-18 C to 38 C)
- Four 10-32 x self-tapping screws are included with each heater
- Ball bearing fan
- Terminal strip with clamp connector that accepts both solid and stranded wire

FINISH

- Brushed aluminum

⚠ CAUTION

These electric heaters are not designed for use in dusty, dirty, corrosive, or hazardous locations. Portions of the heater can get hot. Adequate protection must be taken to protect people from potential burns, and to protect other components from this heat. nVent recommends this heater only be installed in a totally-enclosed metal enclosure.

DO NOT INSTALL HEATERS ON WOOD PANELS.
Heat sensitive components should not be placed near the heater discharge area since this air can be quite warm. The clearance range defines the space that must be kept free of these components for proper and safe operation of the heater.

Performance Data 100 and 200 Watt Heaters

CATALOG NUMBERS	DAH1001A	DAH1002A	DAH2001A	DAH2002A
ELECTRICAL DATA				
Rated Voltage	**115**	**230**	**115**	**230**
Frequency (Hz)	50/60	50/60	50/60	50/60
Power Consumption (Watts)	100	100	200	200
Nominal Current (Amps)	0.98	0.49	1.89	0.95
HEATING PERFORMANCE				
Watts	**100**	**100**	**200**	**200**
UNIT CONSTRUCTION				
Weight (lb./kg)	1.6/0.73	1.6/0.73	1.6/0.73	1.6/0.73
X (in./mm)	4.00/102	4.00/102	6.00/152	6.00/152

Performance Data 400 and 800 Watt Heaters

CATALOG NUMBERS	DAH4001B	DAH4002B	DAH8001B	DAH8002B
ELECTRICAL DATA				
Rated Voltage	**115**	**230**	**115**	**230**
Frequency (Hz)	50/60	50/60	50/60	50/60
Power Consumption (Watts)	400	400	800	800
Nominal Current (Amps)	3.72	1.86	7.37	3.69
HEATING PERFORMANCE				
Watts	**400**	**400**	**800**	**800**
UNIT CONSTRUCTION				
Weight (lb./kg)	2.2/1.00	2.2/1.00	2.2/1.00	2.2/1.00
X (in./mm)	6.00/152	6.00/152	8.00/203	8.00/203

Performance Data 1300 Watt Heaters

CATALOG NUMBERS	DAH13001C	DAH13002C
ELECTRICAL DATA		
Rated Voltage	**115**	**230**
Frequency (Hz)	50/60	50/60
Power Consumption (Watts)	1300	1300
Nominal Current (Amps)	11.5	5.7
HEATING PERFORMANCE		
Watts	**1300**	**1300**
UNIT CONSTRUCTION		
Weight (lb./kg)	3.4/1.54	3.4/1.54
X (in./mm)	8.00/203	8.00/203

RH Series Compact Power Relays

Key features

- SPDT through 4PDT, 10A contacts
- Compact power type relays
- Miniature power relays with a large capacity
- 10A contact capacity
- Compact size saves space

Part Number Selection

Contact	Model	Part Number: Blade Terminal	Part Number: PCB Terminal	Coil Voltage Code (Standard Stock in bold)
SPDT 	Standard	RH1B-U ☐	RH1V2-U ☐	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH1B-UL ☐	—	
	With Check Button	RH1B-UC ☐	—	
	With Indicator and Check Button	RH1B-ULC ☐	—	
	Top Bracket Mounting	RH1B-UT ☐	—	
	With Diode (DC coil only)	RH1B-UD ☐	RH1V2-UD ☐	DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH1B-ULD ☐	—	**DC12V**, **DC24V**, DC48V, DC110V
DPDT 	Standard	RH2B-U ☐	RH2V2-U ☐	AC6V, AC12V, **AC24V**, **AC110-120V**, **AC220-240V** DC6V, **DC12V**, **DC24V**, DC48V, DC100-110V
	With Indicator	RH2B-UL ☐	RH2V2-UL ☐	
	With Check Button	RH2B-UC ☐	—	
	With Indicator and Check Button	RH2B-ULC ☐	—	
	Top Bracket Mounting	RH2B-UT ☐	—	
	With Diode (DC coil only)	RH2B-UD ☐	RH2V2-UD ☐	DC6V, **DC12V**, **DC24V**, DC48V, DC100-110V
	With Indicator and Diode (DC coil only)	RH2B-ULD ☐	RH2V2-ULD ☐	
3PDT 	Standard	RH3B-U ☐	RH3V2-U ☐	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH3B-UL ☐	RH3V2-UL ☐	
	With Check Button	RH3B-UC ☐	—	
	With Indicator and Check Button	RH3B-ULC ☐	—	
	Top Bracket Mounting	RH3B-UT ☐	—	
	With Diode (DC coil only)	RH3B-UD ☐	—	DC6V, DC12V, DC24V, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH3B-ULD ☐	—	
4PDT 	Standard	RH4B-U ☐	RH4V2-U ☐	AC6V, AC12V, **AC24V**, AC110V, **AC120V**, AC220V, **AC240V** DC6V, **DC12V**, **DC24V**, DC48V, DC110V
	With Indicator	RH4B-UL ☐	RH4V2-UL ☐	
	With Check Button	RH4B-UC ☐	—	
	With Indicator and Check Button	RH4B-ULC ☐	—	
	Top Bracket Mounting	RH4B-UT ☐	—	
	With Diode (DC coil only)	RH4B-UD ☐	RH4V2-UD ☐	DC6V, DC12V, DC24V, DC48V, DC110V
	With Indicator and Diode (DC coil only)	RH4B-ULD ☐	—	

PCB terminal relays are designed to mount directly to a circuit board without any socket.

Ordering Information
When ordering, specify the Part No. and coil voltage code:
(example) **RH3B-U** (Part No.) **AC120V** (Coil Voltage Code)

Sockets (for Blade Terminal Models)

Relays	Standard DIN Rail Mount [1]	Finger-safe DIN Rail Mount [1]	Through Panel Mount	PCB Mount
RH1B	SH1B-05	SH1B-05C	SH1B-51	SH1B-62
RH2B	SH2B-05	SH2B-05C	SH2B-51	SH2B-62
RH3B	SH3B-05	SH3B-05C	SH3B-51	SH3B-62
RH4B	SH4B-05	SH4B-05C	SH4B-51	SH4B-62
				

1. DIN Rail mount socket comes with two horseshoe clips. Do not use unless you plan to insert pullover wire spring. Replacement horseshoe clip part number is Y778-011.

Hold Down Springs & Clips

Appearance	Item	Relay	For DIN Mount Socket	For Through Panel & PCB Mount Socket
	Pullover Wire Spring	RH1B	SY2S-02F1 [2]	SY4S-51F1
		RH2B	SY4S-02F1 [2]	
		RH3B	SH3B-05F1 [2]	
		RH4B	SH4B-02F1 [2]	
	Leaf Spring (side latch)	RH1B, RH2B, RH3B, RH4B	SFA-202 [3]	SFA-302 [3]
	Leaf Spring (top latch)	RH1B, RH2B, RH3B, RH4B	SFA-101 [3]	SFA-301 [3]

2. Must use horseshoe clip when mounting in DIN mount socket. Replacement horseshoe clip part number is Y778-011.
3. Two required per relay.

AC Coil Ratings

Voltage (V)	Rated Current (mA) ±15% at 20°C								Coil Resistance (Ω) ±10% at 20°C				Operation Characteristics (against rated values at 20°C)		
	AC 50Hz				AC 60Hz										
	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	Max. Continuous Applied Voltage	Pickup Voltage	Dropout Voltage
6	170	240	330	387	150	200	280	330	330	9.4	6.4	5.4	110%	80% maximum	30% minimum
12	86	121	165	196	75	100	140	165	165	39.3	25.3	21.2			
24	42	60.5	81	98	37	50	70	83	83	153	103	84.5			
110	9.6	—	18.1	21.6	8.4	—	15.5	18.2	18.2	—	2,200	1,800			
110-120	—	9.4-10.8	—	—	—	8.0-9.2	—	—	—	—	—	—			
120	8.6	—	16.4	19.5	7.5	—	14.2	16.5	16.5	—	10,800	7,360			
220	4.7	—	8.8	10.7	4.1	—	7.7	9.1	9.1	—	10,800	7,360			
220-240	—	4.7-5.4	—	—	—	4.0-4.6	—		—	18,820	—	—			
240	4.9	—	8.2	9.8	4.3	—	7.1	8.3	8.3	—	12,100	9,120			

DC Coil Ratings

Voltage (V)	Rated Current (mA) ±15% at 20°C				Coil Resistance (Ω) ±10% at 20°C				Operation Characteristics (against rated values at 20°C)		
	SPDT	DPDT	3PDT	4PDT	SPDT	DPDT	3PDT	4PDT	Max. Continuous Applied Voltage	Pickup Voltage	Dropout Voltage
6	128	150	240	250	47	40	25	24	110%	80% maximum	10% minimum
12	64	75	120	125	188	160	100	96			
24	32	36.9	60	62	750	650	400	388			
48	18	18.5	30	31	2,660	2,600	1,600	1,550			
100-110	—	8.2-9.0	—	—	—	12,250	—	—			
110	8	—	12.8	15	13,800	—	8,600	7,340			

Standard coil voltages are in **BOLD**.

Submittal Spec Sheet
PS158004EN

Effective October 2013
Supersedes May 2007

Critical filter and surge protective device—ITCFxxx10xxx models

ITCFxxx10

Introduction

Since 1980, Eaton's Innovative Technology® has provided surge protective devices (SPDs) to power quality equipment users around the world. Whatever your electrical surge protection need may be, Eaton's Innovative Technology has a surge protective device to fill it.

Product description

Series or parallel wired, terminal strip connected, multi-stage hybrid Active Tracking Network (ATN®) sine wave tracking surge protective device.

Application description

Dedicated AC and DC power circuits operating at 5–275 Vac / 5–300 Vdc, ≤10A, feeding variable speed drives, variable frequency drives, process controllers, PLCs, power supplies, microprocessor-based loads, CNCs, and a wide variety of other mission-critical and general-purpose loads.

Features

- Peak surge current: 40 kA per phase; 20 kA per mode
- Warranty: 10-year free replacement ①
- Enclosure: ABS plastic UL® 94-5VA
- Connection: wire clamping box terminals
  - Minimum 22 AWG (0.34 mm^2) wire size
  - Maximum 12 AWG (4.0 mm^2) wire size
- Weight: ≈ 1 lb (0.45 kg)
- Operating temperature: –40°F (–40°C) to +140°F (+60°C)
- Provides three modes of protection: L–G, L–N, and N–G
- Input power frequency: 0–64 Hz (AC)
- Response time: active <1 nanosecond
- Maximum continuous operating current: 10A rms up to 250V
- Circuit interrupt: reference installation instructions for details
- UL nominal discharge current rating: 5 kA ②
- UL SCCR: 10 kA ②
- UL voltage protection rating: 500 L–G, 500 L–N, 500 N–G ②

① With product registration.

② 120 Vac model only.

Table 1. Maximum EMI/RFI Attenuation—MIL-STD-220

10 kHz	100 kHz	1 MHz	10 MHz	100 MHz	Maximum Attenuation Frequency
Model xxCF12010					
17 dB	35 dB	64 dB	33 dB	51 dB	64 dB at 1.0 MHz
Model xxCF12010-CP					
16 dB	35 dB	62 dB	40 dB	50 dB	68 dB at 1.25 MHz

Standards and certifications

- Unit listings: recognized components under UL 1449 Third Edition (certain models, see performance data table on page 2), UL 1283 Fifth Edition filter, CSA®
- Manufacturer qualifications: ISO® 9001:1994 Quality System Certification BSI FM 30833
- RoHS compliant

Powering Business Worldwide

RoHS COMPLIANT

ISO 9001

EXCLUSIVE *I.T.* 10 YEAR WARRANTY FREE REPLACEMENT

Performance data

Table 2. Technical Specifications

Catalog Number	Voltage Range	Protection Modes	VPR	MCOV	I_n	SCCR	Peak Surge Current Per Mode
ITCF02410 ①	5–38 Vdc ①	L–N, L–G, N–G	—	—	—	—	4, 2, 2 kA
ITCF04810 ①	24–65 Vdc ①	L–N, L–G, N–G	—	—	—	—	13, 6.5, 6.5 kA
ITCF12010 ②	48–149 Vdc ① 100–127 Vac	L–N	500	150	5 kA	10 kA	40 kA
		L–G	500	150	5 kA	10 kA	20 kA
		N–G	500	150	5 kA	10 kA	20 kA
ITCF24010 ③	150–300 Vdc ① 200–240 Vac	L–N, L–G, N–G	—	—	—	—	16, 8, 8 kA

① UL 1449 Third Edition does not list SPD products rated less than 100 Vac or DC voltages.

② UL 1449 Third Edition, UL 1283 Fifth Edition.

③ UL 1283 Fourth Edition, EMI filter.

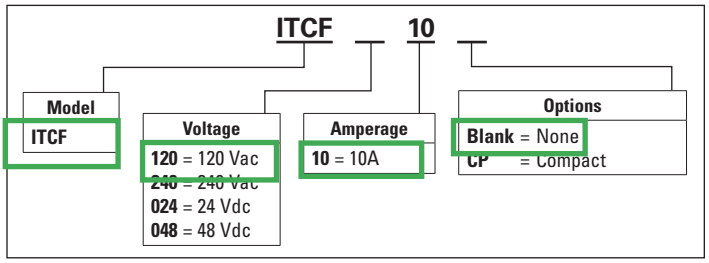
Table 3. Let-Through Voltages Based Upon IEEE Std C62.62-2010 Testing Waveforms ①

Test Impulse	xxCF12010	xxCF12010-CP
IEEE Category A 100 kHz ring wave—6000V, 200A	150V	300V
IEEE Category B 100 kHz ring wave—6000V, 500A	330V	400V
IEEE Category B combination wave—6000V, 3000A (UL 1449-3 VPR)	470V	460V

① All tests conducted on 120 Vac units.

Product selection

Table 4. Catalog Numbering Selection



Dimensions

Approximate dimensions in inches (mm).

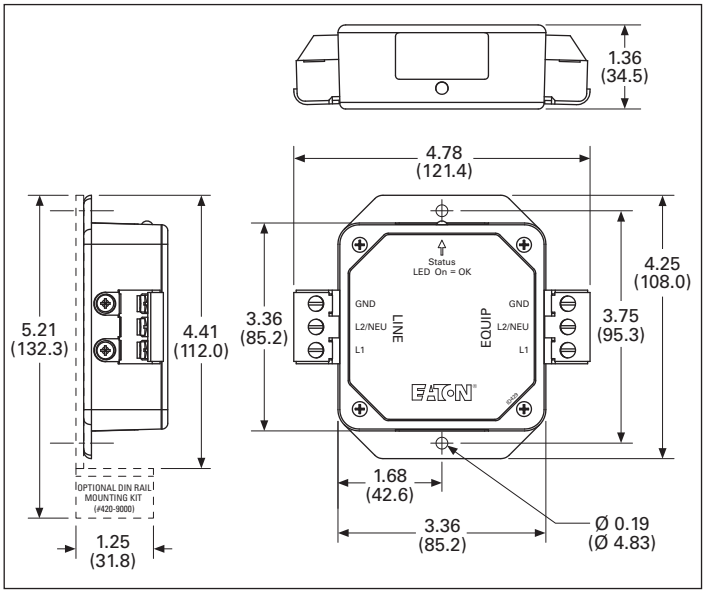


Figure 1. ITCFxxx10 Model Dimensions

For additional information, go to www.itvss.com or call 1-800-809-2772 option 4, option 2.

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October 2013

Powering Business Worldwide

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Class CC and Class CD Fuses

600 VAC • 1/10 – 60 Amperes

CCMR Series

For space saving protection of motor circuits up to 40 HP**, we recommend Littelfuse POWR-PRO® CCMR series fuses. These fuses are the only true dual-element time-delay CC fuses specifically engineered for motor branch circuit protection. They provide Type 2 "No Damage" protection to both NEMA-rated and the more sensitive IEC (International Electrotechnical Commission) type motor circuit components.

CCMR series fuses are now available in larger sizes — from 35 to 60 amperes! **No other 600V fuse is available with this current carrying capacity in a package this small.**

***Consult the Motor Protection Tables in the Fuse-ology section for specific motor sizing information*

For more information on CCMR series Class CC fuses, see the CCMR series pages in the POWR-PRO section of this catalog.
1/10 – 30A: UL Listed Class CC
35 – 60A: UL Listed Class CD

Ampere Ratings

2/10	1¼	2½	5	9	30
¼	1 4/10	2 8/10	5 6/10	10	35
3/10	1½	3	6	12	40
½	1 6/10	3 2/10	6¼	15	45
6/10	1 8/10	3½	7	17½	50
8/10	2	4	7½	20	60
1	2¼	4½	8	25	

Example part number (series & amperage): CCMR 30

KLDR Series

KLDR fuses are time-delay fuses specifically designed for the protection of control transformers, solenoids and similar inductive components with high magnetizing currents during the first half-cycle. They closely match most control power transformer characteristics, which permits the fuses to be sized in accordance with the latest revisions of UL 508 (Industrial Control) and UL 845 (Motor Control Centers). When the time delay of KLDR fuses is adequate to carry motor starting current, they provide excellent protection of motor branch circuits containing IEC or NEMA rated motor controllers or contactors.

Ampere Ratings

1/10	6/10	1 8/10	4½	10
1/8	¾	2	5	12
15/100	8/10	2¼	5 6/10	15
1/16	1	2½	6	17½
2/10	1⅛	2 8/10	6¼	20
¼	1¼	3	7	25
3/10	1 4/10	3 2/10	7½	30
4/10	1½	3½	8	
½	1 6/10	4	9	

Example part number (series & amperage): KLDR 5 6/10

KLKR Series

KLKR series Class CC fuses are fast acting fuses intended for general purpose branch circuit protection. Their compact size, fast acting overload response, and highly current-limiting design make them ideal for use in OEM equipment and control panels. Solid state devices such as SCRs and other electronic equipment generally require fast acting protection.

Ampere Ratings

1/10	½	2½	6	12
1/8	¾	3	7	15
2/10	1	3½	8	20
¼	1½	4	9	25
3/10	2	5	10	30

Example part number (series & amperage): KLKR 25

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7012FX2 Industrial Ethernet Switch

N-Tron Networking Series

▶▶▶ Managed Industrial Ethernet Switch

PRODUCT FEATURES

- Eight 10/100BaseTX RJ-45 ports
- Two 100BaseFX ports, ST or SC style
- Two SFP gigabit ports
- -40ºC to 70ºC operating temperature
- Onboard temperature sensor
- ESD and surge protection diodes on all ports
- Auto-sensing 10/100BaseTX, duplex, and MDIX
- Store-and-Forward technology
- Rugged DIN-rail enclosure
- Redundant power inputs (10-49VDC)

FULLY MANAGED FEATURES

- SNMP v1, v2, v3 and web browser management
- Configuration backup via optional SD card
- Detailed ring map and fault location charting
- N-Ring™ technology with ~30ms healing
- N-Link™ redundant N-Ring coupling
- N-View™ OPC monitoring
- RSTP - IEEE 802.1D
- IGMP auto-configuration
- 802.1Q tag VLAN and port VLAN
- 802.1p QoS, port QoS, and DSCP
- EtherNet/IP™ CIP messaging
- LLDP (Link Layer Discovery Protocol)
- Trunking and port mirroring
- 802.1d, 802.1w, 802.1D RSTP
- DHCP server, option 82 relay, option 61, IP fallback
- Local port IP addressing
- Port security—MAC address-based

BUILT FOR EXTREME CONDITIONS

The compact N-TRON® 7012FX2 fully-managed industrial Ethernet switch is ideal for industrial and utility applications that demand extreme performance under harsh conditions. Housed in a rugged industrial metal enclosure, the switch offers a powerful combination of eight 10/100BaseTX copper ports, two 100Base fiber ports, two SFP gigabit ports, and redundant power inputs for robust network support. The device boasts exceptional MTBF and extended tolerances to shock, vibration, temperature fluctuations and noise—common elements in factory floor control networks, utilities, wastewater treatment, wind turbines, rail car, intelligent traffic control and transportation applications.

ADVANCED RING TECHNOLOGY

Advanced N-Ring technology provides expanded capacity, detailed fault diagnostics, and fast ~30ms healing time for N-TRON-based rings. The integrity of the ring is continually checked by sending heart beat packets around the network. If an error is detected, the ring converts to a linear topology within ~30ms and communication is immediately restored. A detailed ring map and fault location chart may be accessed by the ring manager's web browser or the OPC server. Each N-Ring accommodates up to 250 fully-managed N-TRON switches. To establish redundancy, N-Link technology easily connects multiple N-Rings, creating additional pathways to critical applications and increasing overall resiliency.

MONITORING OPTIONS

N-TRON provides multiple tools to monitor the 7012FX2. The robust web-based interface provides a convenient dashboard to view and configure switch options, as well as monitor network traffic, alarms, and trend information. For tightly controlled environments, N-View OPC server software easily combines with HMI control and monitoring applications to form a complete surveillance solution for N-View-enabled switches. The iSNMP Software Suite is also available for link and status monitoring. For local monitoring, each switch features configurable LEDs to indicate power failure and N-Ring status.

EASY TO USE

The 7012FX2 features auto-sensing and auto-configuring 10/100BaseTX ports. Each copper port automatically negotiates for maximum speed and performance but can be hardcoded through the user interface. A high-speed processor allows wire speed capability on all ports simultaneously.

industrial networking

▶▶▶ 7012FX2 Specifications

SPECIFICATIONS

Switch Properties
Number of MAC Addresses: 8000
Aging Time: Configurable
Latency (typical): 2.6 µs
Switching Method: Store-and-Forward

Case Dimensions
Height: 4.3" (10.8 cm)
Width: 3.1" (7.9 cm)
Depth: 4.6" (11.5 cm)
Weight (maximum): 1.4 lbs (0.64 kg)
DIN-Rail Mount: 35mm

Electrical
Redundant Input Voltage: 10-49VDC (regulated)
Input Current (max): 525mA@24VDC
BTU/hr: 44@24VDC
N-TRON Power Supply: NTPS-24-1.3 (1.3A@24V)

Environmental
Operating Temperature: -40ºC to 70ºC
Storage Temperature: -40ºC to 85ºC
Operating Humidity: 5% to 95% (non condensing)
Operating Altitude: 0 to 10,000 ft.

Shock and Vibration (Bulkhead Mounted)
Shock: 200g@10ms
Vibration/Seismic: 50g, 5-200Hz, triaxial

Reliability
MTBF: >2 million hours

Network Media
10BaseT: ≥Cat3 cable
100BaseTX: ≥Cat5 cable
1000BaseT: ≥Cat5e cable

Connectors
10/100BaseTX: Eight (8) RJ-45 copper ports
100BaseFX: Two (2) SC or ST fiber duplex ports
1000BaseT: Up to two (2) RJ-45 gigabit copper ports
1000BaseSX: Up to two (2) LC duplex gigabit fiber ports

Recommended Wiring Clearance
Top: 1" (2.6 cm)
Front: 4" (10.2 cm)
Side: 1" (2.6 cm)

100 mb Fiber Transceiver Characteristics

Fiber Length	2km*	15km**	40km**	80km**
TX Power Min	-19dBm	-15dBm	-5dBm	-5dBm
RX Sensitivity Max	-31dBm	-31dBm	-34dBm	-34dBm
Wavelength	1310nm	1310nm	1310nm	1550nm

* Multimode Fiber Optic Cable
** Singlemode Fiber Optic Cable

SFP Gigabit Fiber Transceiver Characteristics

Fiber Length	550m for 50/125µm 275m @62.5/125µm*	10km**	40km**	80km**
TX Power Min	-9.5dBm	-9.5dBm	-2dBm	0dBm
RX Sensitivity Max	-17dBm	-20dBm	-22dBm	-24dBm
Wavelength	850nm	1310nm	1310nm	1550nm
Assumed Fiber Loss	-3.5 to 3.75 dB/km	-0.45dB/km	-0.35dB/km	-0.25dB/km

* SX Fiber Optic Cable
** LX Fiber Optic Cable

Designed to comply with
- IEEE 1613 for electric utility substations
- NEMA TS1/ TS2 for traffic control

Regulatory Certifications
Certificate
POCC
US.AB28.B06519

FCC Part 15
Class A

UL Listed
Class I, Div 2
Groups A/B/C/D
E214222

Industry Canada
ICES-003 Issue 3

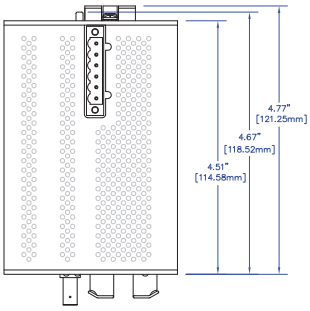
RoHS compliant

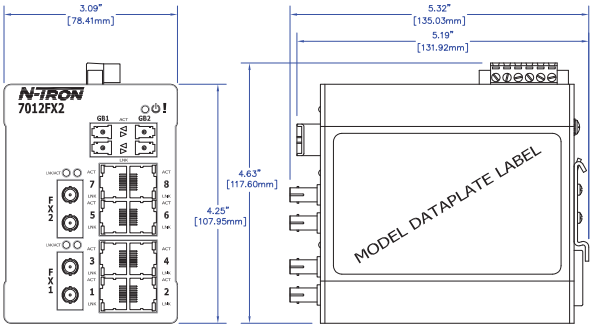
EtherNet/IP

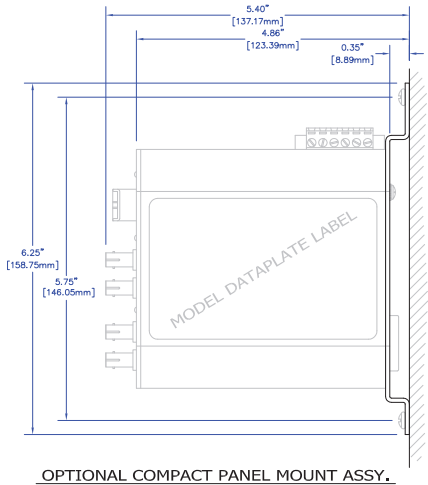
ORDERING INFORMATION

PART NUMBER	DESCRIPTION
7012FX2-XX	12-port (8 10/100BaseTX, 2 100BaseFX Fiber, and 2 SFP Mini-GBIC Gigabit Fiber Expansion Ports) switch
7012FXE2-XX-YY	12-port (8 10/100BaseTX, 2 100BaseFX Fiber, and 2 SFP Mini-GBIC Gigabit Fiber Expansion Ports) switch
NTSFP-TX	Optional SFP (mini-GBIC) transceiver with one 1000BaseT GB copper port
NTSFP-SX	Optional SFP (mini-GBIC) transceiver with one 1000BaseSX multimode GB fiber optic port
NTSFP-LX-ZZ	Optional SFP (mini-GBIC) transceiver with one 1000BaseLX singlemode GB fiber optic port
NTCD128	Optional configuration card for backup/restore
NTPS-24-1.3	N-TRON DIN-rail power supply (1.3 amp@24VDC)
CPMA-2	Compact panel mount (factory installed option)
URMK	Universal rack mount kit

Where: XX = ST or SC connector
YY = 15, 40, or 80 for singlemode, blank for multimode
ZZ = 10, 40, or 80 for GB singlemode (If SFP transceiver is not specified at the time of purchase, slots will remain blank with covers)
E = Singlemode







OPTIONAL COMPACT PANEL MOUNT ASSY.
(P/N: CPMA-2)

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As the global experts in communication, monitoring and control for industrial automation and networking, Red Lion has been delivering innovative solutions for over forty years. Our automation, Ethernet and cellular M2M technology enables companies worldwide to gain real-time data visibility that drives productivity. Product brands include Red Lion, N-Tron and Sixnet. With headquarters in York, Pennsylvania, the company has offices across the Americas, Asia-Pacific and Europe. Red Lion is part of Spectris plc, the productivity-enhancing instrumentation and controls company. For more information, please visit www.redlion.net.

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StructuredGround™ Universal Ground Bar System

PANDUIT®

SPECIFICATION SHEET

specifications

Provide a field wiring terminal for the connection of an equipment grounding conductor in each control panel and enclosure. The terminal shall be UL 467 Listed or CSA 22.2 certified. The equipment grounding conductor shall have electrical continuity with the enclosure or sub-panel. The field wiring terminal may also provide multiple locations or ports for terminating equipment ground conductors from devices inside the panel or enclosure, functioning as the ground bar within the panel or enclosure. The ground bar shall provide a means to attach and to identify the main equipment grounding conductor.

PATENT PENDING

technical information

Performance level:	UL 467 Listed and CSA 22.2 Certified for grounding and bonding an equipment grounding conductor up to 2/0 AWG; meets UL 508A requirements
Main:	Provides a location for the main equipment grounding conductor using a compression or mechanical connector
Wire ports:	Accept bare stripped copper wire from #14 to #4 AWG Accept wire ferrules from #14 AWG to #6 AWG Top of ground bar accepts ring terminals, compression connectors or mechanical connectors with a ¼" stud hole size and maximum width of 0.55"
Materials:	Ground bars and bonding stand-offs precision machined from 110 electrolytic copper with a 99.9% copper content and then tin-plated for additional corrosion resistance
Packaging:	Each part is provided with all fasteners required for terminating wires and for each mounting option

key features and benefits

Flexible design	Works with all types of wire termination methods including stripped wire, ferrules, terminals, and compression or mechanical connectors; compatible with over 140 Panduit connectors
Multiple mounting options	In addition to surface mounting, two mounting stand-off options are available, one that bonds to the mounting surface and one that isolates from the mounting surface; both options provide additional finger wiring space in tight places
Unique geometry	The unique shape of the universal ground bar allows more surface contact between the wire connectors and the ground bar

applications

The StructuredGround™ Universal Ground Bar System (UGB) offers multiple termination methods and mounting options making it ideal for any control panel or enclosure application. The UGB enables the end user to choose the method in which to terminate conductors with connectors of their choice or simply cut and strip the wires. The UGB system will help reduce the types of ground bars that a panel shop or distributor needs to keep in stock to meet the various applications and customer requirements.

Universal Ground Bar System

6-port ground bar:	UGB2/0-414-6
12-port ground bar:	UGB2/0-414-12
18-port ground bar:	UGB2/0-414-18
Isolation standoffs:	UGB-IN-SO
Bonding standoffs:	UGB-B-SO

Recommended Connectors for Main Equipment Ground Conductor, Maximum 2/0 AWG

Copper Mechanical with Anti-Rotation

#14 – 2/0 AWG:	CLMAR2/0-14-Q

Two-Hole Copper Compression, 1/4" Stud Hole with 5/8" Spacing; #14 to 2/0 AWG

#14 – 10 AWG:	LCA10-14A-L
#8 AWG:	LCD8-14A-L
#6 AWG:	LCD6-14A-L
#4 AWG:	LCD4-14A-L
#2 AWG:	LCD2-14A-Q
#1 AWG:	LCD1-14A-E
1/0 AWG:	LCD1/0-14A-X
2/0 AWG:	LCD2/0-14A-X

One-Hole Copper Compression, 1/4" Stud Hole; #14 to 2/0 AWG

#14 – 10 AWG:	LCA10-14-L
#8 AWG:	LCAS8-14-L
#6 AWG:	LCAS6-14-L
#4 AWG:	LCAS4-14-L
#2 AWG:	LCAS2-14-Q
#1 AWG:	LCAS1-14-E
1/0 AWG:	LCAS1/0-14-X
2/0 AWG:	LCAS2/0-14-X

One and two-hole copper compression connectors available for both code and flex conductors, with narrow tongue and bent tongue configurations.

Recommended Connectors for Port Connections

Ring Terminals, ¼" Stud Hole, Maximum Width of 0.55"; #22 to #4 AWG

Ring terminals available with vinyl, nylon, KYNAR*, high-temp, or heavy duty insulation or non-insulated.

Compression Connectors, Maximum Width of 0.55"; up to #4 AWG Typical

Ferrules, Minimum Pin Depth of 12mm; #14 to #6 AWG

*KYNAR is a registered trademark of Atofina Chemicals, Inc.

Heavy-Duty Spec Grade Single Receptacles, Back & Side Wire, 20A, 125V, Gray - 5361GRY

Heavy-Duty Spec Grade Single Receptacle Back & Side Wire
20amp 125volt Gray

FEATURES

- Corrosion-resistant, plated steel strap locked in to face and back body to resist pulling away from face/body assembly.
- One-piece brass, triple-wipe power contacts for lasting retention.
- Easily accessed break-off, line-contact connecting tab for fast, easy split-circuit wiring.
- Impact-resistant nylon face and thermoplastic back body.
- Internal screw-pressure-plate back wire capable of accepting #14 - #10 AWG solid or stranded copper or copper-clad wire.
- Terminal compartments isolated from each other for positive conductor containment.
- Tri-drive terminal and mounting screws.
- Auto-ground clip assures positive ground.

Specifications

DIMENSION INFO

© 2011 Legrand

Single Receptacle Openings, One Gang, 302 Stainless Steel

SS7

Smooth Metal Wall Plate 1gang Single 302 Stainless Steel

features & benefits

- Type 302 Stainless Steel, non-magnetic: .032" nominal thickness.
- Brushed finish.
- This alloy contains 18% chromium and 8% nickel for superior resistance to corrosion.
- Recommended for use in food processing plants, dairies, chemical plants, and other industrial, institutional, and commercial applications where corrosive atmospheres exist.
- Constructed of corrosion-resistant stainless steel, brass, aluminum, chrome, brushed bronze, or galvanized steel.
- Standard, Jumbo, and Tandem plates available, as well as special Panel plates up to 5-gangs high and 10-gangs wide.
- Packaged in protective film, with finish-matching screws.
- Variety of special plated finishes.
- Paintable to match plastic plates.
- Can be silk-screened or engraved, and custom punched with over 300 opening styles.

specifications

General Info

Size: Standard
Type: Single

Listing Agencies/Third Party Information

Surge protection plug - PT 1X2-24DC-ST - 2856032

Please be informed that the data shown in this PDF Document is generated from our Online Catalog. Please find the complete data in the user's documentation. Our General Terms of Use for Downloads are valid (http://phoenixcontact.com/download)

PT protective connector with protective circuit for a 2-wire floating signal circuit. HART-compatible.

Your advantages

- Easy testing and documentation with CHECKMASTER 2 with pluggable protective modules
- Maximum ease of maintenance thanks to the two-piece design
- Easy selection for all possible demands in MCR applications with a complete product portfolio
- The signal is not influenced during maintenance work, thanks to the impedance-neutral insertion and removal of protective plugs

Key Commercial Data

Packing unit	1 pc
GTIN	4 017918 599201
GTIN	4017918599201
Weight per Piece (excluding packing)	19.780 g
Custom tariff number	85363010
Country of origin	Germany

Technical data

Dimensions

Height	45 mm
Width	17.7 mm
Depth	52 mm
Horizontal pitch	1 Div.
Complete module height	90 mm

Surge protection plug - PT 1X2-24DC-ST - 2856032

Technical data

Dimensions

Complete module width	17.7 mm
Complete module depth	65.5 mm

Ambient conditions

Ambient temperature (operation)	-40 °C ... 85 °C
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Altitude	≤ 2000 m (amsl (above mean sea level))
Degree of protection	IP20

General

Housing material	PA 6.6
Flammability rating according to UL 94	V-0
Color	jet black RAL 9005
Overvoltage category	II
Degree of pollution	3
Mounting type	on base element
Type	Male
Direction of action	Line-Line & Line-Signal Ground/Shield & optional Signal Ground/Shield-Earth Ground
Arrester can be tested with CHECKMASTER from software version:	From SW rev. 1.00

Additional descriptions

Note	Technical data is valid in association with the following specified base elements:
	PT 1X2+F-BE 2856126
	PT 1X2-BE 2856113

Protective circuit

IEC test classification	C1
	C2
	C3
	D1
Nominal voltage U_N	24 V DC
Maximum continuous voltage U_C	28 V DC
	20 V AC
Rated current	450 mA (45 °C)
Operating effective current I_C at U_C	≤ 5 µA
Residual current I_{PE}	≤ 1 µA (with PT 1X2+F-BE)
	≤ 2 µA (with PT 1X2-BE)
Nominal discharge current I_n (8/20) µs (line-line)	10 kA

Surge protection plug - PT 1X2-24DC-ST - 2856032

Technical data

Protective circuit

Nominal discharge current I_n (8/20) µs (line-earth)	10 kA
Pulse discharge current I_{imp} (10/350) µs	2.5 kA
Total discharge current I_{total} (8/20) µs	20 kA
Max. discharge current I_{max} (8/20) µs maximum (line-line)	10 kA
Max. discharge current I_{max} (8/20) µs maximum (line-earth)	10 kA
Nominal pulse current Ian (10/1000) µs (line-line)	30 A
Output voltage limitation at 1 kV/µs (line-line) spike	≤ 45 V
Output voltage limitation at 1 kV/µs (line-earth) spike	≤ 450 V (with PT 1X2-BE)
	≤ 1 kV (with PT 1X2+F-BE)
Output voltage limitation at 1 kV/µs (line-line) static	≤ 40 V
Output voltage limitation at 1 kV/µs (line-earth) static	≤ 25 V (with PT 1X2-BE)
	≤ 50 V (with PT 1X2+F-BE)
Residual voltage at I_n (line-line)	≤ 40 V
Residual voltage with Ian (10/1000) µs (line-line)	≤ 50 V
Voltage protection level U_p (line-line)	≤ 70 V (C1 - 1 kV/500 A)
	≤ 70 V (C2 - 10 kV / 5 kA)
	≤ 60 V (C2 - 6 kV / 3 kA)
	≤ 50 V (C3 - 25 A)
Voltage protection level U_p (line-earth)	≤ 450 V (C1 - 1 kV / 500 A with PT 1X2-BE)
	≤ 550 V (C2 - 10 kV / 5 kA with PT 1X2-BE)
	≤ 1000 V (C2 - 10 kV / 5 kA with PT 1X2+F-BE)
	≤ 500 V (C2 - 6 kV / 3 kA with PT 1X2-BE)
Voltage protection level U_p static (line-line)	≤ 40 V (C2 - 10 kV / 5 kA)
Voltage protection level U_p static (line-earth)	≤ 50 V (C2 - 10 kV / 5 kA with PT 1X2-BE)
	≤ 100 V (C2 - 10 kV / 5 kA with PT 1X2+F-BE)
Response time t_A (line-line)	≤ 1 ns
Response time t_A (line-earth)	≤ 100 ns
Input attenuation aE, sym.	typ. 0.5 dB (≤ 1 MHz / 50 Ω)
	typ. 0.2 dB (≤ 400 kHz / 150 Ω)
	typ. 0.1 dB (≤ 70 kHz / 600 Ω)
Cut-off frequency fg (3 dB), sym. in 50 Ω system	typ. 4.5 MHz
Cut-off frequency fg (3 dB), sym. in 150 Ω system	typ. 1.5 MHz
Cut-off frequency fg (3 dB), sym. in 600 Ω system	typ. 600 kHz
Capacity (line-line)	typ. 1.4 nF
Capacity (line-earth)	typ. 4 pF (with PT 1X2-BE)
	typ. 2 pF (with PT 1X2+F-BE)
Resistance per path	2.2 Ω ±10 %

Surge protection plug - PT 1X2-24DC-ST - 2856032

Technical data

Protective circuit

Surge protection fault message	none
Max. required back-up fuse	500 mA (T)
Impulse durability (line-line)	C1 - 1 kV / 500 A
	C2 - 6 kV / 3 kA
	C2 - 10 kV / 5 kA
	C3 - 25 A
Impulse durability (line-earth)	C1 - 1 kV / 500 A
	C2 - 6 kV / 3 kA
	C2 - 10 kV / 5 kA
	D1 - 2.5 kA

Connection data

Connection method	Screw connection (in connection with the base element)
Screw thread	M3
Tightening torque	0.5 Nm
Stripping length	8 mm
Conductor cross section flexible	0.2 mm² ... 2.5 mm²
Conductor cross section solid	0.2 mm² ... 4 mm²
Conductor cross section AWG	24 ... 12

Standards and Regulations

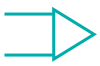
Standards/specifications	IEC 61643-21 2000 + corrigendum 2001 + A1:2008, modified + A2:2012
	EN 61643-21 2001 + A1:2009 + A2:2013

Environmental Product Compliance

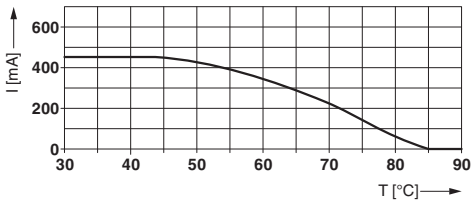
REACh SVHC	Lead 7439-92-1
China RoHS	Environmentally Friendly Use Period = 50 years
	For details about hazardous substances go to tab “Downloads”, Category “Manufacturer's declaration”

Drawings

Pictogram

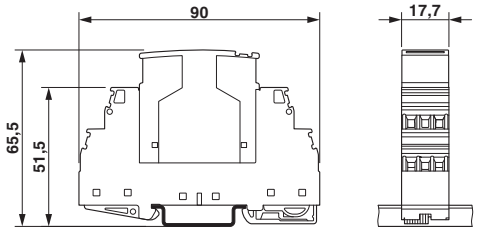


Diagram

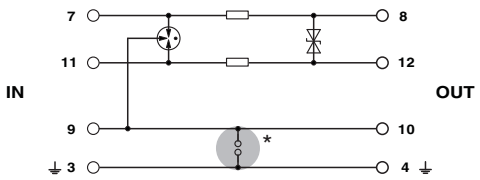


Surge protection plug - PT 1X2-24DC-ST - 2856032

Dimensional drawing



Circuit diagram



The figure shows the complete module consisting of a base element and connector

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Surge protection base element - PT 1X2-BE - 2856113

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Base element for protective plug PT with protective circuit for a 2-core floating signal circuit. Mounting on NS 35/7.5 und NS 35/15, housing width: 17.5 mm.

Your advantages

- Maximum ease of maintenance thanks to the two-piece design
- Easy selection for all possible demands in MCR applications with a complete product portfolio
- The signal is not influenced during maintenance work, thanks to the impedance-neutral insertion and removal of protective plugs

Key Commercial Data

Packing unit	1 pc
GTIN	4 017918 599287
GTIN	4017918599287
Weight per Piece (excluding packing)	49.520 g
Custom tariff number	85363010
Country of origin	Germany

Technical data

Dimensions

Height	90 mm
Width	17.7 mm
Depth	51.5 mm (incl. DIN rail 7.5 mm)
Horizontal pitch	1 Div.

Ambient conditions

Ambient temperature (operation)	-40 °C ... 85 °C

Surge protection base element - PT 1X2-BE - 2856113

Technical data

Ambient conditions

Ambient temperature (storage/transport)	-40 °C ... 85 °C
Altitude	≤ 2000 m (amsl (above mean sea level))
Degree of protection	IP20

General

Housing material	PA 6.6
Flammability rating according to UL 94	V-0
Color	jet black RAL 9005
Mounting type	DIN rail: 35 mm
Type	Base element, DIN rail mounting
Number of positions	2
Direction of action	Signal Ground/Shield-Earth Ground

Protective circuit

Nominal voltage U_N	48 V DC
Maximum continuous voltage U_C	53 V DC
	37 V AC
Rated current	450 mA (45 °C)
Resistance per path	2.2 Ω ±10 %
Surge protection fault message	none
Max. required back-up fuse	500 mA (T)

Connection data

Connection method	Screw connection
Screw thread	M3
Tightening torque	0.5 Nm
Stripping length	8 mm
Conductor cross section flexible	0.2 mm² ... 2.5 mm²
Conductor cross section solid	0.2 mm² ... 4 mm²
Conductor cross section AWG	24 ... 12

Standards and Regulations

Standards/specifications	IEC 61643-21 2000 + corrigendum 2001 + A1:2008, modified + A2:2012
	EN 61643-21 2001 + A1:2009 + A2:2013

Environmental Product Compliance

China RoHS	Environmentally Friendly Use Period = 50 years
	For details about hazardous substances go to tab “Downloads”, Category “Manufacturer's declaration”

Power supply unit - QUINT-PS/1AC/24DC/ 5 - 2866750

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Primary-switched QUINT POWER power supply for DIN rail mounting with SFB (Selective Fuse Breaking) Technology, input: 1-phase, output: 24 V DC/5 A

Product Description

QUINT POWER power supplies with maximum functionality
QUINT POWER circuit breakers magnetically and therefore quickly trip at six times the nominal current, for selective and therefore cost-effective system protection. The high level of system availability is additionally ensured, thanks to preventive function monitoring, as it reports critical operating states before errors occur.
Reliable starting of heavy loads takes place via the static power reserve POWER BOOST. Thanks to the adjustable voltage, all ranges between 5 V DC ... 56 V DC are covered.

Product Features

- Reliable starting of difficult loads with the static POWER BOOST power reserve with up to 1.5 times the nominal current permanently
- Fast tripping of standard circuit breakers with dynamic power reserve SFB (selective fuse breaking) technology with up to 6 times the nominal current for 12 ms
- For superior system availability
- Preventive function monitoring

Key Commercial Data

Packing unit	1 pc
Weight per Piece (excluding packing)	1011.4 g
Custom tariff number	85044030
Country of origin	Thailand

Technical data

Dimensions

Width	40 mm
Height	130 mm
Depth	125 mm
Width with alternative assembly	122 mm

Power supply unit - QUINT-PS/1AC/24DC/ 5 - 2866750

Technical data

Dimensions

Height with alternative assembly	130 mm
Depth with alternative assembly	43 mm

Ambient conditions

Degree of protection	IP20
Ambient temperature (operation)	-25 °C ... 70 °C (> 60 °C Derating: 2,5 %/K)
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Max. permissible relative humidity (operation)	≤ 95 % (at 25 °C, non-condensing)
Noise immunity	EN 61000-6-2:2005
Maximum altitude	6000 m

Input data

Nominal input voltage range	100 V AC ... 240 V AC
Input voltage range	85 V AC ... 264 V AC
	90 V DC ... 350 V DC
Dielectric strength maximum	300 V AC
AC frequency range	45 Hz ... 65 Hz
Frequency range DC	0 Hz
Discharge current to PE	< 3.5 mA
Inrush surge current	< 15 A (typical)
Power failure bypass	> 55 ms (120 V AC)
	> 55 ms (230 V AC)
Input fuse	5 A (slow-blow, internal)
Choice of suitable circuit breakers	6 A ... 16 A (AC: Characteristics B, C, D, K)
Type of protection	Transient surge protection
Protective circuit/component	Varistor

Output data

Nominal output voltage	24 V DC ±1 %
Setting range of the output voltage	18 V DC ... 29.5 V DC (> 24 V DC, constant capacity restricted)
Nominal output current	5 A (-25°C ... 60°C, U_{OUT} = 24 V DC)
POWER BOOST	7.5 A (-25°C ... 40°C permanent, U_{OUT} = 24 V DC)
SFB technology current reserve	30 A (12 ms)
Derating	60 °C ... 70 °C (2.5%/K)
Connection in parallel	Yes, for redundancy and increased capacity
Connection in series	Yes
Control deviation	< 1 % (change in load, static 10 % ... 90 %)
	< 2 % (change in load, dynamic 10 % ... 90 %)
	< 0.1 % (change in input voltage ±10 %)

Power supply unit - QUINT-PS/1AC/24DC/ 5 - 2866750

Technical data

Output data

Residual ripple	< 40 mV_{PP} (with nominal values)
Output power	120 W
Typical response time	< 0.15 s
Maximum power dissipation in no-load condition	3 W
Power loss nominal load max.	15 W

General

Net weight	0.7 kg
Efficiency	> 90 % (for 230 V AC and nominal values)
Insulation voltage input/output	4 kV AC (type test)
	2 kV AC (routine test)
Protection class	I
MTBF (IEC 61709, SN 29500)	> 1134000 h (25 °C)
	> 635000 h (40°C)
	> 270000 h (60°C)
Mounting position	horizontal DIN rail NS 35, EN 60715
Assembly instructions	Alignable: 5 mm horizontally, 15 mm next to active components, 50 mm vertically
Electromagnetic compatibility	Conformance with EMC Directive 2004/108/EC
Noise emission	EN 55011 (EN 55022)
Low Voltage Directive	Conformance with LV directive 2006/95/EC
Standard – Electrical equipment of machines	EN 60204-1
Standard - Electrical safety	IEC 60950-1/VDE 0805 (SELV)
Shipbuilding approval	Germanischer Lloyd (EMC 2), ABS, LR, RINA, NK, DNV, BV
Standard – Electronic equipment for use in electrical power installations and their assembly into electrical power installations	EN 50178/VDE 0160 (PELV)
Standard – Safety extra-low voltage	IEC 60950-1 (SELV) and EN 60204-1 (PELV)
Standard - Safe isolation	DIN VDE 0100-410
Standard – Limitation of mains harmonic currents	EN 61000-3-2
Standard - Equipment safety	BG (design tested)
Standard - Approval for medical use	IEC 60601-1, 2 x MOOP
Approval - requirement of the semiconductor industry with regard to mains voltage dips	SEMI F47-0706 Compliance Certificate
Information technology equipment - safety (CB scheme)	CB Scheme
Rail applications	EN 50121-4
UL approvals	UL Listed UL 508
	UL/C-UL Recognized UL 60950-1
	UL ANSI/ISA-12.12.01 Class I, Division 2, Groups A, B, C, D (Hazardous Location)

Power supply unit - QUINT-PS/1AC/24DC/ 5 - 2866750

Technical data

General

Overvoltage category	III
DeviceNet approval	DeviceNet™ Power Supply Conformance Tested

Connection data, input

Connection method	Pluggable screw connection
Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	2.5 mm²
Conductor cross section flexible min.	0.2 mm²
Conductor cross section flexible max.	2.5 mm²
Conductor cross section AWG min.	20
Conductor cross section AWG max.	12
Stripping length	7 mm
Screw thread	M3

Connection data, output

Connection method	Pluggable screw connection
Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	2.5 mm²
Conductor cross section flexible min.	0.2 mm²
Conductor cross section flexible max.	2.5 mm²
Conductor cross section AWG min.	20
Conductor cross section AWG max.	12
Stripping length	7 mm
Screw thread	M3

Connection data for signaling

Conductor cross section solid min.	0.2 mm²
Conductor cross section solid max.	2.5 mm²
Conductor cross section flexible min.	0.2 mm²
Conductor cross section flexible max.	2.5 mm²
Conductor cross section AWG min.	20
Conductor cross section AWG max.	12
Screw thread	M3

Classifications

eCl@ss

eCl@ss 4.0	27040702
eCl@ss 4.1	27040702

Power supply unit - QUINT-PS/1AC/24DC/ 5 - 2866750

Classifications

eCl@ss

eCl@ss 5.0	27049002
eCl@ss 5.1	27049002
eCl@ss 6.0	27049002
eCl@ss 7.0	27049002
eCl@ss 8.0	27049002

ETIM

ETIM 2.0	EC001039
ETIM 3.0	EC001039
ETIM 4.0	EC000599
ETIM 5.0	EC002540

UNSPSC

UNSPSC 6.01	30211502
UNSPSC 7.0901	39121004
UNSPSC 11	39121004
UNSPSC 12.01	39121004
UNSPSC 13.2	39121004

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Feed-through terminal block - UT 4 - 3044102

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Feed-through terminal block, Connection method: Screw connection, Cross section: 0.14 mm² - 6 mm², AWG: 26 - 10, Width: 6.2 mm, Color: gray, Mounting type: NS 35/7,5, NS 35/15

Product Features

- The large wiring space enables the connection of solid and stranded conductors without ferrules, even above the nominal cross section
- Tested for railway applications
- As well as saving space, the compact design enables user-friendly wiring in a small amount of space
- The multi-conductor connection offers maximum flexibility and wiring density
- Optimum screwdriver guidance through closed screw shafts
- The cable entry funnel enables the use of conductors with ferrules and plastic collars within the nominal cross section

Key commercial data

Packing unit	1 pc
Weight per Piece (excluding packing)	9.46 GRM
Custom tariff number	85369010
Country of origin	Germany

Classifications

eCl@ss

eCl@ss 4.0	27141120
eCl@ss 4.1	27141120
eCl@ss 5.0	27141120
eCl@ss 5.1	27141120
eCl@ss 6.0	27141120
eCl@ss 7.0	27141120
eCl@ss 8.0	27141120

Feed-through terminal block - UT 4 - 3044102

Approvals

CSA		http://www.csagroup.org/services/testing-and-certification/certified-product-listing/	13631

	B	C
mm²/AWG/kcmil	26-10	26-10
Nominal current IN	30 A	30 A
Nominal voltage UN	600 V	600 V

UL Recognized		http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm	FILE E 60425

	B	C
mm²/AWG/kcmil	26-10	26-10
Nominal current IN	30 A	30 A
Nominal voltage UN	600 V	600 V

VDE Gutachten mit Fertigungsüberwachung		http://www.vde.com/en/Institute/OnlineService/VDE-approved-products/Pages/Online-Search.aspx	40013658

mm²/AWG/kcmil	0.2-4
Nominal voltage UN	800 V

cUL Recognized		http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.htm	FILE E 60425

	B	C
mm²/AWG/kcmil	26-10	26-10
Nominal current IN	30 A	30 A
Nominal voltage UN	600 V	600 V

LR		http://www.lr.org/en	05/20042

GL		http://exchange.dnv.com/tari/	5447707 HH

End cover - D-UT 2,5/10 - 3047028

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End cover, Length: 47.7 mm, Width: 2.2 mm, Height: 48.4 mm, Color: gray

Key commercial data

Packing unit	1 pc
Minimum order quantity	50 pc
Weight per Piece (excluding packing)	2.4 GRM
Custom tariff number	85389099
Country of origin	Germany

Classifications

eCl@ss

eCl@ss 4.0	27141111
eCl@ss 4.1	27141111
eCl@ss 5.0	27141133
eCl@ss 5.1	27141133
eCl@ss 6.0	27141133
eCl@ss 7.0	27141133
eCl@ss 8.0	27141133

ETIM

ETIM 2.0	EC000886
ETIM 3.0	EC000886
ETIM 4.0	EC000886
ETIM 5.0	EC000886

UNSPSC

UNSPSC 6.01	30211827
UNSPSC 7.0901	39121424
UNSPSC 11	39121424

End clamp - E/NS 35 N - 0800886

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End clamp, width: 9.5 mm, color: gray

Product Features

- Large-surface labeling

Key commercial data

Packing unit	1 pc
GTIN	4 017918 129309
Weight per Piece (excluding packing)	14.8 GRM
Custom tariff number	39269097
Country of origin	Germany

Classifications

eCl@ss

eCl@ss 4.0	27141199
eCl@ss 4.1	27141199
eCl@ss 5.0	27141135
eCl@ss 5.1	27141145
eCl@ss 6.0	27141135
eCl@ss 7.0	27141135
eCl@ss 8.0	27141135

ETIM

ETIM 2.0	EC000761
ETIM 3.0	EC001041
ETIM 4.0	EC001041
ETIM 5.0	EC001041

Single Phase 120VAC & 240VAC Transient Voltage Filters

RCS

Specifications

Electrical

Input Voltage: Up to 240VAC, 1Ø, 50/60Hz.
Capacitance: 0.47 microfarads, ±10%
Resistance: 22 to 680 ohms, ±10%, 0.5 watt
Varistors:

Voltage Code	Max. Allowable AC Voltage	Max. Clamping Voltage	Energy (Joules)
1	130VAC	340V @ 10A	10
2	130VAC	340V @ 10A	10
3	250VAC	650V @ 10A	17
7	150VAC	395V @ 25A	25

Power Consumption: 10VA @ 240VAC

Physical

Termination: #18 Stranded Wire Leads or #20 Solid Wire Leads
Packaging: Epoxy Filled
Weight: 1 Oz.

Ambient Temperatures

Operating: -40°C to 85°C
Storage: -40°C to 85°C

Ordering Information

RC S 1 A - 6

R-K Model

Arrangement
S - Single Phase

Voltage Series
1 - 120VAC Nom.
130VAC Max. with Varistor
2 - 240VAC Nom.
130VAC Max. with Varistor
3 - 240VAC Nom.
250VAC Max. with Varistor
7 - 150VAC Nom.
150VAC Max. with Varistor

DIN Rail Bracket #DRB-1

Resistors
A - 220 Ohms
B - 22 Ohms
C - 33 Ohms
D - 47 Ohms
E - 68 Ohms
F - 82 Ohms
G - 100 Ohms
H - 150 Ohms
J - 180 Ohms
K - 330 Ohms
L - 470 Ohms
M - 680 Ohms
18- 18 Ohms
Z - No Resistor

Varistor Option
V - Varistor (May change AC voltage)

Lead Length
6 - 6 Inches
__ - Specify Lead Length
SW - Solid Wire

- **120 & 240 Volt Ratings**
- **Single Phase (1Ø) Applications**
- **Varistor Options**
- **Stranded Wire or Solid Wire Leads**

E71902
STANDARD 508

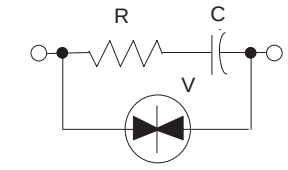
LR43414

Operation

Transient Voltage Filters
R-C networks (Resistance-Capacitance) are applied to circuits where transient electrical voltages can cause a malfunction or damage in solid state controls or control systems (PLCs, CNCs, NCs, Solid State Counters, etc.) The RCSs are typically applied in parallel with single phase inductive loads (motor starter coils, contactor coils, solenoid valves, etc.) to absorb the transients generated when the load is de-energized.

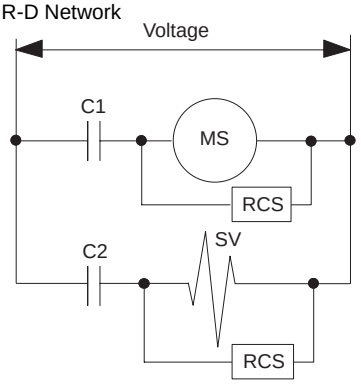
Connections

Without Varistor

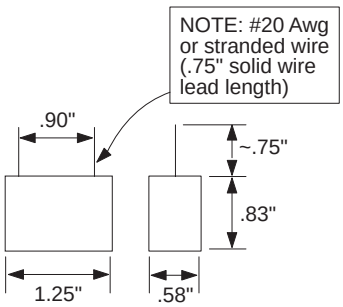


With Varistor

Hook-Up Example
MS = Motor Starter
C1 = Contact
RCS = R-D Network
SV = Solenoid Valve
C2 = Contact



Dimensions



shade aide™

Issue #04-06-812

SEE YOUR HMI. FINALLY.

Your HMI Lasts Longer with SHADE AIDE™

How it works

IT'S EASY TO SEE THE DIFFERENCE

The SHADE AIDE™ easily installs and comes completely assembled. Simply match drill on the front of the control panel, install the gas tight sealing washers and sealing gasket when you install the screws and nuts and you easily maintain your NEMA 4X control panel rating. The SHADE AIDE™ collapses when not in use and is fully lockable. It also protects your display from the harmful effects of constant UV ray exposure. Start viewing your display – no matter how bright the sun!

TO ORDER, CALL 1-800-922-9048

Size options

Part #	SHADE AIDE™ Type	Dimensions
H87A379	SHADE AIDE™ Small HMI Screen Size	7” H x 9.5” W 178mm H x 241mm W
H87A379-VISTA	SHADE AIDE™ Small HMI Screen Size – CAMO (Limited QTY Available)	7” H x 9.5” W 178mm H x 241mm W
H87A379-4X	SHADE AIDE™ Small Screen Size Stainless Steel	7” H x 9.5” W 177mm H x 241mm W
H87A485	SHADE AIDE™ Large HMI Screen Size	11” H x 15.5” W 279mm H x 394mm W
H87A485-4X	SHADE AIDE™ Large HMI Screen Size Stainless Steel	11” H x 15.5” W 279mm H x 394mm W
H87A503A	SHADE AIDE™ XL HMI Screen Size	14” H x 19.5” W 356mm H x 495mm W
H87A503-4X	SHADE AIDE™ XL HMI Screen Size Stainless Steel	14” H x 19.5” W 356mm H x 495mm W
H87A498A	SHADE AIDE™ XL Xtra Tall HMI Screen Size	18” H x 19.5” W 457mm H x 495mm W
H87A498-4X	SHADE AIDE™ XL Xtra Tall HMI Screen Size Stainless Steel	18” H x 19.5” W 457mm H x 495mm W
H87A526A	SHADE AIDE™ HMI Mega Screen Size	24” H x 28” W x 13” D 610mm x 711mm W x 330mm D
H87A526D	SHADE AIDE™ Mega Shallow HMI Screen Size	24” H x 28” W x 2 7/16” D 610mm H x 711mm W x 62mm D

TO ORDER, CALL 1-800-922-9048

Type T and Type TF

Type T transformers are designed with low impedance windings for excellent voltage regulation and can accommodate the high inrush current associated with contactors, starters, solenoids, and relays. Type T transformers are manufactured using the most advanced insulating materials and are the best choice if size and cost are of concern.

Type TF transformers include factory-installed primary and secondary fuse blocks. Type TF transformers consist of two primary fuse blocks and one secondary fuse block. The primary includes rejection-style clips to increase the AIC ratings for the fuses. Since the fuse blocks are mounted on the top of the transformer, Type TF transformers are interchangeable with Type T transformers except for their increased height.

Selection Guide

1. Determine the inrush and sealed VA of each coil in the control circuit and the VA of all other components.
2. Total the **sealed** VA of all operating coils and the VA of all other loads. (This determines the minimum VA size required for the circuit.)
3. Total the **inrush** VA of all coils that are starting at the same time and all loads and coils that are running.
4. Locate a value in the VA column ofTable 14.23 Regulation Chart for Type T, page 14-11, shown below, that is **equal to** or **greater than** the value calculated in step 2.
5. In the VA row selected in step 4, find the inrush value under the appropriate voltage regulation column ofTable 14.23 Regulation Chart for Type T, page 14-11, shown below. If this value is **greater than** the calculated value from step 3, this is the correct transformer VA rating.

   If the inrush value on the selected VA row is **not greater than** the calculated value from step 3, use the next higher transformer VA rating, that is, the rating on the next row.

If your supply voltage is stable and fluctuates less than 5%, Schneider Electric recommends you use the 90% secondary voltage column. If your supply voltage is not stable and fluctuates more than 10% we recommend you use the 95% secondary voltage column. We recommend that you never use the 85% secondary voltage column since magnetic devices lose life expectancy if they are continuously started at 85% of rated voltage.

Table 14.23: Regulation Chart for Type T

VA	Inrush VA @ 20% power factor			Inrush VA @ 40% power factor		
	95% Secondary Voltage	90% Secondary Voltage	85% Secondary Voltage	95% Secondary Voltage	90% Secondary Voltage	85% Secondary Voltage
50	193	266	339	151	215	282
75	271	396	20	210	318	430
100	339	499	659	266	404	549
150	666	893	1120	529	731	942
200	588	815	1041	459	659	866
250	1416	1910	2388	1057	1494	1936
300	1634	2184	2709	1194	1681	2169
350	1894	2592	3261	1392	2005	621
500	3197	4104	4981	2374	3195	4019
750	3770	5515	7231	2887	4391	5945
1000	6587	9079	11430	4706	6886	9051
1500	19324	23983	28607	15066	19361	23756
2000	31384	38777	6161	24794	31630	38667
3000	26539	39934	52713	19355	30721	42216
5000	53111	85265	116277	39368	66309	93882

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Table 14.24: 240 x 480 V Primary, 120 V Secondary; 230 x 460 V Primary, 115 V Secondary; 220 x 440 V Primary, 110 V Secondary

VA		Type T	Type TF	Weight	Height				Width		Depth		Acce-sory Finger-safe Covers
					Type T		Type TF						
UL/CSA/NOM	CE	Catalog No			In	mm	In	mm	In	mm	In	mm	
25	25	9070T25D1	9070TF25D1	2.5	2.58	66	4.00	102	3.00	76	3.09	79	FSC1
50	50	9070T50D1	9070TF50D1	2.5	2.58	66	4.00	102	3.00	76	3.09	79	FSC1
75	75	9070T75D1	9070TF75D1	3.8	2.89	73	4.18	106	3.38	86	3.34	85	FSC1
100	100	9070T100D1	9070TF100D1	3.8	2.89	73	4.18	106	3.38	86	3.34	85	FSC1
150	150	9070T150D1	9070TF150D1	5.5	3.20	81	4.50	114	3.75	95	3.59	91	FSC1
200	200	9070T200D1	9070TF200D1	5.5	3.20	81	4.50	114	3.75	95	3.59	91	FSC1
250	160	9070T250D1	9070TF250D1	7.1	3.20	81	4.50	114	3.75	95	5.30	135	FSC2
300	200	9070T300D1	9070TF300D1	8.5	3.84	98	5.13	130	4.50	114	4.74	120	FSC2
350	250	9070T350D1	9070TF350D1	10.5	3.84	98	5.13	130	4.50	114	5.11	130	FSC2
500	300	9070T500D1	9070TF500D1	11.9	3.84	98	5.13	130	4.50	114	5.49	139	FSC2
750	500	9070T750D1	9070TF750D1	11.0	4.51	115	5.80	147	5.25	133	5.61	143	FSC2
1000	630	9070T1000D1	9070TF1000D1	20.6	4.51	115	5.80	147	5.25	133	6.30	160	FSC2
1500	1000	9070T1500D1	9070TF1500D1	34.0	6.17	157	7.46	190	7.06	179	5.92	150	FSC2
2000	1500	9070T2000D1	9070TF2000D1	47.0	6.17	157	7.46	190	7.06	179	7.17	182	FSC2
3000	2000	9070T3000D1	—	60.0	8.75	222	—	—	9.00	229	7.24	184	FSC2
5000	3000	9070T5000D1	—	89.0	8.75	222	—	—	9.00	229	9.15	232	FSC2

Table 14.25: 208 Vac Primary, 120 Vac Secondary

VA		Type T	Type TF	Weight	Height				Width		Depth		Acce-sory Finger-safe Covers
					Type T		Type TF						
UL/CSA/NOM	CE	Catalog No			In	mm	In	mm	In	mm	In	mm	
25	25	9070T25D3	9070TF25D3	2.5	2.58	66	4.00	102	3.00	76	3.09	79	FSC1
50	50	9070T50D3	9070TF50D3	2.5	2.58	66	4.00	102	3.00	76	3.09	79	FSC1
75	75	9070T75D3	9070TF75D3	3.8	2.89	73	4.18	106	3.38	86	3.34	85	FSC1
100	100	9070T100D3	9070TF100D3	3.8	2.89	73	4.18	106	3.38	86	3.34	85	FSC1
150	150	9070T150D3	9070TF150D3	5.5	3.20	81	4.50	114	3.75	95	3.59	91	FSC1
200	200	9070T200D3	9070TF200D3	5.5	3.20	81	4.50	114	3.75	95	3.59	91	FSC1
250	160	9070T250D3	9070TF250D3	7.1	3.20	81	4.50	114	3.75	95	5.30	135	FSC2
300	200	9070T300D3	9070TF300D3	8.5	3.84	98	5.13	130	4.50	114	4.74	120	FSC2
350	250	9070T350D3	9070TF350D3	10.5	3.84	98	5.13	130	4.50	114	5.11	130	FSC2
500	300	9070T500D3	9070TF500D3	11.9	3.84	98	5.13	130	4.50	114	5.49	139	FSC2
750	500	9070T750D3	9070TF750D3	11.0	4.51	115	5.80	147	5.25	133	5.61	143	FSC2
1000	630	9070T1000D3	9070TF1000D3	20.6	4.51	115	5.80	147	5.25	133	6.30	160	FSC2
1500	1000	9070T1500D3	9070TF1500D3	34.0	6.17	157	7.46	190	7.06	179	5.92	150	FSC2
2000	1500	9070T2000D3	9070TF2000D3	47.0	6.17	157	7.46	190	7.06	179	7.17	182	FSC2
3000	2000	9070T3000D3	—	60.0	8.75	222	—	—	9.00	229	7.24	184	FSC2
5000	3000	9070T5000D3	—	89.0	8.75	222	—	—	9.00	229	9.15	232	FSC2

Table 14.26: 600 Vac Primary, 120 Vac Secondary

VA		Type T	Type TF	Weight	Height				Width		Depth		Acce-sory Finger-safe Covers
					Type T		Type TF						
UL/CSA/NOM	CE	Catalog No			In	mm	In	mm	In	mm	In	mm	
25	25	9070T25D5	9070TF25D5	2.5	2.58	66	4.00	102	3.00	76	3.09	79	FSC1
50	50	9070T50D5	9070TF50D5	2.5	2.58	66	4.00	102	3.00	76	3.09	79	FSC1
75	75	9070T75D5	9070TF75D5	3.8	2.89	73	4.18	106	3.38	86	3.34	85	FSC1
100	100	9070T100D5	9070TF100D5	3.8	2.89	73	4.18	106	3.38	86	3.34	85	FSC1
150	150	9070T150D5	9070TF150D5	5.5	3.20	81	4.50	114	3.75	95	3.59	91	FSC1
200	200	9070T200D5	9070TF200D5	5.5	3.20	81	4.50	114	3.75	95	3.59	91	FSC1
250	160	9070T250D5	9070TF250D5	7.1	3.20	81	4.50	114	3.75	95	5.30	135	FSC2
300	200	9070T300D5	9070TF300D5	8.5	3.84	98	5.13	130	4.50	114	4.74	120	FSC2
350	250	9070T350D5	9070TF350D5	10.5	3.84	98	5.13	130	4.50	114	5.11	130	FSC2
500	300	9070T500D5	9070TF500D5	11.9	3.84	98	5.13	130	4.50	114	5.49	139	FSC2
750	500	9070T750D5	9070TF750D5	11.0	4.51	115	5.80	147	5.25	133	5.61	143	FSC2
1000	630	9070T1000D5	9070TF1000D5	20.6	4.51	115	5.80	147	5.25	133	6.30	160	FSC2
1500	1000	9070T1500D5	9070TF1500D5	34.0	6.17	157	7.46	190	7.06	179	5.92	150	FSC2
2000	1500	9070T2000D5	9070TF2000D5	47.0	6.17	157	7.46	190	7.06	179	7.17	182	FSC2
3000	2000	9070T3000D5	—	60.0	8.75	222	—	—	9.00	229	7.24	184	FSC2
5000	3000	9070T5000D5	—	89.0	8.75	222	—	—	9.00	229	9.15	232	FSC2

Table 14.27: 277 Vac Primary, 120 Vac Secondary

VA		Type T	Type TF[1]	Weight	Height				Width		Depth		Acce-sory Finger-safe Covers
					Type T		Type TF						
UL/CSA/NOM	CE	Catalog No			In	mm	In	mm	In	mm	In	mm	
25	25	9070T25D4	—	2.5	2.58	66	—	—	3.00	76	3.09	79	FSC1
50	50	9070T50D4	—	2.5	2.58	66	—	—	3.00	76	3.09	79	FSC1
75	75	9070T75D4	—	3.8	2.89	73	—	—	3.38	86	3.34	85	FSC1
100	100	9070T100D4	—	3.8	2.89	73	—	—	3.38	86	3.34	85	FSC1
150	150	9070T150D4	—	5.5	3.20	81	—	—	3.75	95	3.59	91	FSC1
200	200	9070T200D4	—	5.5	3.20	81	—	—	3.75	95	3.59	91	FSC1
250	160	9070T250D4	—	7.1	3.20	81	—	—	3.75	95	5.30	135	FSC2
300	200	9070T300D4	—	8.5	3.84	98	—	—	4.50	114	4.74	120	FSC2
350	250	9070T350D4	—	10.5	3.84	98	—	—	4.50	114	5.11	130	FSC2
500	300	9070T500D4	—	11.9	3.84	98	—	—	4.50	114	5.49	139	FSC2
750	500	9070T750D4	—	11.0	4.51	115	—	—	5.25	133	5.61	143	FSC2
1000	630	9070T1000D4	—	20.6	4.51	115	—	—	5.25	133	6.30	160	FSC2
1500	1000	9070T1500D4	—	34.0	6.17	157	—	—	7.06	179	5.92	150	FSC2
2000	1500	9070T2000D4	—	47.0	6.17	157	—	—	7.06	179	7.17	182	FSC2
3000	2000	9070T3000D4	—	60.0	8.75	222	—	—	9.00	229	7.24	184	FSC2
5000	3000	9070T5000D4	—	89.0	8.75	222	—	—	9.00	229	9.15	232	FSC2

[1] TF units are design for line to line voltages on the primary, 277 Vac is a line to neutral voltage.

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TSUBAKI SHOCK RELAY

THE ELECTRONIC SHEAR PIN!

Shock Relay selection is simple; it is based on the motor voltage and amperage of your equipment.

Shock Relay has an unlimited life – it does not wear out.

Shock Relay accepts single three-phase motors up to 600 volts.

Pioneered by Tsubaki, the Shock Relay protects your equipment against unexpected shock loads, overloads, and underloads before damage occurs. The Shock Relay protects the mechanical parts of your equipment by monitoring the current draw on your electric drive motor, and shutting it down when the motor works too hard for too long.

Advantages to you:

- Back to work with the press of a button
- No moving parts, CPU design ensures repeatability
- Precise set-points retain accuracy day after day
- Permits problem notification by alarm or warning lights
- Protect equipment that is up to 1000 feet away

The Shock Relay adapts to virtually any kind of equipment that's driven by an electric motor and is used in applications in a broad variety of industries. Some of the common industries and applications are listed below:

Industry	Application
Material handling	Conveyors, turntables, elevators
Water treatment plants	Pumps, scrapers, water screens
Food machinery	Screw and belt conveyors, bucket elevators
Machine tool	Tapping machines, drill presses
Chemical	Pumps, agitators, filters

Reacts only when there is a problem

At installation, two set-points are made to the Shock Relay:

- How hard is the equipment allowed to work as measured by motor amperage
- Once the motor starts to work too hard, how soon in seconds must we stop production

Balancing these two settings allows for protection when the unexpected happens, limiting damage and downtime.

TSUBAKI SHOCK RELAY

THEORY OF OPERATION – HOW DOES IT WORK?

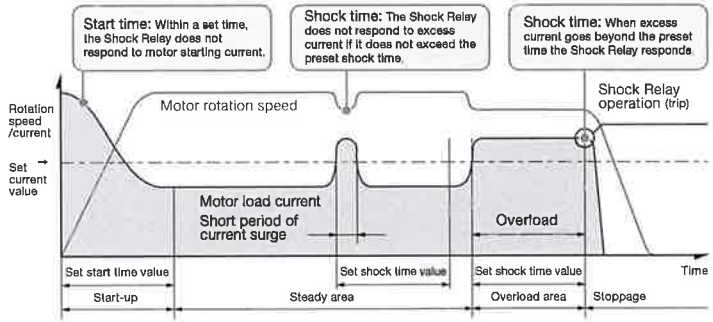


Figure 1: Shock Relay operation example

Figure 1 above reflects a typical set-up for a Tsubaki Shock Relay. As depicted in the above example, the Shock Relay is set up to accept a higher motor amperage draw at start-up for a limited amount of time. This "Start Time" period allows the motor to spool to its steady state operation mode where maximum continuous RPM is achieved, and current draw drops to a normal value that is below the maximum "Current Value" set in the Shock Relay. As depicted, the amperage draw of the motor then momentarily increases (resulting in a drop in RPM due to induced load) above the maximum "Current Value" setting, but quickly falls back to a steady state value. Since the "Shock Time" value was not exceeded, the Shock Relay does not trip, and allows continued operation. However, as time passes by, the Shock Relay senses an increase in motor amperage draw and a drop in RPM that exceeds set current value and "Shock Time." The overload condition sensed by the Shock Relay causes the unit to trip, resulting in the Shock Relay breaking the motor starter contact – thus, shutting the system down to prevent mechanical damage from occurring.

Important Key Concepts:
* Shock Relays generally work with any voltage AC motor, single or three-phase.
* Besides the power to the motor, the Shock Relay needs its own power supply. Power supply requirements generally fall into 115 or 230V single phase.
* It is best practice to have one Shock Relay monitor one motor. Grouping multiple motors to a single Shock Relay generally does not give satisfactory results.

TSUBAKI SHOCK RELAY

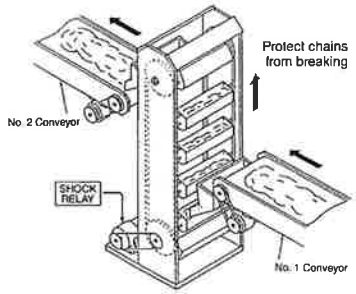
TARGET MARKETS & APPLICATION EXAMPLES

Target Markets

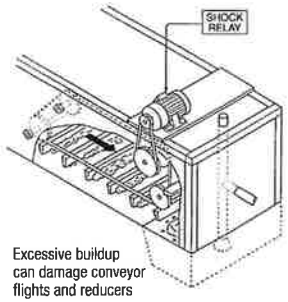
- Material Handling
  Conveyors, Turntables, Elevators
- Water Treatment Plants
  Pumps, Scrapers, Water Screens
- Food Machinery
  Pumps, Agitators, Mixers
- Agriculture
  Screw and Belt Conveyors, Bucket Elevators
- Machine Tool
  Tapping Machines, Drill Press
- Chemical Industry
  Pumps, Agitators, Packagers

Application Examples

Bucket Elevators

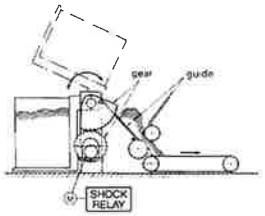


Drag Conveyors



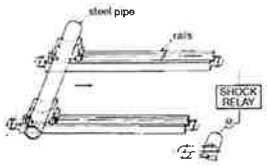
Excessive buildup can damage conveyor flights and reducers

Gear Drives



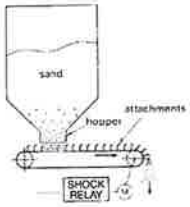
Protect gears from damage

Conveyor Applications



Detect damaging overloads that lead to downtime

Chain Feeders



Protect attachments from damage

HOW TO ORDER

The model code listed below is intended to provide an example of how a given Tsubaki Shock Relay is configured. The most important aspect of ordering a Tsubaki Shock Relay is knowing the electric drive motor horsepower, voltage and amperage rating. As seen below, these three attributes are used to select the correct size range. Selecting a given series is a matter of preference based upon the features and benefits of a given Shock Relay series.

How to Order Code: Example Model # TSBSB Series Shock Relay

TSB	SB	30

Shock Relay	Series	Max Amperage	Amperage Range	230 Volt Motor HP*	460 Volt Motor HP*
Tsubaki Shock Relay Overload Protection	SB Series: Basic overload protection. Manual reset with fail safe contact	5	0.5 - 6A	1/8 to 1 HP	1/4 to 3 HP
		10	1 - 12A	2 to 3 HP	3 to 5 HP
		30	3 - 30A	5 to 7 HP	7 to 15 HP
		60	5 - 60A	10 to 15 HP	20 to 30 HP
		100	10 - 100A	20 to 25 HP	40 to 60 HP
		200	20 - 200A	30 to 50 HP	70 to 120 HP
		300	30 - 300A	60 to 100 HP	150 to 175 HP

* The motor horsepower ranges are approximates; best option is to select based on actual current readings.

The above example for the TSBSB series Shock Relay is used to illustrate the various models within one Shock Relay series and How to Order a Shock Relay for your application.

TSB: There are two families within Tsubaki's line of electronic protection devices. The Shock Relay series begins with TSB. The Shock Monitor series begins with TSM.

SB: The SB-series is one of five types of Shock Relays, each having slightly different features and focusing on different types of applications. While there is overlap between the Shock Relay series, the combinations of features such as ease of set-up, type of display, and communication options will make one Shock Relay series more desirable than another. See the preceding page for a delineation of the various Shock Relay series.

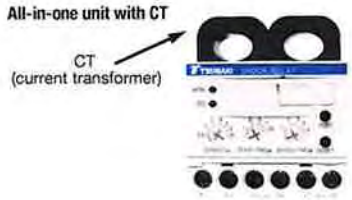
30: The numerical sizing of a Shock Relay series. The TSBSB series is available in seven sizes and for this series, the number relates to the max amperage rating for that Shock Relay. While all Shock Relays can be adjusted over a wide range of amperages, here are a few suggestions that will aid with selection:

- **Select the Shock Relay based on actual running amperage**
  There is a tendency to oversize the electric motor for the application. For example, the motor nameplate may say 6 amps but measurement shows the application only uses 3 amps. Select the Shock Relay based on the 3-amp reading.

TSBSB SERIES - SHOCK RELAY

Features:

- Output relay is self-holding type
- Contacts open when an overload is detected and remain until the reset button is pushed
- Fail-safe relay de-energizes when over current detected
- Economically priced
- Wide current setting range
- High degree of repeatability with low hysteresis
- Includes TEST and RESET buttons
- All-in-one unit with built-in current transformer
- 35 mm DIN rail mount or panel mount
- Can be used with single-phased motors
- UL listed
- Permits trip notification by alarm or warning lights



How to Order Code: Example Model # for TSBSB Series Shock Relay

TSB	SB	30

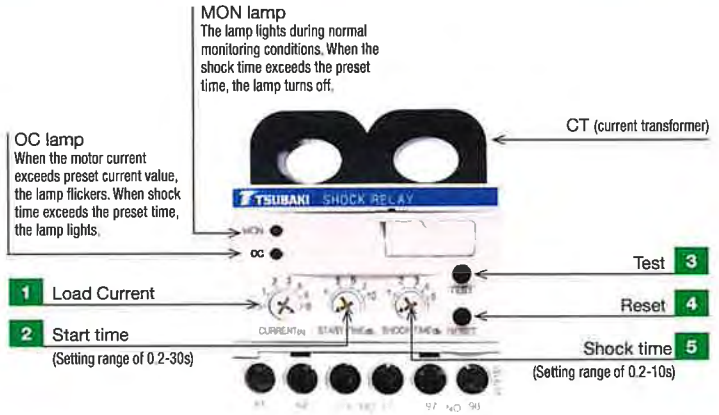
Shock Relay	Series	Max Amperage	Amperage Range	230 Volt Motor HP*	460 Volt Motor HP*
Tsubaki Shock Relay Overload Protection	SB Series: Basic overload protection. Manual reset with fail safe contact	5	0.5 - 6A	1/8 to 1 HP	1/4 to 3 HP
		10	1 - 12A	2 to 3 HP	3 to 5 HP
		30	3 - 30A	5 to 7 HP	7 to 15 HP
		60	5 - 60A	10 to 15 HP	20 to 30 HP
		100	10 - 100A	20 to 25 HP	40 to 60 HP
		200	20 - 200A	30 to 50 HP	70 to 120 HP
		300	30 - 300A	60 to 100 HP	150 to 175 HP

* The motor horsepower ranges are approximates; best option is to select based on actual current readings. Select the Shock Relay based on the motor amperage or motor horsepower.

The following table provides a breakdown of the components provided when ordering a given TSBSB Series Shock Relay. Note that TSBSB Shock Relay sizes with model numbers containing 100, 200, and 300 require additional components when selected. For example, a TSBSB100 Shock Relay will be supplied with a TSBSB05 Shock Relay and a TSB2CT100 current transformer.

TSBSB - All in one unit		TSBSB Externally Mounted Current Transformer Type		
Shock Relay Assembly Part Number	Current Transformer Part Number	Shock Relay Assembly Part Number	Shock Relay Part Number	Current Transformer Part Number
TSBSB05	Not Applicable	TSBSB100	TSBSB05	TSB2CT100
TSBSB10	Not Applicable	TSBSB200	TSBSB05	TSB2CT200
TSBSB30	Not Applicable	TSBSB300	TSBSB05	TSB2CT300
TSBSB60	Not Applicable	NA		

TSBSB SERIES - SHOCK RELAY



Control interface

1 LOAD CURRENT
Load current can be set to stop the motor at the desired level when overload occurs. When the motor current exceeds the preset CURRENT value (at the same time, overload time continues to exceed the preset SHOCK TIME), the Shock Relay activates and stops the motor.

2 START TIME
When the motor starts there is a possibility that the motor current will exceed the set current value. To prevent the Shock Relay from tripping due to the spike in start current, start time is set a little bit longer than the period of motor start-up to ignore the spike.

3 TEST Button
Shock Relay operation can be tested stand-alone or during motor operation. (When testing the Shock Relay, continue to press and hold the TEST button longer than the set START TIME or SHOCK TIME, whichever is longer.)

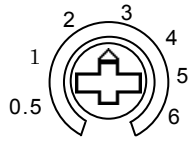
4 RESET Button
After the Shock Relay activates, the RESET button is used to cancel the self-holding of the output contact.

5 SHOCK TIME
Shock time is the amount of time set until the Shock Relay will activate when overload occurs. Within the set time, the Shock Relay will not activate, even if it is overloaded.

13. Volume Setting Step

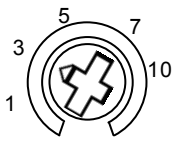
13.1 Setup before operation

・Current set volume



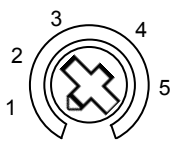
Set to motor rate current

・Start time set volume



Set to 3 seconds

・Shock time set volume



Set to the minimum

13.2 Start Time volume setting

①Start motor. In case that Shock Relay does not operate but motor operates, turn volume counterclockwise by slow degrees and set to the minimum.

②In case that Shock Relay operates, turn volume clockwise by slow degrees, prolong Start Time sequentially until motor operates, and set to the position where Shock Relay does not operate at the starting.

③ For settings beyond the scale, check operating time with TEST button.

13.3 Current volume setting

Turn volume counterclockwise until Shock Relay activates. Turn volume back (about 20～30%) clockwise to set.

13.4 Shock Time volume setting

Set Shock Time volume to the position at which Shock Relay will not trip due to instantaneous overload.

Preferably, set Shock Time to the minimum in accordance with the device property.

14. Troubleshooting

Trouble	Check	Result	Solution
Mon does not light	A1, A2 wiring	Incorrect wiring	Wire correctly
	A1, A2 voltage	Not between 24～240V	Supply 24～240V
Does not trip at current volume MIN.	Wiring of CT	Incorrect wiring	Wire correctly
	Press and hold TEST	Does not trip	Change Shock Relay
Instantly trip after startup.	Start Time setting	Set too short	Set properly
	Current setting	Set too low	Set properly
Trip at instantaneous overload.	Current setting	Set too low	Set properly
	Shock Time setting	Set too short	Set properly
Does not trip at overload	Current setting	Set too high	Set properly
	Shock Time setting	Set too long	Set properly
	Press and hold TEST	Does not trip	Change Shock Relay

If above contents are not applicable or the replacement of Shock Relay is necessary, please contact our sales office.

15. Maintenance

Maintenance and check must be performed in accordance with the following matters.

①To prevent an accident, keep the surrounding area clean and safe.

②Power off before the installation / connection of Shock Relay

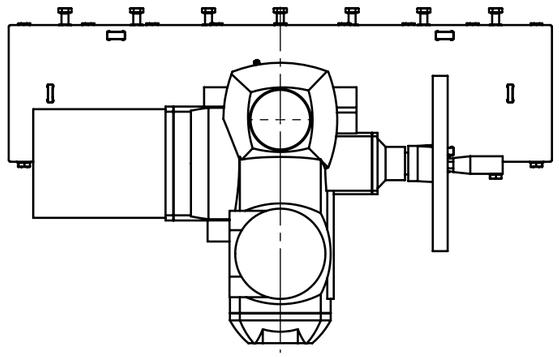
③Comply with the 2-1-1 General Standard of “Ordinance on Labor Safety and Hygiene “.

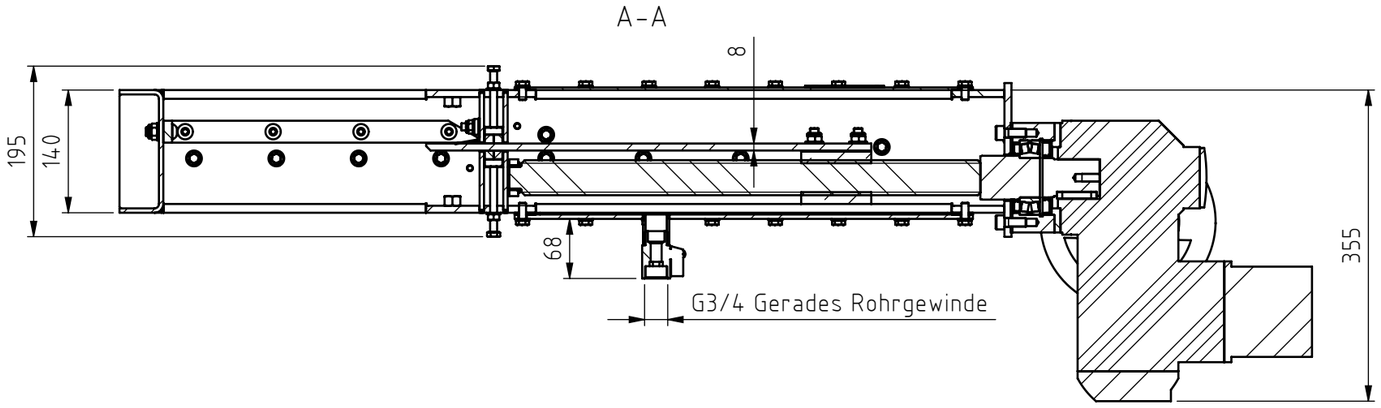
16. Daily check

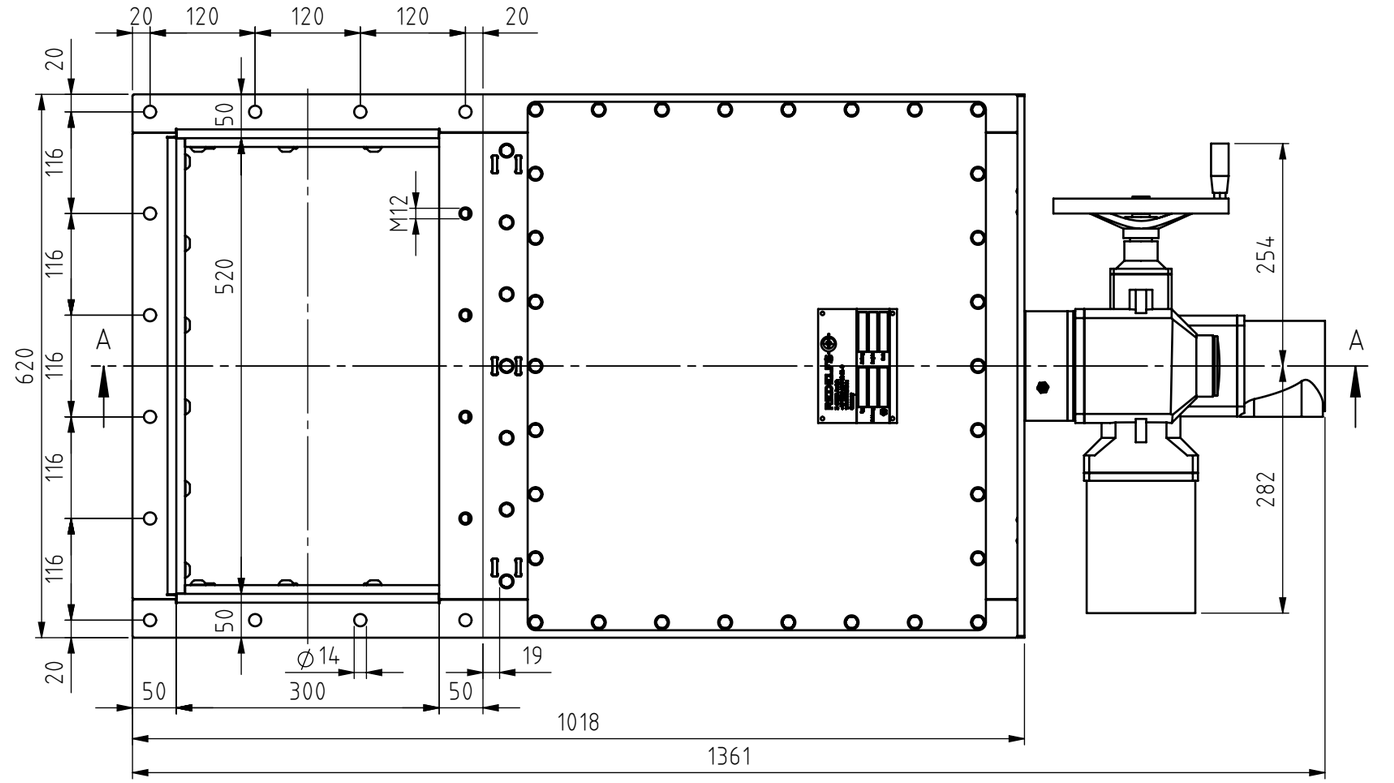
MON lamp (green) lights when Shock Relay is power on.

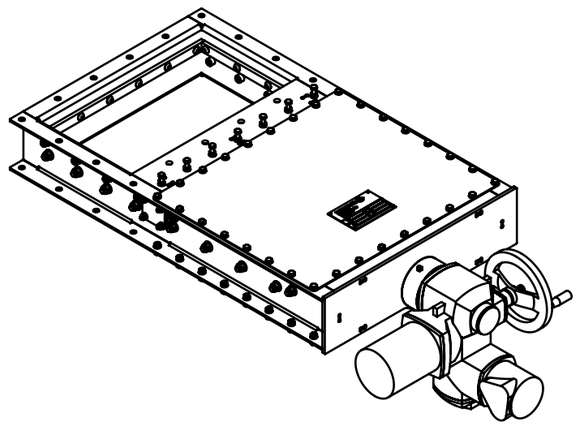
17. Periodic check

(1) Check whether there is any looseness in the installation of the Shock Relay and current transformer. (Every six months)









2x fertigen

Atex Zone:
innen keine
außen keine
Schüttgut:
Rechengut aus kommunaler Kläranlage
Materialstärke/Werkstoff Gehäuse:
5mm / 1.4301
Materialstärke/Werkstoff Schieberblech:
8mm / 1.4301
Materialstärke/Werkstoff Abdeckungen:
oben 3mm, unten 5mm / 1.4301
Verbindungselemente:
Edelstahl A2
Schieberblechauflage:
Gleitstollen
Abdichtung:
metallisch dichtend im Durchgang
produktdicht nach außen
EPDM unterhalb Abdeckung unten
PTFE Packung
Schüttguttemperatur:
0 bis 60°C
Umgebungstemperatur:
0 bis 60°C
Oberfläche Schieberblech:
manuell geschliffen
Oberfläche Rahmen:
glasperlengestrahlt
Antrieb:
AUMA SA10.2
460V / 60Hz
Abtriebsdrehzahl 108 UpM
Drehmoment Einstellbereich 40-120 Nm
Betrieb ohne Aumatic

Diese Zeichnung bleibt mit allen Rechten unser Eigentum und darf ohne schriftliche Genehmigung weder kopiert noch dritten Personen oder Konkurrenzfirmen vorgelegt oder in irgendeiner Weise mitgeteilt werden. Zuwiderhandlung verpflichtet zu Schadenersatz.

Allgemeintoleranzen DIN ISO 2768-mK	Nahtgüte DIN EN ISO 5817-C	Masse: 126.056kg	Dichte:	Anzahl: .	Maßstab: 1:7
Schweißkonstruktionen DIN EN ISO 13920-C	Beschichtung DIN EN ISO 12944	Werkstoff:			Blatt: 1 / 7
					Format: DIN A3

	Datum:	Name:
Bearbeitet	10.10.23	Karsten Wallis
Geprüft	.	

Benennung:
ZSB-Flachschieber-FS140-AUMA-300x520

Zeichnungsnummer:
4186.01.B01

REDELFS
Tel.: 04941/60424-0 E-Mail: info@redelfs.eu

Basisnummer: .

pos 1	
article	**SA 10.2**
description	**multi-turn actuator AUMA-NORM**
qty	**2**

product characteristics

	Order code	*Description*
Valve attachment :	F10	F10 according to EN ISO 5210
Output socket vers.:	ST	output drive sleeve made of steel
Output drive :	B1-42	B1, bore 42mm, DIN6885.1
Output speed :	108	108 rpm,
Type of duty :	1	S2 - 15 min
Temperature version:	N-30-70	-30*C - +70*C
Lubricant :	F15	ALVANIA 1029
Corrosion protect. :	KS-P1.001	powder coating, primer coatingfinish coating
Colour :	A0001	AUMA silver-grey
Enclosure protect. :	IP68/NEMA4X	NEMA 4X
Handwheel :	200	200mm, aluminium
Close direction :	RH	clockwise closing
Mains :	460/60/3	460V 60Hz 3-ph AC
Insulation class :	F	F, tropicalised
Motor protection :	00	thermoswitch 140*C NC
Motor :	AD00071-2-0,70	0,7kW, 2-pole 3-phase AC motor
Torque :	40-120	setting range 40-120 Nm
set to CLOSE :	40	Nm in sense of rotation CLOSE
set to OPEN :	40	Nm in sense of rotation OPEN
Position transm. :	0	no position transmitter
Mech.pos.indicator :	11	with symbols OPEN and CLOSED
Travel set to :	X	please indicate t/stroke
Reduction gearing :	10.2	reduction gearing adjustable
Torque switches :	6	single switches Ag (1 NC/1 NO)for each direction
Limit switches :	8	single switches Ag (1 NC/1 NO)for each direction
Limit switching :	300	1,5-500 t/stroke adjustable
Heater :	22.1	110V-250V AC/DC self-regula- ting PTC heater, 5-20W
Running indication :	24	blinker transmitter

AUMA Riester GmbH & CoKG
Armaturen- und Maschinenantriebe
Aumastr. 1 ° D-79379 Müllheim
Tel +49 7631 809-0 ° Fax +49 7631 809-1250
www.auma.com ° email: info@auma.com

Terminal plan :	00R1AA-101-000	TPA
El. connection :	1	S0 plug
Electrical connect.:	S0-105	M20;M25;M32 plug
Mount.pos.pin car. :	A	cable entries in motor direct.
Name plate :	EN-AL	English, aluminium
Oper. instructions :	EN	English
Inspect. accord. KV:	01.03.200.02	inspection certificate/ declaration of compliance

motor characteristics

	Order code	*Description*
Article number :	Z105.263	
Type designation :	AD00071-2-0,70	
Type of current :	3ph-AC	
Nominal voltage [V]:	460	
Nominal freq. [Hz]:	60	
Nominal power [kW]:	0,700	
Nominal speed [rpm]:	3.360	
Power factor :	0,540	
Nominal current [A]:	3,100	
Starting current[A]:	17,000	
Type of service :	S2 - 15 MIN.	
Type enclosure IP:	68	
Insulation class :	F	
Thermal protection :	1T-140	
Weight :	6,467	

auma®

Solutions for a world in motion

ELECTRIC ACTUATORS

for industrial valve automation

UNIFORM DESIGN FOR SA AND SQ

UNIFORM DESIGN FOR SA AND SQ

SA multi-turn actuator and SQ part-turn actuator
The basic actuator consists of the following components: motor, worm gearing, control unit, handwheel for emergency operation, electrical connection and valve attachment.

For actuators with this type of basic equipment, operation commands and feedback signals can be processed by means of external controls provided with switchgear and the pertaining logic.

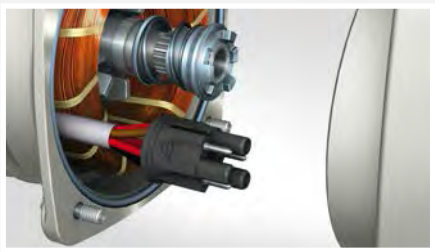
Typically, AUMA actuators are supplied with AM or AC integral controls. Due to the modular design principle, the controls are connected to the actuator via a simple plug/socket connection.

Differences between SA and SQ actuators
The output shaft 1a of SA multi-turn actuators is a hollow shaft to allow the stem to pass through the actuator should the valve be equipped with a rising valve stem.

SQ part-turn actuators are equipped with mechanical end stops 1b for swing angle limitation to make sure that valve end positions can be precisely approached during manual operation. Part-turn actuators are available with various swing angle ranges. Please also refer to page 67.

2 Motor
Use of 3-phase, 1-phase AC and DC motors with high starting torques - specifically developed for valve automation. Thermal protection is ensured by thermoswitches or PTC thermistors.

A dog coupling for torque transmission and an internal motor plug/socket connector allow for fast replacement. For further information, please refer to page 70.



Control unit
Determining the valve position and setting the valve end positions/torque monitoring to protect the valve against overload. Depending on customer specifications, a control unit is installed either as electromechanical or electronic version.

3a Control unit - electromechanical version
Travel and torque are mechanically sensed; switches are operated when reaching the tripping points. The tripping points for both end positions and the tripping torques for both directions are mechanically set.

As an option, the valve position can be transmitted as continuous signal to the control room.

The electromechanical control unit is needed if the actuator is supplied without integral controls. The unit can be combined with both AUMA controls types: AM and AC.

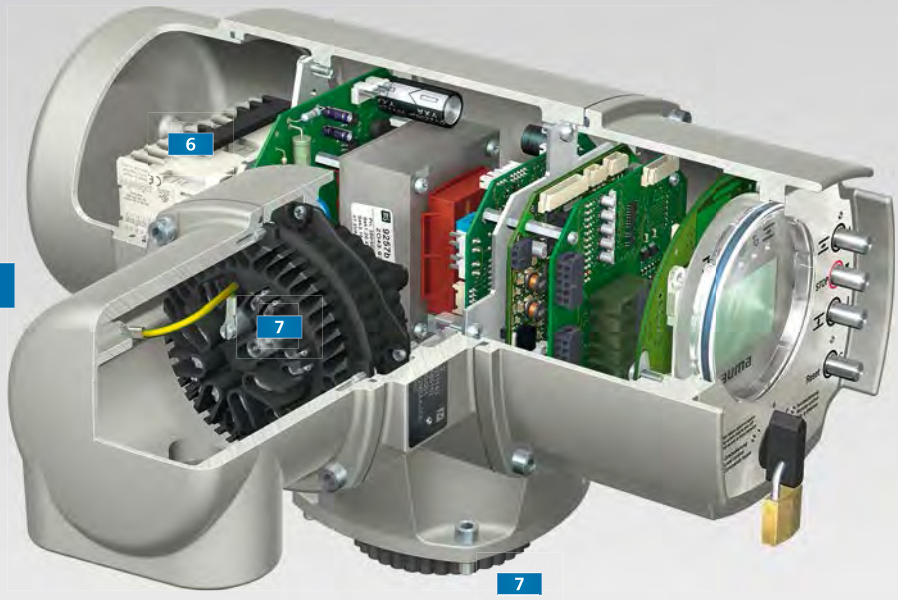
3b Control unit - electronic version
High-resolution magnetic transmitters convert valve position and applied torque into electronic signals. End position and torque settings during commissioning are performed at AC controls without opening the enclosure. Valve position and torque are transmitted as continuous signal.

The electronic control unit comprises sensors to record the torque changes, vibration and device temperature. AC controls time stamp and analyse this data, serving as basis for preventive maintenance schedules (please also refer to page 26).

For further information, please refer to pages 51 and 68.

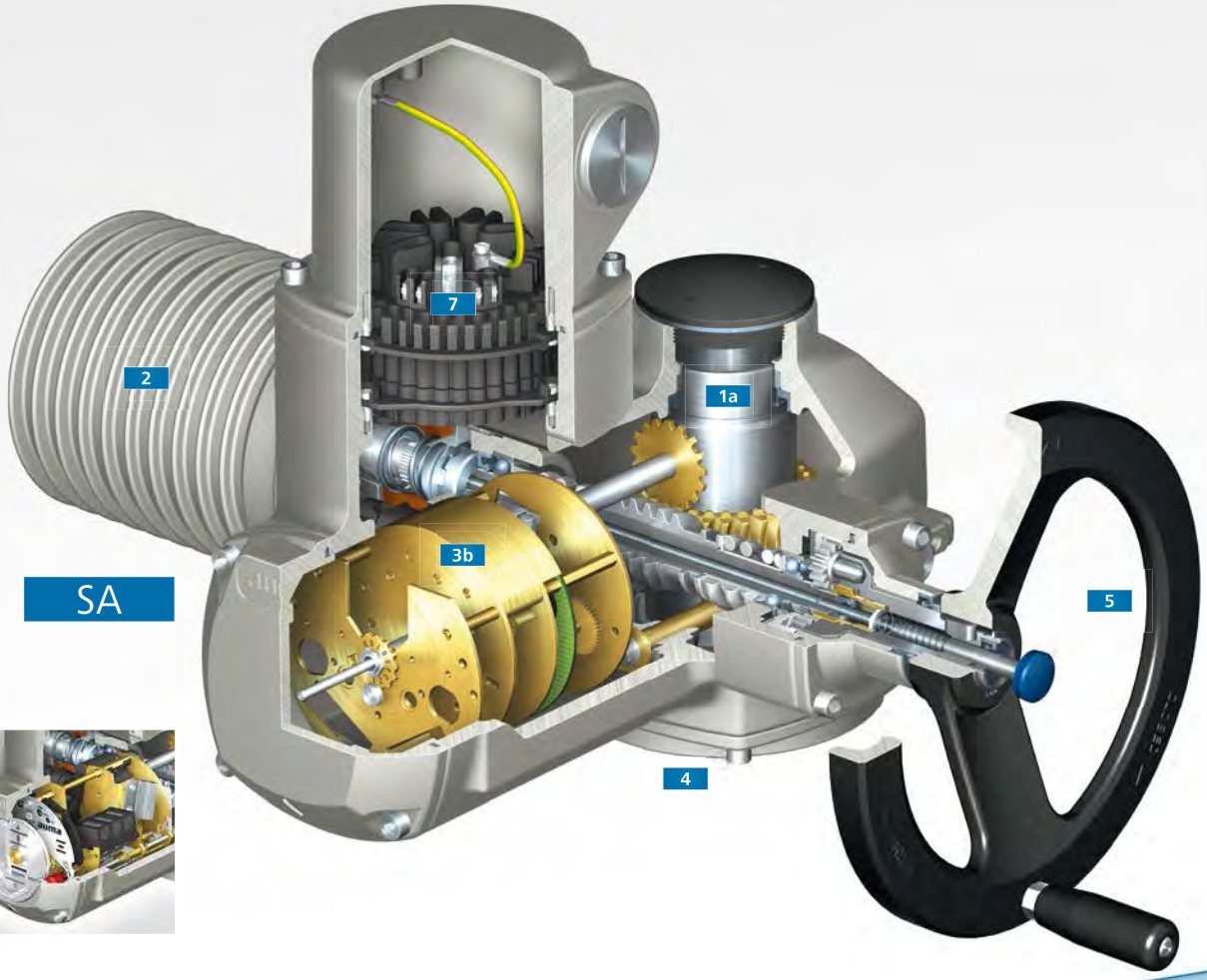
4 Valve attachment
Standardised in compliance with EN ISO 5210 or DIN 3210 for SA multi-turn actuators, complying to EN ISO 5211 for SQ part-turn actuators. All output drive types are available in a multitude of variants.Please also refer to page 52.

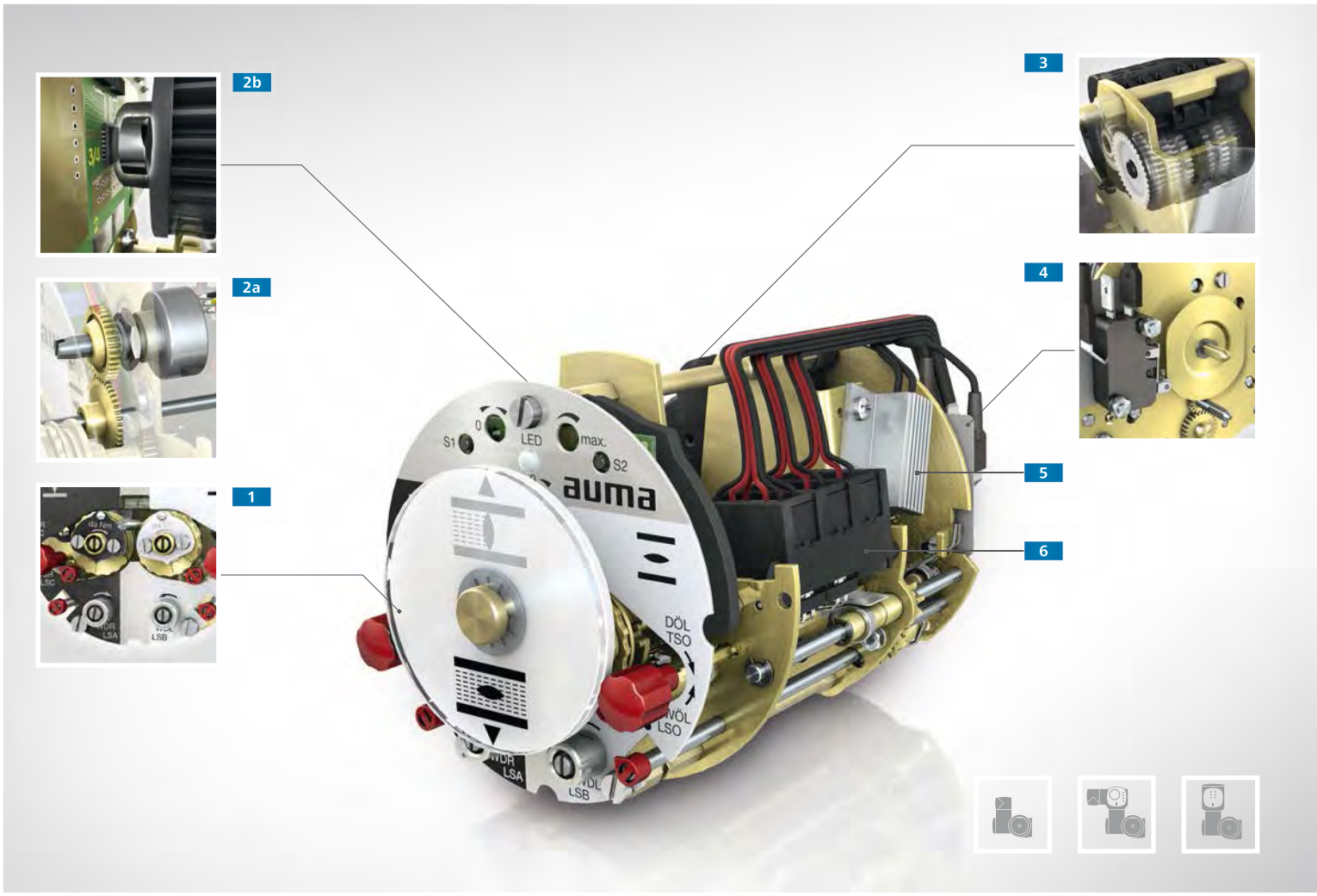
AC



AM

SA





ELECTROMECHANICAL CONTROL UNIT

The control unit contains a sensor system for automatic actuator switch-off once the end position is reached. For this version, end position and torque recording are on mechanical basis.

1 Setting limit and torque switches
After removal of the housing cover and the mechanical position indicator, all setting elements are freely accessible (also refer to page 68).

2 Remote position transmitter
Valve position can be signalled to the DCS via the potentiometer 2a or a 4 – 20 mA signal (via EWG/RWG) (please also refer to page 69). Valve position detection by the EWG 2b is made contactless and consequently avoids wear.

3 Reduction gearing
The reduction gearing is required to reduce the valve stroke to the recording range of the remote position transmitter and the mechanical position indicator.

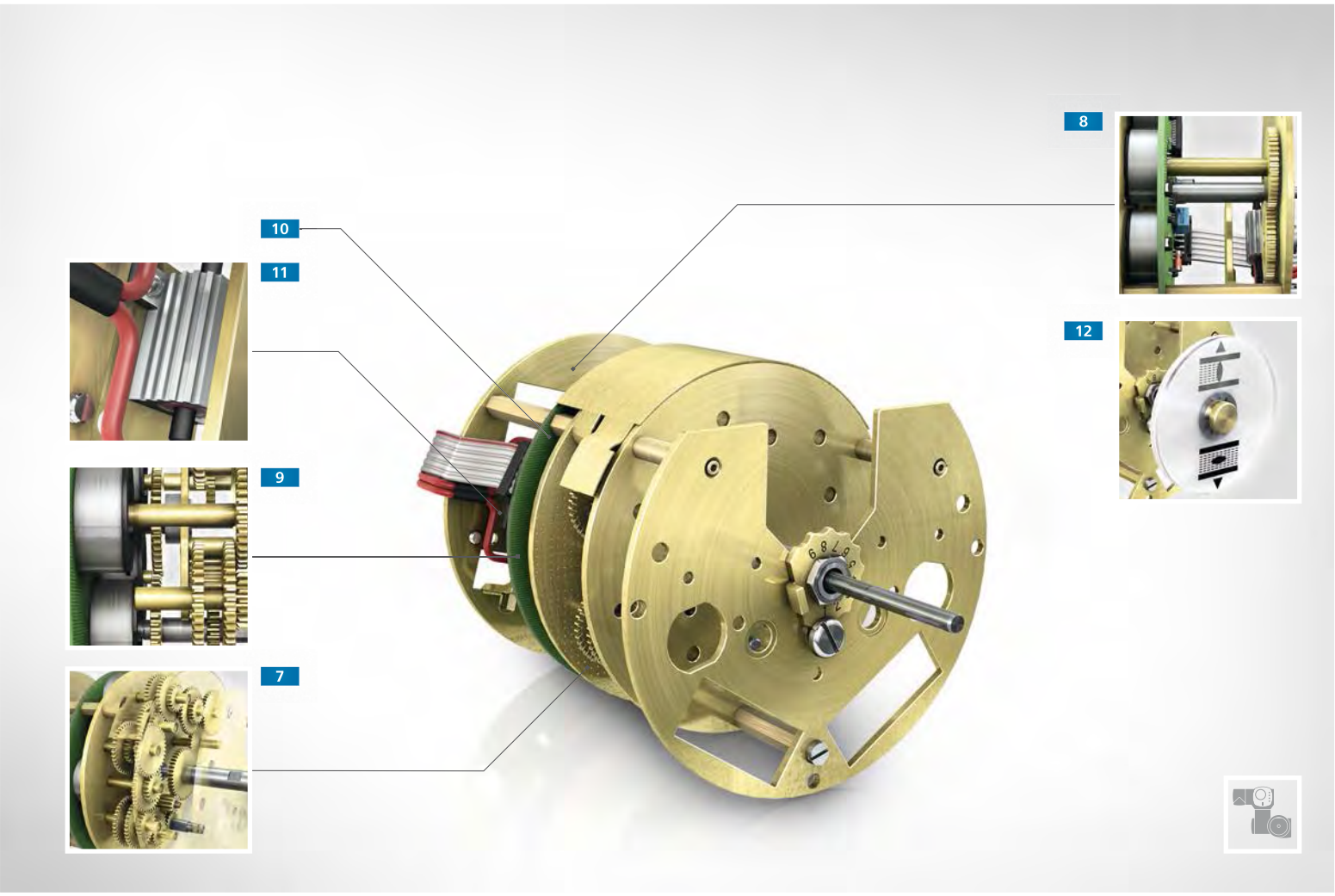
4 Blinker transmitter for running indication
Throughout travel, the segment washer operates the blinker switch (please also refer to page 68).

5 Heater
The heater minimises condensation within the switch compartment (also refer to page 71).

6 Limit and torque switches
The respective contact is operated when reaching an end position or exceeding a tripping torque.

In the basic version, one limit switch each is available for end positions OPEN and CLOSED and one torque switch for directions OPEN and CLOSE (also refer to page 68). For switching two different potentials, tandem switches with two galvanically isolated compartments can be integrated.

Intermediate position switches
As an option, intermediate switches can be installed for each direction to set one further switching point for each direction, as required.



ELECTRONIC CONTROL UNIT

Non-Intrusive - without requiring any tools or opening the device - all settings are made externally if equipped with an electronic control unit (MWG) and AC integral controls.

7 Absolute encoder - Limit
Positions of magnets in the four gear stages correspond to the valve position. This type of limit sensing identifies valve position changes even in case of power failure. Consequently, battery backup is not required.

8 Absolute encoder - Torque
Magnet position senses the torque applied at valve flange.

9 Electronic recording of limit and torque
Hall sensors permanently sense magnet positions for limit and torque recording within the absolute encoders. A continuous limit and torque signal is generated by the integral electronics. The magnetic functional principle is robust and resistant against electromagnetic interference.

End position and torque settings are saved in the electronic control unit. These settings are still available and valid even when replacing AC controls.

10 Vibration and temperature sensors
The electronic board houses a vibration and temperature sensor for continuous temperature measurement. Data is evaluated using internal diagnostic functions.

11 Heater
The heater minimises condensation within the switch compartment (also refer to page 71).

12 Mechanical position indicator
Optional position indication disc identifies valve position even without power supply during manual actuator operation.

Switch for SIL version (not shown)
If the electronic control unit is used in an actuator in SIL version (refer to page 64), additional limit switches are installed in the control unit.

On demand of the safety function, the switches trip when reaching the end position and the motor is switched off.

VALVE ATTACHMENT

The mechanical interface to the valve is standardised. For multi-turn actuators, flange dimensions and output drive types comply with EN ISO 5210 or DIN 3210.

1 Flange and hollow shaft
The hollow shaft transmits the torque via internal splines to the output drive plug sleeve. In accordance with EN ISO 5210, the valve attachment is equipped with a pilot.

1a Output drive plug sleeve with splines
The output drive plug sleeve solution allows for flexible adaptation to all output drive types. For output drive types **B1, B2, B3 or B4**, the plug sleeve is provided with appropriate holes. If one of the output drive types as described below is used, the output drive plug sleeve acts as connecting piece.

1b Output drive type A
Stem nut for rising, non-rotating valve stems. The mounting flange together with the stem nut and axial bearings form a unit, which is suitable for accepting thrust.

1c Output drive type IB
Integral laminated fabric components provide electric isolation between actuator and valve. This output drive type is used for pipelines with cathodic corrosion protection. The torque is transmitted to the valve by means of a so-called output drive sleeve described in section 1a.

1d Output drive type AF
Similar to type A, this stem nut is additionally spring-loaded. The springs compensate for dynamic axial forces when operating at high speeds and even for thermal expansion of the valve stem.

Output drive type AK (not shown)
Similar to type A with pendulum stem nut for compensating deviations of valve stem Corresponds to type AF with regard to appearance and dimension.

2 Anti-backdrive device (LMS)
To be used when self-locking is essential e.g. for high-speed actuators. The anti-backdrive device inhibits any valve displacement in case external forces act upon the closing element. This way, the use of brake motors is not required. The unit is mounted between actuator and valve.

ELECTRICAL CONNECTION

The plug-in electrical connector is a key element of the modular actuator design. The connector is a separate unit. The different connection types are compatible throughout all type ranges and can be used for actuators with or without integral controls.

During maintenance work, the wiring remains undisturbed; electrical connections can be quickly separated and reconnected. This reduces downtimes and avoids wiring faults when reconnecting.

1 AUMA plug/socket connector
The 50 contact AUMA plug/socket connector is the core element for all connection types. Incorrect connection is prevented by special code pins. The AUMA plug/socket connector also forms the electrical connection between actuator and integral actuator controls. Integral controls can be quickly removed from and reconnected to the actuator.

2 Cover for electrical connection S
With three cable entries.

3 Cover for electrical connection SH
With additional cable entries, offers 75 % more space than standard version.

4 Intermediate frame DS for double sealing
Preserves the enclosure protection even if the electrical connection is removed and prevents ingress of dirt or humidity into the housing. Can be combined with any electrical connection type and is easily retrofitted.

Combining an SA multi-turn actuator with a GS part-turn gearbox results in a part-turn actuator. This combination generates large output torques as required for automating butterfly valves as well as ball and plug valves with large nominal diameters and/or high pressure values.

This device combination supplies torque values up to 675,000 Nm.

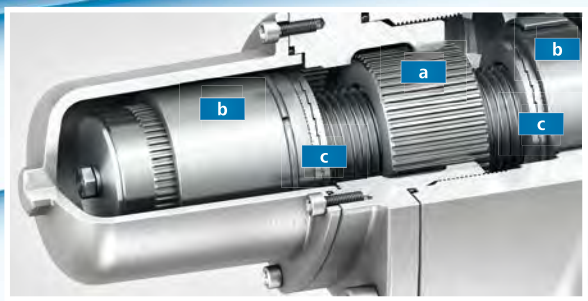
1 End stops

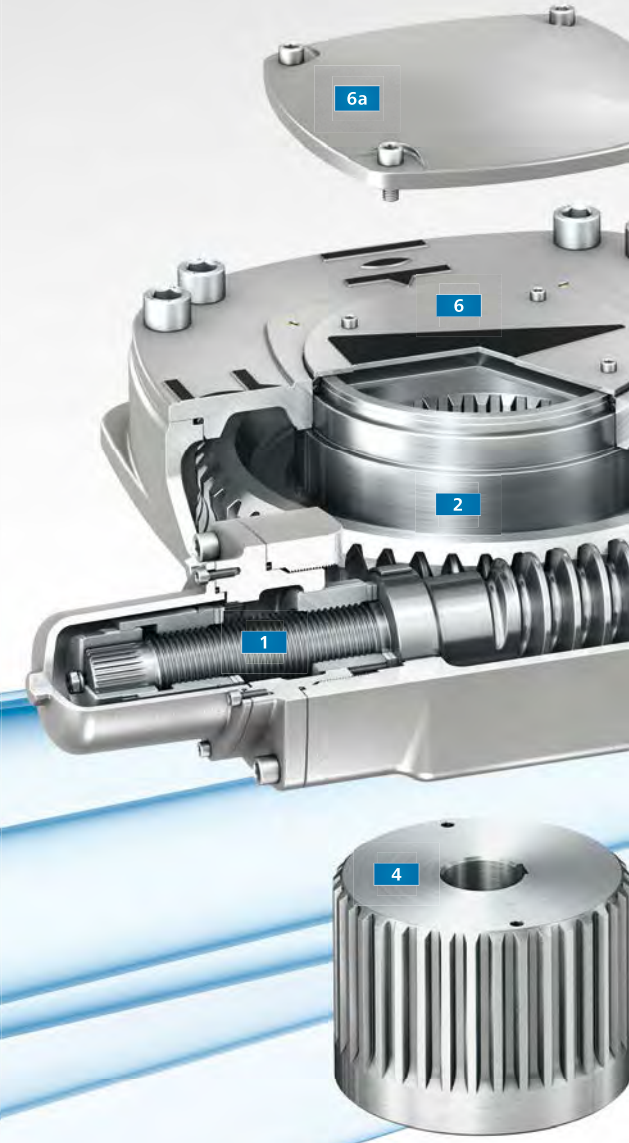
End stops serve the purpose of limiting the swing angle and to allow for precise valve positioning into the end positions during manual operation, especially if the valve is not equipped with own end stops. In motor operation, switching off is generated by the built-on SA multi-turn actuator, gearbox end stops are not reached in this mode.

For the AUMA design, the travelling nut a travels between both end stops b during operation. Advantages of this design:

> Only relatively low input torques are applied to the end stops.
> Excessive input torques have no impact on the housing. Even in the event of end stop break, the main gearbox remains undamaged and can still be operated.

A patented design consisting of two safety wedge discs c per end stop prevents travelling nut seizure at mechanical stop. The unseating torque required amounts to merely 60 % of the torque previously applied to approach the end stop.



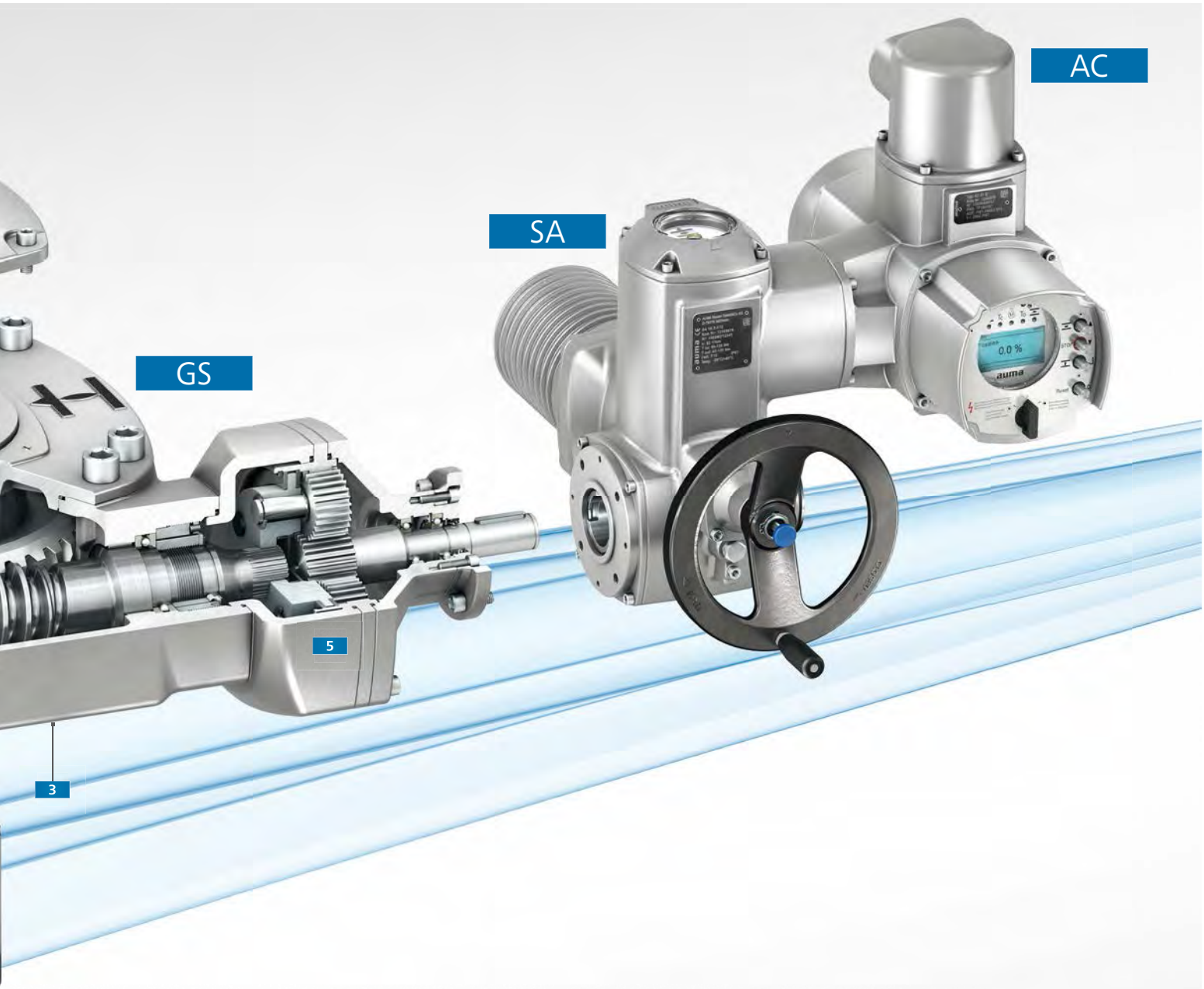


2 Worm wheel and worm shaft

They form the core components of the gearbox. The design allows high reduction ratios within one gear and has an important self-locking effect thus preventing valve position displacement in case external forces act upon the closing element.

3 Output mounting flange

In compliance with EN ISO 5211.



4 Coupling
The separate coupling enables easier mounting of the gearbox to the valve. On request, the coupling is supplied with a suitable bore for the valve shaft (please also refer to page 53). The coupling with bore is placed on the valve shaft and secured against axial movement. The gearbox can then be mounted onto the valve flange.

5 Primary reduction gearing
These planetary or spur gear stages ensure reduction of the required input torque.

6 Pointer cover
The large pointer cover allows perfect visibility of the valve position even at long distance. It continuously follows the valve movement and consequently serves the purpose of running indication. For high requirements with regard to enclosure protection, e.g. for buried service, a protective cover 6a is used instead of the pointer cover.

SA MULTI-TURN ACTUATORS FOR OPEN-CLOSE DUTY

The following data applies to actuators with 3-phase motors, operated in type of duty S2 - 15 min/classes A and B in compliance with EN 15714-2. For further information on other motor types and types of duty, refer to separate technical and electrical data sheets.

Type	Output speeds at 50 Hz[1]	Setting range for tripping torque	Number of starts Starts max.	Valve mounting flange	
	[rpm]	[Nm]	[1/h]	EN ISO 5210	DIN 3210
SA 07.2	4 – 180	10 – 30	60	F07 or F10	G0
SA 07.6	4 – 180	20 – 60	60	F07 or F10	G0
SA 10.2	4 – 180	40 – 120	60	F10	G0
SA 14.2	4 – 180	100 – 250	60	F14	G1/2
SA 14.6	4 – 180	200 – 500	60	F14	G1/2
SA 16.2	4 – 180	400 – 1,000	60	F16	G3
SA 25.1	4 – 90	630 – 2,000	40	F25	G4
SA 30.1	4 – 90	1,250 – 4,000	40	F30	G5
SA 35.1	4 – 45	2,500 – 8,000	30	F35	G6
SA 40.1	4 – 32	5,000 – 16,000	20	F40	G7
SA 48.1	4 – 16	10,000 – 32,000	20	F48	–

SAR MULTI-TURN ACTUATORS FOR MODULATING DUTY

The following data applies to actuators with 3-phase motors, operated in type of duty S4 - 25 %/class C in compliance with EN 15714-2. For further information on other motor types and types of duty, please refer to separate technical and electrical data sheets.

Type	Output speeds at 50 Hz[1]	Setting range for tripping torque	Maximum torque for modulating duty	Number of starts Starts max.[2]	Valve mounting flange	
	[rpm]	[Nm]	[Nm]	[1/h]	EN ISO 5210	DIN 3210
SAR 07.2	4 – 90	15 – 30	15	1,500	F07 or F10	G0
SAR 07.6	4 – 90	30 – 60	30	1,500	F07 or F10	G0
SAR 10.2	4 – 90	60 – 120	60	1,500	F10	G0
SAR 14.2	4 – 90	120 – 250	120	1,200	F14	G1/2
SAR 14.6	4 – 90	250 – 500	200	1,200	F14	G1/2
SAR 16.2	4 – 90	500 – 1,000	400	900	F16	G3
SAR 25.1	4 – 11	1,000 – 2,000	800	300	F25	G4
SAR 30.1	4 – 11	2,000 – 4,000	1,600	300	F30	G5

SUPPLY VOLTAGES/MAINS FREQUENCIES

Hereafter, please find the standard supply voltages (other voltages upon request). Some actuator versions or sizes are not available with the stipulated motor types or voltages/frequencies. For detailed information, please refer to the separate electrical data sheets.

3-phase AC current

Voltages	Frequency
[V]	[Hz]
220; 230; 240; 380; 400; 415; 500; 525; 660; 690	50
440; 460; 480; 575; 600	60

1-phase AC current

Voltages	Frequency
[V]	[Hz]
230	50
115; 230	60

DC current

Voltages
[V]
24; 48; 60; 110; 220

Permissible fluctuations of mains voltage and frequency

> Standard for SA, SQ, AM, and AC
Mains voltage: ±10 %
Frequency: ±5 %
> Option for AC
Mains voltage: –30 %
Requires special sizing when selecting the actuator.

MOTOR

Type of duty according to IEC 60034-1/EN 15714-2

Type	3-phase AC current	1-phase AC current	DC current
SA 07.2 – SA 16.2	S2 - 15 min, S2 - 30 min/ classes A,B	S2 - 15 min[1]/ classes A,B[1]	S2 - 15 min/ classes A,B
SA 25.1 – SA 48.1	S2 - 15 min, S2 - 30 min/ classes A,B	–	–
SAR 07.2 – SAR 16.2	S4 - 25 %, S4 - 50 %/ class C	S4 - 25 %[1]/ class C[1]	–
SAR 25.1 – SAR 30.1	S4 - 25 %, S4 - 50 %/ class C	–	–
SQ 05.2 – SQ 14.2	S2 - 15 min, S2 - 30 min/ classes A,B	S2 - 10 min/ classes A,B[1]	–
SQR 05.2 – SQR 14.2	S4 - 25 %, S4 - 50 %/ class C	S4 - 20 %/ class C[1]	–

Indications on type of duty refer to the following conditions: Nominal voltage, 40 °C ambient temperature, average load of approx. 35 % of maximum torque

Motor insulation classes

	Insulation classes
3-phase AC motors	F, H
1-phase AC motors	F
DC motors	F, H

Rated values for motor protection

Thermoswitches are used as motor protection as standard. When using integral controls, motor protection signals are internally processed. This also applies for the optional PTC thermistors. For actuators without integral controls, signals must be processed in external controls.

Rating of the thermoswitches	
1-phase AC voltage (250 V AC)	Switch rating I_{max}
cos φ = 1	2.5 A
cos φ = 0.6	1.6 A
DC voltage	Switch rating I_{max}
60 V	1 A
42 V	1.2 A
24 V	1.5 A

Special motors

For special requirements, the actuators can be equipped with special motors, e.g. brake motors or two-speed motors.

[1] not available for all sizes

QUALITY IS NOT JUST A MATTER OF TRUST

Actuators must be reliable and dependable. They determine the cycle of precisely defined work processes. Reliability does not begin during commissioning.

For AUMA, this commences with a well-thought out design, careful selection of material used and conscientious production using state-of-the-art machinery. With clearly controlled and supervised production steps we pay close attention to the environment.

The importance of environmentally sound production is reflected in our certifications according to ISO 9001 and ISO 14001.

However, quality management is no one-time or static matter. It has to be proven day by day. Numerous audits by our customers and independent institutes confirm these high standards.

ZERTIFIKAT ■ CERTIFICATE ■ 認證證書 ■ СЕРТИФИКАТ ■ CERTIFICADO ■ CERTIFICAT

TÜV SÜD Management Service

CERTIFICATE

The Certification Body
of TÜV SÜD Management Service GmbH

certifies that

auma®

AUMA Riester GmbH & Co. KG
Aumastr. 1, 79379 Müllheim
Germany

has established and applies a
Quality, Environmental,
Occupational Health and Safety Management System
for the following scope of application:

Design and development, manufacture, sales and service of electric actuators, integral controls and gearboxes for valve automation as well as components for general actuation technology.

Performance of audits (Report-No. 70009378)
has furnished proof that the requirements under:

ISO 9001:2008
ISO 14001:2004
OHSAS 18001:2007

are fulfilled. The certificate is valid in conjunction
with the main certificate from **2015-06-09** until **2018-06-08**.

Certificate Registration No. **12 100/104/116 4269/01 TMS**

Product Compliance Management
Munich, 2015-06-09

DAkkS Deutsche Akkreditierungsstelle
D-ZM-14143-01-03
D-ZM-14143-01-04
D-ZM-14143-01-05

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