SAVANNAH AIRPORT COMMISSION

BIDDING AND CONTRACT DOCUMENTS, GENERAL CONDITIONS, AND TECHNICAL SPECIFICATIONS

FOR

COOLING TOWER NO. 1 UPGRADE

SAVANNAH/HILTON HEAD INTERNATIONAL AIRPORT

CITY OF SAVANNAH EVENT NO. 5137
JUNE, 2017

SAVANNAH AIRPORT COMMISSION

COOLING TOWER NO. 1 UPGRADE

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Revised 02/01/01

NOTICE TO BIDDERS

Sealed proposals, in duplicate, will be received by the Mayor and Aldermen of the City of Savannah and the Savannah Airport Commission in the office of the City Purchasing Agent, Post Office Box 1027, (2 East Bay Street, 31401) Savannah, Georgia 31402 until June 20, 2017, 1:30 p.m. local time, at which time and place all proposals received will be publicly opened and read aloud.

Bidders are invited to submit proposals for:

COOLING TOWER NO. 1 UPGRADE
CITY OF SAVANNAH EVENT NO. 5137

This project consists of providing all labor and materials to refurbish Cooling Tower No. 1 which will include, but not be limited to, the addition of variable frequency drives, fill, motor, pump assembly, fan drive, flow sensors, and other items as noted in the plans and specifications.

Bidders are invited to submit proposals for this work on the proposal forms provided. Other proposal forms will not be accepted.

The complete examination and understanding of the construction plans, specifications, contract documents and site of the proposed work is necessary to properly submit a proposal. Construction plans, specifications and contract documents are available for examination and may be obtained from the offices of the Savannah Airport Commission, 400 Airways Avenue, Savannah / Hilton Head International Airport, Savannah, Georgia 31408, Phone (912) 964-0514, for a cost of $50.00 per set. This cost is non-refundable. Please make checks payable to Savannah Airport Commission.

A pre-bid conference for bidders will be conducted in the Savannah Airport Commission Conference Room, Third Floor, Savannah/Hilton Head International Airport, Savannah, Georgia, on Tuesday, June 6, 2017, at 1:30 PM.

A Bid Bond in the form as bound in the contract documents or certified check in the amount of not less than five percent (5%) of the total amount bid must accompany each bid.

Successful bidder will be required to execute and to provide a Payment Bond and Performance Bond each in an amount of one hundred percent (100%) of the total value of the contract awarded to him with a satisfactory surety or sureties for the full and faithful performance of the work. If the total value of the contract is less than $100,000.00, a Payment Bond or Performance Bond may not be required.

The Savannah Airport Commission, in accordance with Title VI of the Civil Rights Act of 1964, 78 Stat. 252, 42 U.S.C. 2000d to 2000d-4 and Title 49, Code of Federal Regulations, Department of Transportation, Subtitle A, Office of the Secretary, Part 21, Nondiscrimination in Federally assisted programs of the Department of Transportation issued pursuant to such Act, hereby notifies all bidders that, in any contract entered into pursuant to this advertisement, Disadvantaged Business Enterprises will be afforded equal opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

The Contractor agrees to ensure that Disadvantaged Business Enterprises that are presumed to be socially and economically disadvantaged as defined in 49 CFR Part 26.5 have an equal opportunity to participate in the performance of this contract. In this regard all Contractors shall take all necessary and reasonable steps to ensure that such Disadvantaged Business Enterprises have an equal opportunity to compete for and perform contracts. Contractors shall not discriminate on the basis of race, color, national origin, or sex in the award or performance of this contract.

The Contractor, or any subcontractor, submitting a bid for utility contracting, as defined in O.C.G.A. Section 43-14-2 to a utility system as defined in said section, shall conform to O.C.G.A. Section 43-14-8.2 et seq. with reference to Utility Contractor's Licenses. Utility contracting means a proposal to perform utility work to a utility system as defined in O.C.G.A. Section 43-14-2(17).

No bid may be withdrawn after closing time for the receipt of proposals for a period of ninety (90) days.

This is a bid for construction and therefore the City's local vendor preference ordinance will not apply.

The Mayor and Aldermen of the City of Savannah and the Savannah Airport Commission reserve the right to waive any informalities, irregularities, and/or technicalities in or reject any and all bids and/or to award or refrain from awarding the Contract for the Work.

Mayor and Aldermen of the
City of Savannah and the
Savannah Airport Commission

Dated: _____

By: _____
Purchasing Director

INSTRUCTIONS TO BIDDERS

I. GENERAL

A. State Licenses

The successful bidder must be a licensed contractor as specified by the Georgia State Licensing Board, and will be required to obtain any necessary licenses or permits to conduct the work as may be prescribed by the State of Georgia and by the City of Savannah.

B. Pre-Bid Conference

A Pre-Bid Conference for bidders will be conducted in the Savannah Airport Commission Conference Room, Third Floor floor, Savannah/Hilton Head International Airport, Savannah, Georgia on Tuesday, June 6, 2017, at 1:30 PM.

B. Examination of Conditions Affecting Work

Prior to submitting a Proposal, each Bidder shall examine and thoroughly familiarize himself with all existing conditions including all applicable laws, codes, ordinances, rules and regulations that will affect his work. Bidders shall visit the site, examine the grounds and all existing buildings, utilities, and roads, and shall ascertain by any reasonable means all conditions that will in any manner affect the work. The drawings have been prepared on the basis of surveys and inspections of the site, and represent the best factual information available without being considered as a representation of the Owner. This, however, shall not relieve the Bidder of the necessity for fully informing himself as to existing physical conditions.

C. Nondiscrimination and Segregated Facilities

1. Bidders must comply with the President's Executive Order No. 11246 which prohibits discrimination in employment regarding race, creed, color, sex or national origin.

2. Each bidder shall complete, sign and include in his bid proposal the Equal Opportunity Report Statement. When a determination has been made to award a contract to a specific Contractor, such Contractor shall, prior to award, after award or both, furnish such other pertinent information regarding his own employment policies and practices as well as those of his proposed subcontractors as the Owner or the Secretary of Labor may require. All such information required of a subcontractor shall be furnished by the Contractor.

3. The Equal Opportunity Report Statement, Equal Opportunity Clause (41 CFR 60-741.5), and all other EEO requirements shall be included in all non-exempt subcontracts entered into by the Contractor. Subcontracts entered into by the Contractor shall also include all other applicable labor provisions. No subcontract shall be awarded to a non-complying subcontractor.

4. In addition, the Contractor will also insert in each of his subcontracts a clause requiring the subcontractor to include these provisions in any lower tier subcontracts that may in turn be made.

D. Compliance With Law

1. Bidders must comply with Title IV of the Civil Rights Act of 1964, the Davis-Bacon Act, the Anti-Kickback Act and the Contract Work Hours Standard Act.

2. Bidders must comply with all state laws and local ordinances, except that any preferential consideration of local in-state bidders is not allowed.

3. Employment Eligibility Verification
Pursuant to the "Georgia Security and Immigration Compliance Act of 2006," O.C.G.A. Section 13-10-91, public employers and their contractors and subcontractors are required to verify the work eligibility of all newly hired employees through an electronic federal work authorization program. The Georgia Department of Labor has added a new Chapter 300-10-1, entitled "Public Employers, Their Contractors and Subcontractors Required to Verify New Employee Work Eligibility Through a Federal Work Authorization Program," to the Rules and Regulations of the State of Georgia. (See website: http://www.dol.state.ga.us/pdf/rules/300_10_1.pdf.) The new rules designate the "Employment Eligibility Verification (EEV) Basic Pilot Program" operated by the U. S. Citizenship and Immigration Services Bureau of the U. S. Department of Homeland Security as the electronic federal work authorization program to be utilized for these purposes. The EEV/Basic Pilot Program can be accessed at: https://www.vis-dhs.com/EmployerRegistration. Bidders shall comply with this new rule, and submit with their bid the form titled "Contractor Affidavit and Agreement", page I-2(a). After the contract has been awarded, the Contractor shall secure from all subcontractors the form titled "Subcontractor Affidavit and Agreement", page I-2(b), which must be submitted to the Savannah Airport Commission prior to the subcontractor beginning work at the site.

CONTRACTOR AFFIDAVIT AND AGREEMENT

By executing this affidavit, the undersigned contractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm, or corporation which is contracting with the Savannah Airport Commission has registered with and is participating in a federal work authorization program* [any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603], in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

The undersigned further agrees that, should it employ or contract with any subcontractor(s) in connection with the physical performance of services pursuant to this contract with the Savannah Airport Commission, contractor will secure from such subcontractor(s) similar verification of compliance with O.C.G.A. 13-10-91 on the Subcontractor Affidavit provided in Rule 300-10-01-.08 or a substantially similar form. Contractor further agrees to maintain records of such compliance and provide a copy of each such verification to the Savannah Airport Commission the time the subcontractor(s) is retained to perform such service.

_____
Company Name

_____
EEV/Basic Pilot Program* User Identification Number

_____ _____
BY: Authorized Officer or Agent Date
(Contractor Name)

_____
Title of Authorized Officer or Agent of Contractor

_____
Printed Name of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME
ON THIS THE _____ DAY OF _____, _____

Notary Public
My Commission Expires:

_____

* As of the effective date of O.C.G.A. 13-10-91, the applicable federal work authorization program is the "EEV/Basic Pilot Program" operated by the U. S. Citizenship and Immigration Services Bureau of the U. S. Department of Homeland Security, in conjunction with the Social Security Administration (SSA).

SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services under a contract with _____ on behalf of the Savannah Airport Commission has registered with and is participating in a federal work authorization program* [any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603], in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91.

_____
Company Name

_____
EEV/Basic Pilot Program* User Identification Number

_____ _____
BY: Authorized Officer or Agent Date
(Contractor Name)

_____
Title of Authorized Officer

_____
Printed Name of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME
ON THIS THE _____ DAY OF _____, _____

Notary Public
My Commission Expires:

_____

* As of the effective date of O.C.G.A. 13-10-91, the applicable federal work authorization program is the "EEV/Basic Pilot Program" operated by the U. S. Citizenship and Immigration Services Bureau of the U. S. Department of Homeland Security, in conjunction with the Social Security Administration (SSA).

E. General Bond Requirements

1. The Bid Bond shall be five percent (5%) of the total amount of the bid. Only the Bid Bond as bound within these documents or a Certified Check is acceptable. **No other form will be accepted.**

2. Payment Bond and Performance Bond shall be one hundred percent (100%) of the total value of the contract. Only the Payment and Performance Bond as bound within and made a part of the specifications and these documents are acceptable. **No other form will be accepted**. If the total value of the contract is less than $100,000.00, a Payment Bond or Performance Bond may not be required.

3. The Bid Bond, Payment Bond and Performance Bond and Bond Affidavit shall be countersigned by a Georgia Resident. The Georgia Resident Agent shall furnish their Georgia License Number in the space provided.

F. Insurance Requirements

1. Insurance requirements shall be as specified in Article 12, General Conditions.

II. PREPARATION AND SUBMISSION OF BID PROPOSALS

A. Sealed proposals for the construction of the project will be received until 1:30 P.M. local time, **June 20, 2017**.

B. The proposal shall be in duplicate on the "Proposal Form" provided; no other forms are acceptable.

C. Each Bidder shall present his Proposal in a sealed opaque envelope and marked at the lower left hand corner, **"COOLING TOWER No. 1 UPGRADE, Savannah/Hilton Head International Airport, City of Savannah Event No. 5137, with the name of the Bidder."**

Proposals in duplicate shall be delivered to the office of the Director of Purchasing, City of Savannah, 2 East Bay Street (31401), P.O. Box 1027, Savannah, GA 31402.

D. The Bidder's envelope shall contain the signed original and one complete copy of the following documents:

Proposal Form
Equal Employment Opportunity Statement
Disadvantaged Business Enterprise Requirements
Disadvantaged Business Enterprise Assurance Form
Bidder Qualification Questionnaire
Bid Bond or Certified Check
Bid Schedule

E. Proposals shall be submitted as indicated by the "Proposal Form" and shall be signed in ink by an official of the firm submitting the proposal.

F. Erasures or other changes in a proposal shall be explained or noted over the signature of the bidder.

G. Proposals containing reservations, conditions, omissions, unexplained erasures or alterations, items not required in the bid, or irregularities of any kind, may be rejected by the Owner as being incomplete and not qualified for consideration.

H. Each proposal shall indicate the full business name and address of the bidder and shall be signed by him with the usual signature.

I. A proposal submitted by a partnership shall list the names of all partners and shall be signed in the partnership name by one of the members of the partnership.

J. A proposal submitted by a corporation shall be signed by the legal name of the corporation, followed by the state of incorporation and the title designation of the Corporation in legal matters. The name of each person signing the proposal shall be typed or printed below the signature.

K. A Power of Attorney or other satisfactory evidence of the authority of the officer signing on behalf of the corporation shall be furnished for the Owner's records.

L. The proposal must be accompanied by a Bid Bond executed on the form provided or a Certified Check payable to the Savannah Airport Commission in an amount equal to not less than five percent (5%) of the bid. If a bidder is awarded the contract, but fails, refuses, or neglects to execute the contract or to furnish the required payment and performance bonds within ten (10) days after receipt of written notice of award, then the

amount of this Bond or check shall be paid to, or retained by, the Owner as liquidated damages, although not as a penalty.

M. Acknowledgement of receipt of all Addenda shall be made by each Bidder in the space provided in the Proposal Form.

N. The bidder is required to fill in all the blank spaces on the proposal and all of the unit prices on the proposal.

III. INTERPRETATIONS

A. Each Bidder shall carefully examine the Contract Documents consisting of the Plans and Specifications, and all addenda or other revisions and thoroughly familiarize themselves with the detailed requirements prior to submitting a Proposal. Should a Bidder find discrepancies or ambiguities in, or omission from Contract Bidding Documents, or should the bidder be in doubt as to their meaning, he shall at once notify the Savannah Airport Commission who will send written addenda to all on SAC's Planholder List, but the Savannah Airport Commission will not issue or cause to be issued any addenda modifying plans and specifications (at the sole discretion of the Savannah Airport Commission) within a period of 72 hours prior to the advertised time for the opening of bids or proposals, excluding Saturdays, Sundays, and legal holidays. The City of Savannah normally posts addenda on the Purchasing Department's website. The Savannah Airport Commission will not be responsible for any oral instructions or Internet postings (or the lack thereof). All addenda will become a part of Contract Documents.

B. All inquiries shall be directed to the Executive Director, Savannah Airport Commission, Savannah/Hilton Head International Airport, 400 Airways Avenue, Savannah, Georgia 31408, Telephone Number (912) 964-0514, FAX (912) 964-0877. No allowance will be made after Bids are received for oversight by Bidder.

C. Where a discrepancy occurs between the prices quoted in words and/or in numbers, the unit price written in words shall govern the final costs or award of contract.

IV. MODIFICATIONS AND/OR WITHDRAWALS OF PROPOSALS

A. A bid may not be modified, withdrawn, or canceled by the bidder during a 90 calendar day period following the time and date designated for the receipt of bids, and each bidder so agrees in submitting his bid.

B. Negligence on the part of the Bidder in the preparation of his proposal shall not be grounds for the modification or withdrawal of a proposal after the time set for bid opening.

V. ACCEPTANCE/REJECTION OF BIDS

A. This is a bid for construction and therefore the City's local vendor preference ordinance will not apply.

B. The Contractor, or any subcontractor, submitting a bid for utility contracting, as defined in O.C.G.A. Section 43-14-2 to a utility system as defined in said section, shall conform to O.C.G.A. Section 43-14-8.2 et seq. with reference to Utility Contractor's Licenses. Utility contracting means a proposal to perform utility work to a utility system as defined in O.C.G.A. Section 43-14-2(17).

C. The Owner proposes to award the contract to the lowest qualified bidder (See Page I-3, Section II – Preparation and Submission of Bid Proposals) submitting a reasonable bid as determined at the sole discretion of the Commission.

D. The Mayor and Aldermen of the City of Savannah and the Savannah Airport Commission reserve the right to waive any informalities, irregularities, and/or technicalities in or reject any and all bids and/or to award or refrain from awarding the Contract for the Work.

BIDDER'S CHECKLIST

THIS CHECKLIST MUST BE ATTACHED AS THE COVER SHEET TO YOUR BID PRIOR TO SEALING YOUR BID AND SUBMITTING IT TO THE OFFICE OF THE PURCHASING DIRECTOR. IF THIS CHECKLIST IS NOT ATTACHED, YOUR BID WILL BE DISQUALIFIED. IF THIS CHECKLIST IS INCOMPLETE OR IF ANY ITEM CANNOT BE VERIFIED AS BEING INCLUDED WITH YOUR BID, YOUR BID WILL BE DISQUALIFIED.

NAME AND ADDRESS: _____

_____

_____

CITY OF SAVANNAH EVENT NUMBER: 5137

PROJECT NAME: **COOLING TOWER NO. 1 UPGRADE**

INSTRUCTIONS TO BIDDERS

The contents of your bid package must be clearly marked and submitted IN THE FOLLOWING ORDER: 1) acknowledgement of addendum, 2) bid bond, and 3) the bid proposal page. Please place a check mark in the appropriate space and indicate the number of addendums received:

1) Addendum received? _____Yes _____No

Indicate number of addendums received: _____

2) Bid Bond enclosed? _____Yes _____No

Form of bid bond: ___Surety Bond ___Cashier's Check ___Certified Check

3) Are all signature pages of the bid proposal signed? _____Yes _____No

4) Total Amount of Bid: $ _____

FOR CITY USE ONLY

Verification of Bid Package Content:

1) Addendum Acknowledged? _____Yes _____No

Number of Addendums Issued: _____

2) Bid Bond Enclosed: _____Yes _____No

Form of bid bond: ___Surety Bond ___Cashier's Check ___Certified Check

3) Bid Proposal Pages Signed: _____Yes _____No

I certify that the above items were/were not included with the attached bid at the time and place of the bid opening.

_____
Title

_____
Signature

_____
Date

SAVANNAH AIRPORT COMMISSION

PROPOSAL FORM

TO: Mayor and Aldermen of the
City of Savannah and the
Savannah Airport Commission

FROM: _____
Bidder's Name

_____
Address

_____
City, State and Zip Code and Telephone Number

1. The undersigned, as Bidder, does hereby declare that he has familiarized himself with the local conditions affecting the cost of the work, the Contract Documents including the "Notice to Bidders," "Instructions to Bidders," "Proposal," "Bid Schedule," "General Conditions," "Supplementary Conditions", and the Specifications and Drawings and other related Construction Documents, together with any addenda to such Construction Documents as listed herein (paragraph 12) and hereby proposes to furnish all material and perform all work required in strict accordance with the provisions of documents noted above for the consideration of prices quoted in the "Bid Schedule" (see Page P-20) and attached hereto and incorporated by reference.

   The undersigned understands that the quantities shown in the "Bid Schedule" are approximate only, are intended principally to serve as a guide in evaluating proposals, and are subject to either increase or decrease.

2. The undersigned affirms that in making such bid, neither he nor any company that he may represent, nor anyone on behalf of him or his company, directly or indirectly, has entered into any combination, collusion, undertaking or agreement with any other Bidder or Bidders to maintain the prices of said work, or any compact to prevent any other Bidder or Bidders from bidding on said contract or work and further affirms that such bid is made without regard or reference to any other Bidder or proposal and without any agreement or understanding or combination either directly or indirectly with any other person or persons with reference to such bidding in any way or manner whatsoever.

3. The undersigned, when notified of the acceptance of this proposal, does hereby agree to enter into a construction contract with the Owner, within ten (10) days from the date on the Notice of Acceptance, for the execution of the work described within the period of time prescribed, and he shall give 100%

Performance Bond and Payment Bond with good and sufficient surety to assure satisfactory completion thereof.

4. The undersigned further agrees that if awarded the contract he will commence the work within ten (10) calendar days after the date of the Notice to Proceed and that he will complete the work in accordance with the schedules and time frame set forth in the Contract or such amended time as may be granted. If the undersigned fails to complete any phase of the work within the given time frame and if he fails to complete all of the work on or before the expiration of the allowed calendar days, then and in that event, he further expressly agrees that, for each day that any phase of the work under this Contract remains uncompleted thereafter, the Owner may deduct from the Contract price herein specified the stipulated sum of liquidated damages as scheduled in the Contract and retain for failure of the undersigned to complete this Contract on or before the expiration of the scheduled critical time frames.

   The undersigned agrees that the Owner's damages caused by delay are capable of being established but would be difficult to measure accurately and that the sums herein specified as liquidated damages listed in the General Conditions and Supplementary General Conditions are not a penalty, but represent that parties' estimate of the actual damages which the Owner would suffer per day if the work is not completed as scheduled.

5. In submitting this bid, it is understood that the right is reserved by the Owner to waive irregularities and informalities and to reject all bids and to negotiate with the apparent qualified low bidders if necessary. It is agreed that this bid may not be withdrawn for a period of ninety (90) days after the opening thereof.

6. The undersigned has attached hereto a Cashiers Check, or Bid Bond in the sum of _____ ($_____), payable to the Savannah Airport Commission, as required in the Notice to Bidders, and the undersigned agrees that in case he fails to fulfill his obligations under the aforegoing Bid and Contract, the Mayor and Aldermen of the City of Savannah and the Savannah Airport Commission may, at its option, determine that the undersigned has abandoned his rights and interests in such bid and that the Cashiers Check, or Bid Bond accompanying his bid has been forfeited. Otherwise, the Check or Bid Bond shall be returned to the undersigned upon the execution of the contract and the acceptance of the bonds and insurance, or upon rejection of his bid.

7. The undersigned affirms that he has completed, signed and included in the bid proposal the following:

   a. Equal Opportunity Report Statement
   b. Disadvantaged Business Enterprise Requirements
   c. Disadvantaged Business Enterprise Assurance Form
   d. Bidder Qualifications Questionnaire
   e. Bid Bond or Certified Check
   f. Bid Schedule
   g. Contractor Affidavit and Agreement (EEV)

A bid shall be considered unqualified and shall be rejected if it fails to include these fully executed statements or if the Bidder fails to furnish required data. When a determination has been made to award a contract to a specific contractor, such contractor shall, prior to award, furnish such other pertinent information regarding his own employment policies and practices as well as those of his proposed subcontractors as the City of Savannah, the Savannah Airport Commission, Secretary of Labor or the Office of Federal Contract Compliance (OFCC) may require.

The Bidder shall furnish similar statements executed by each of his first tier and second tier subcontractors whose contracts equal $10,000 or more and shall obtain similar compliance by such subcontractors before awarding such subcontracts. No subcontract shall be awarded to any noncomplying subcontractor.

8. It is understood and agreed that all workmanship and materials under all items of work are guaranteed for one year from the date of final acceptance, unless otherwise specified.

9. The undersigned affirms that he has completed all of the blank spaces in the Bid Schedule with an amount in words and numbers and agrees that where a discrepancy occurs between the prices quoted in words and/or in numbers the unit price written in words, unless obviously incorrect, shall govern the final costs or award of Contract. In the case of a tie bid price, the Owner may negotiate a price with each low tie Bidder.

10. The undersigned agrees that the Contract lump sum shall be decreased or increased where planned quantities shown on the drawings are decreased or increased, and that such increase or decrease shall be determined by use of the appropriate unit price if shown on the Bid Schedule.

11. The undersigned affirms that wages not less than the minimum rates or wages, as predetermined for this project by the U. S. Secretary of Labor and City of Savannah, were used in the preparation of this proposal.

12. The undersigned acknowledges receipt of the following addenda:

Addendum No.	Date
_____	_____
_____	_____
_____	_____
_____	_____

13. The legal status of the undersigned is:

The Bidder shall fill out the appropriate form (a, b, or c) and strike out the other two.

a. A corporation duly organized and doing business under the laws of the State of _____, for whom _____, bearing official title of _____, whose signature is affixed to this bid, is duly authorized to execute contracts.

If Foreign Corporation or non State of Georgia corporation: date of qualification in _____ (State). Name and address of process agent: _____.

(Out of State contractor shall provide name and address of Agent for service of process in the State of Georgia.)

b. A partnership, all of the members of which, with addresses are: (Designate general partners as such).

_____ _____ _____

_____ _____ _____

If all partners are nonresidents of Georgia: Designate name and address of agent for service of process located in Georgia.

c. An individual, whose signature is affixed to this bid. (If nonresidents of Georgia, agent for the service of process in the State of Georgia must be designated.)
_____.

Dated and signed at _____, _____,
_____, this _____ day of 2017

NAME OF BIDDER _____

BY _____

TITLE _____

BUSINESS ADDRESS _____

_____

PHONE: _____

GEORGIA TAX REGISTRATION NO. _____

WITNESS:

_____ _____

DISADVANTAGED BUSINESS ENTERPRISE REQUIREMENTS

THE FOLLOWING BID CONDITIONS APPLY TO THIS CONTRACT. SUBMISSION OF A PROPOSAL BY A PROSPECTIVE CONTRACTOR SHALL CONSTITUTE FULL ACCEPTANCE OF THESE BID CONDITIONS.

A. DEFINITION (49 CFR Part 26.5)

Disadvantaged Business Enterprise (DBE) as used in this Contract shall have the same meaning as those firms that are presumed to be socially and economically disadvantaged as defined in Paragraph 26.5, 49 CFR Part 26. (Definition: Socially and economically disadvantaged individual).

B. POLICY

It is the policy of the Savannah Airport Commission that Disadvantaged Business Enterprises shall have an equal opportunity to participate in the performance of all contracts and subcontracts.

C. DBE OBLIGATION

All Bidders, Prospective Contractors, and Contractors shall take all necessary and reasonable steps to ensure that Disadvantaged Business Enterprises have an equal opportunity to compete for and perform contracts. Bidders, Prospective Contractors, and Contractors shall not discriminate on the basis of race, color, national origin, or sex in the award and performance of Contracts.

D. COMPLIANCE

All Bidders, Prospective Contractors, and Contractors for this Contract are hereby notified that failure to carry out the Policy and DBE Obligation, as set forth above, may be considered by the Savannah Airport Commission as a breach of Contract which may result in termination of the Contract or other such action as deemed appropriate by the Savannah Airport Commission.

E. SUBCONTRACT CLAUSES

All Bidders, Prospective Contractors, and Contractors hereby assure that they will include the above clauses in all subcontracts, which offer further subcontracting opportunities.

F. CONTRACT AWARD ELIGIBILITY

1. Bidders, Prospective Contractors, and Contractors shall meet the DBE goal or provide the Commission with documentation of its good-faith effort(s) to meet the DBE goal to the satisfaction of, and as requested by the Savannah Airport Commission.

2. The Savannah Airport Commission has the right, at its sole discretion, to accept or reject any and all bids submitted, accept or reject any DBE participation (and/or percentage of) being proposed, and accept or reject any good-faith efforts.

G. SUBCONTRACT GOAL

1. The attainment of the goal established for this Contract is to be measured as a percentage of the total dollar value of the Contract.

   a. The goal established for this Contract is as follows:

Race-Neutral performed by DBEs.

H. AVAILABLE ELIGIBLE DBEs

1. For this Contract, the Savannah Airport Commission will accept, as an eligible DBE, firms that are currently certified by any Federal, State, or municipal government agency or other organizations approved by the Commission and/or firms registered as a DBE(includes MBE/WBE firms) with and accepted by the City of Savannah or other municipality, or organizations approved by the Commission provided they are owned by individuals presumed to be socially and economically disadvantaged in accordance with paragraph A, Definition, of these requirements. Proof of certification/registration shall be provided to the Savannah Airport Commission as requested.

2. Bidders, Prospective Contractors, and Contractors are encouraged to inspect the Georgia Department of Transportation, City of Savannah, and other DBE directories to assist in locating possible DBEs for the work to be performed. Credit towards meeting the DBE goal will not be counted until the DBE(s) to be used is/are either certified or registered as outlined in paragraph 1 above and such certification(s) and/or registration(s) are accepted by the Commission.

I. BIDDER'S REQUIRED SUBMISSION

1. The following documents must be submitted with the Bid Proposal:

   a. **DBE SUBCONTRACTORS LIST** – Bidders must complete and properly execute the DBE Subcontractor list (Page P- 8).
   b. Bidders must complete and properly execute the **"DBE ASSURANCE FORM"** (Page P-14).

2. The following document must be submitted to the Commission prior to award of the contract.

a. Bidders must complete **DBE NOTIFICATION OF INTENT TO SUBCONTRACT** for each DBE subcontractor (Page P-9).

b. Good-faith efforts documentation (if applicable).

SAVANNAH AIRPORT COMMISSION

DISADVANTAGED BUSINESS ENTERPRISE (DBE) SUBCONTRACTORS LIST

(Reproduce if additional copies are needed)

Disadvantaged Business Enterprise Subcontractor (Company Name)	Description of Work/Materials	Dollar Value of Subcontract Work

Total Dollar Value of Subcontract Work $ _____

Total Dollar Value of Basic Bid $ _____

Percent of Total _____ %

SAVANNAH AIRPORT COMMISSION

DBE NOTIFICATION OF INTENT TO SUBCONTRACT

Project Name. **COOLING TOWER NO. 1 UPGRADE**

Bid Date: _____

Contractor: _____

Hereby intends to subcontract or purchase materials for the following work items to:

DBE: Name _____

Address _____

City/State/Zip _____ Phone _____

Item No.	Description of Work/Materials	Unit	Quantity	Unit Cost	Amount

Total amount of subcontract $ _____

DBE Sub or Supplier Signature _____

Title _____

Date _____

Prime Contractor Signature _____

Title _____

Date _____

This form must be signed by the Prime Contractor and the DBE Subcontractor. A separate form is required for each DBE Subcontractor. The form(s) shall be submitted whether or not DBE participation is being proposed. If DBE participation is not being proposed, Bidder, Prospective Contractor, or Contractor must indicate "NONE" beside DBE name and mark "O" in $ value space. The proposed contract amounts specified on this form for a DBE firm must be the same (verify) as the amounts shown on the DBE Subcontractor's List for the same DBE firm unless the amounts are more favorable for the DBE or unless otherwise approved by the Commission. This form must be submitted with the Bid Proposal or within five (5) business days after bid opening.

J. GOOD-FAITH EFFORTS

Good-faith efforts are required by the Bidder, Prospective Contractor, and Contractor when the DBE goal established for a contract is not met, or any at any time during the contract when achievement of the DBE goal is in jeopardy. It is the Bidder's, Prospective Contractor's, and Contractor's responsibility to provide documentation as required by the Commission to ascertain the efforts made. Good-faith efforts include documented efforts made by Contractor to include personal contacts, follow-ups and earnest negotiations with DBEs. The Savannah Airport Commission reserves the right to accept or reject any and/or all effort(s) by Bidder, Prospective Contractor, and Contractor. The following are examples of effort(s) that are acceptable by the Savannah Airport Commission.

a. Soliciting through all reasonable and available means (e.g. attendance at pre-bid meetings, advertising and/or written notices) the interest of all certified DBEs who have the capability to perform the work of the contract.

b. Selecting portions of the work to be performed by DBEs in order to increase the likelihood that the DBE goals will be achieved.

c. Providing interested DBEs with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation.

d. Negotiating in good faith with interested DBEs.

e. Not rejecting DBEs as being unqualified without sound reasons based on a thorough investigation of their capabilities.

f. Making efforts to assist interested DBEs in obtaining bonding, lines of credit, or insurance as required by the recipient or contractor.

g. Making efforts to assist interested DBEs in obtaining necessary equipment, supplies, materials, or related assistance or services.

h. Effectively using the services of available minority/women community organizations; minority/women contractors' groups; local, state, and Federal minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBEs.

K. CONTRACTOR ASSURANCES

Agreements between Bidder, Prospective Contractor, and Contractor and a DBE in which the DBE promises not to provide subcontracting quotations to other Bidders are prohibited. The Bidder, Prospective Contractor, and Contractor shall make a

good-faith effort to replace a DBE subcontractor, which is unable to perform successfully, with another DBE subcontractor. Substitutions must be coordinated with and approved by the Commission.

The Bidder, Prospective Contractor, and Contractor shall establish and maintain records and submit reports and cancelled checks, as required, which will identify and assess progress in achieving the DBE subcontract goal and other DBE affirmative action efforts.

In order to properly monitor payments to DBEs, the Savannah Airport Commission will require that the prime contractor send along with each payment to their DBE subcontractor or supplier a "Verification of Payments Received Letter", (Page P-12) which the DBE(s) must sign and return to the Commission's DBELO for monitoring and DBE Program record keeping purposes.

The Savannah Airport Commission will also require each prime contractor to submit to the Commission a monthly pay request that shall be accompanied by a "DBE Utilization Form" (Page p-13) which is a report of DBE expenditures. The report shall show all DBE subcontractors, and non-DBE subcontractors if and as required by the Commission, the amount of their subcontract, the amount earned to date, the amount earned for that respective pay request and the amount remaining to be earned. At the sole discretion of the Commission, the contractor's future pay requests will be withheld or disapproved until the DBE Utilization Form is submitted as required, and until DBEs are promptly and properly paid as verified by receipt of the Verification of Payments Received Letter (Page P-12).

Prior to the close out of the project, if and as required, the Prime Contractor shall furnish the Savannah Airport Commission copies of cancelled checks, invoices, and any other information from all DBE subcontractors utilized on the project.

Failure by the prime contractor to comply with these requirements may result in the prime contractor being placed in default of its contract. In addition, violation of this provision by the prime contractor entitles the Commission to exercise any other rights it has by law or under the Contract.

END OF DBE REQUIREMENTS

VERIFICATION OF PAYMENTS RECEIVED

_____ (Date)

Mr. Dawoud Stevenson
Disadvantaged Business Enterprise Liaison Officer
Savannah Airport Commission
400 Airways Avenue
Savannah, GA 31408

RE: Verification of Payments Received
COOLING TOWER NO. 1 UPGRADE

Dear Sir:

This letter is to certify that _____ (name of DBE firm) has received $_____ (dollar amount) from _____ (prime contractor). This amount represents payment for work performed from _____ (M/D/Y) to _____ (M/D/Y) which is _____% of the total contract amount of $_____.

Sincerely,

_____

(Type or Print name of person signing letter)

_____
Title

Personally appeared before me, the Undersigned Authority, _____ _____who is known to me to be an official of the firm of _____ who after being duly sworn stated his/her oath that he/she had read the above statement and that the same is true and correct.

This _____ day of _____; _____

_____
Notary Public

State of _____

My Commission Expires _____

DBE UTILIZATION FORM

Project Name: **COOLING TOWER NO. 1 UPGRADE**

Contractor (Company): _____

Address: _____

_____

Pay Request #: _____ From _____ To: _____

Subcontractor	DBE/Non-DBE	Work Item	Subcontract Amount	Amount Earned To Date	Amount This Pay Request	Amount Remaining

Signed: _____ Date: _____

Type or Print Name: _____

Title: _____

Personally appeared before me, the Undersigned Authority, _____ who is known to me to be an official of the firm of _____ who after being duly sworn, stated of his oath that he had read the above statement and that the same is true and correct.

This _____ day of _____, _____ Notary Public: _____

State of _____

(Non AIP Constr)
Revised June 2015

DISADVANTAGED BUSINESS ENTERPRISE ASSURANCE FORM

The Bidder, Prospective Contractor, or Contractor shall complete the following statement by checking the appropriate box (check one only). Failure to complete this statement shall be grounds for rejection of Bid.

_____ The Bidder, Prospective Contractor, or Contractor is able to assure meeting the requirements of the DBE Provisions, included under the DISADVANTAGED BUSINESS ENTERPRISE REQUIREMENTS, and shall utilize _____% (percent) Race-Neutral DBE participation.

_____
(Company Name of Bidder/Prospective Contractor/Contractor)
(Printed or Typed)

IRS Number: _____

_____
(Printed Name of Person Signing)

By: _____
(Signature)*

Title: _____

Date: _____

* - Must be same signature of Bid Proposal.

END OF DBE ASSURANCE

SAVANNAH AIRPORT COMMISSION

EQUAL OPPORTUNITY REPORT STATEMENT
as Required by
41 CFR 60-1.7(b)

The Bidder (Proposer) shall complete the following statement by checking the appropriate boxes. Failure to complete these blanks may be grounds for rejection of bid:

1. The Bidder (Proposer) has _____ has not _____ developed and has on file at each establishment affirmative action programs pursuant to 41 CFR 60-1.40 and 41 CFR 60-2.

2. The Bidder (Proposer) has _____ has not _____ participated in any previous contract or subcontract subject to the equal opportunity clause prescribed by Executive Order 11246, as amended.

3. The Bidder (Proposer) has _____ has not _____ filed with the Joint Reporting Committee the annual compliance report on Standard Form 100 (EEO-1 Report).

4. The Bidder (Proposer) does _____ does not _____ employ fifty (50) or more employees.

NAME OF BIDDER: _____

BY: _____

TITLE: _____

DATE: _____

SAVANNAH AIRPORT COMMISSION

BIDDER QUALIFICATION QUESTIONNAIRE

Submitted by_____
Name of Bidder

( ) An Individual _____

( ) A Partnership _____

( ) A Corporation _____

Principal Office Address:

_____

_____

The undersigned guarantees the truth and accuracy of all statements and all answers to questions hereinafter made.

1. How many years has your organization been in business as a contractor under your present name?

   _____

2. How many years experience in construction work has your organization had as a general contractor?

   _____

   As a subcontractor?

   _____

3. List below the requested information concerning projects your organization has completed in the last five (5) years for the type of work required in this project.

   _____

Project Title	Contract Amount	Required Completion Date	Actual Completion Date	Name and Address of Owner

4. Have you ever failed to complete any work awarded to you? If so, where and why?

5. Has any officer or partner of your organization ever been an officer or partner of some other organization that failed to complete a construction contract? If so, state name of individual, name of other organization, and the reason therefor.

6. Has any officer or partner of your organization ever failed to complete a construction contract handled in his own name? If so, state name of individual, name of owner and reason therefor.

7. Give below any information which would indicate the size and capacity of your organization, including number of employees, equipment owned by your organization, etc., which are available for utilization of this Contract.

8. List below the names and addresses of the subcontractors you may expect to employ on this Contract and a description of the work each subcontractor will perform.

Name and Address of Subcontractor	Description of Work

9. List below the sources of supply of the various materials you intend to incorporate in this Contract.

Source of Supply	Material

Name of Bidder: _____

Address of Bidder: _____

_____

By: _____
Title

Date: _____

Georgia Tax Registration No.: _____

Witness or Attest:

_____
(Corporate Seal)

Sworn to and subscribed before me this
_____ day of _____, 2017.

My commission expires:_____

_____
Notary Public

SAVANNAH AIRPORT COMMISSION

BID BOND

(NOT TO BE FILLED OUT IF A CERTIFIED CHECK IS SUBMITTED)

KNOW ALL MEN BY THESE PRESENTS: That we, the undersigned _____, as Principal, and _____, a Corporate Surety authorized under the laws of the State of _____ to do business in the State of _____, as surety, are held and firmly bound unto the Mayor and Aldermen of the City of Savannah and the Savannah Airport Commission in the sum of _____ ($_____) for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves and our heirs, executors, administrator, successors and assigns.

The condition of the above obligation is such that if the attached proposal of _____**($_____)** for the improvement of airport facilities, **COOLING TOWER NO. 1 UPGRADE,** stipulated in said proposal in accordance with the plans and specifications provided therefor, is accepted and the contract awarded to the above named Bidder, and the said Bidder shall within ten (10) days after notice of said award enter into a contract in writing and furnish the required Payment and Performance Bond with surety, or sureties, to be approved by the Mayor and Aldermen of the City of Savannah and the Savannah Airport Commission this obligation shall be void. Otherwise, the same shall be in full force and virtue of law, and the full amount of this Bid Bond will be paid to the Mayor and Aldermen of the City of Savannah and the Savannah Airport Commission as stipulated for liquidated damages.

Signed this _____ day of _____, 2017.

(Principal must indicate whether corporation, partnership, company or individual)

This person signing shall in his handwriting sign the principal's name, his own name, and his title. Where the person signing for a corporation is other than the President or Vice President, he must, by affidavit as contained herein, show his authority to bind the corporation.

_____
Principal

BY: _____

_____
Title

_____
Surety (Company Name)

_____
Surety (Signature)

Countersigned:

_____
Georgia Resident Agent

_____
Georgia License Number

BID SCHEDULE

In accordance with all bid documents, addenda, plans, and specifications, the undersigned proposes to furnish all services, material, labor, tools, equipment, and other means of construction required for **COOLING TOWER NO. 1 UPGRADE.**

Base Bid Written In Words: _____

_____ (Dollars) ($_____.)

NAME OF BIDDER: _____

BY: _____

TITLE: _____

BUSINESS _____

ADDRESS: _____

WITNESS: _____

WITNESS: _____

SAVANNAH AIRPORT COMMISSION

CONTRACT

This AGREEMENT, made and entered into this _____ day of _____ _____, 20____, by and between the Mayor and Aldermen of the City of Savannah and the Savannah Airport Commission, hereinafter designated the Owner, party of the first part, and _____ of the City of _____ and State of _____, hereinafter designated the Contractor, party of the second part,

W I T N E S S E T H:

That the parties to these presents, each in consideration of the undertakings, promises and agreements on the part of the other herein contained, have undertaken, promised and agreed, and do hereby undertake, promise, and agree, the party of the first part for itself, its successors, and assigns, and the part(y) (ies) of the second part for (its) (itself) and (its) (their) heirs, executors, administrators, successors, and assigns, as follows:

That the part(y) (ies) of the second part in consideration of the sums of money herein specified to be paid by said party of the first part to said part(y) (ies) of the second part, shall and will at (its) (their) own cost and expense furnish all labor, materials, tools, and equipment for the improvement of **Cooling Tower No. 1 Upgrade,** Savannah/Hilton Head International Airport, in accordance with the Notice to Bidders, Instructions to Bidders, Proposal, Bid Schedule, and Bonds hereto attached, and in accordance with Plans, Specifications, General Conditions, and Supplemental General Conditions therein referred to as the Contract Documents, are hereby made a part of this agreement, all of said work to be fully completed to the satisfaction of the Engineer and to the acceptance of and by the Mayor and Aldermen of the City of Savannah and the Savannah Airport Commission in the lump sum amount of _____ _____ dollars/cents ($_____).

If the Contractor shall fail to comply with any of the terms, conditions, provisions, or stipulations of this Contract, according to the true intent and meaning thereof, then the party of the first part may avail itself of any or all remedies provided in that behalf in the Contract and shall have the right and power to proceed in accordance with the provisions thereof.

That the Contractor shall commence the Work within ten (10) days of the date set by the Owner in a written Notice-To-Proceed and shall substantially complete all work under this Contract within sixty (60) consecutive calendar days after the date shown in the Notice-To-Proceed, and shall substantially complete the milestones in the CONSTRUCTION SCHEDULE below within the number of Calendar Days from the Notice-To-Proceed shown therein.

The Owner hereby agrees to pay to the Contractor for the said work the unit prices set forth in the BID SCHEDULE, at the times and manner set forth in the Contract Documents. Payment to the Contractor by the Owner shall be made upon presentation of the proper certificates to the Owner and upon terms set forth in the Contract Documents.

It is mutually agreed between the parties hereto that time is the essence of this Contract, and in the event the construction is not substantially complete by the Calendar Days specified below in COLUMN I of the CONSTRUCTION SCHEDULE, it is agreed that from any money due or to become due the Contractor or his Surety, the Owner may retain the dollar amount shown below in COLUMN II per Milestone per day for each calendar day thereafter, Sundays and Holidays included, that the work remains incomplete, not as a penalty but as liquidation of a reasonable portion of damages that will be incurred by the Owner by failure of the Contractor to complete the work within the times stipulated.

CONSTRUCTION SCHEDULE

	Column I Total Calendar Days After Notice-To-Proceed	Column II Liquidated Damages per Calendar Day if Not Completed by Calendar Days Shown on Column I
Final Completion	60	$500.00

IN WITNESS WHEREOF, the parties to the agreement have hereunto set their hands and seals and have executed this agreement the day and year first above written.

SAVANNAH AIRPORT COMMISSION

OWNER
(Party of the First Part)

BY: _____
Stephen S. Green, Chairman

ATTEST: _____
Gregory B. Kelly, Secretary
(Seal)

CONTRACTOR
(Party of the Second Part)

_____
Company

BY: _____
Name (Signature)

TITLE: _____
Title

_____
Name (Print/Type)
(Seal)

ATTEST: _____
Name (Signature)

TITLE: _____
Title

_____
Name (Print/Type)
(Seal)

Contractor must indicate whether Corporation, Partnership, Company or Individual

_____

_____
Out-of-state contractors must affix Georgia tax registration number.

The person signing shall in his own handwriting sign the principal's name, his own name, and his title. Where the person signing for a corporation is other than the President or Vice President, he must, by affidavit, as contained herein, show his authority to bind the corporation.

Corporate seal is required for all companies that are incorporated.

ARCH
Revised June 2015

SAVANNAH AIRPORT COMMISSION

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that _____, as Principal, hereinafter called Contractor, and _____ _____as Surety, hereinafter called Surety, are held and firmly bound unto the Mayor and Aldermen of the City of Savannah, Georgia and the Savannah Airport Commission as Obligee, hereinafter called Owner, in the amount of _____ _____ dollars ($_____) for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated _____, 20___, entered into a Contract with Owner for **Cooling Tower No. 1 Upgrade,** in accordance with all of the construction plans and contract documents listed in the specifications prepared by the Savannah Airport Commission., which Contract is by reference made a part hereof and is hereinafter referred to as the Contract.

NOW, THEREFORE, the condition of the above obligation is such that if the said Contractor shall well and faithfully perform the things agreed by him to be done and performed according to the terms of said Contract, and shall promptly make payments to all persons supplying labor, material, and supplies used directly or indirectly by the said Contractor, or subcontractor(s), in the prosecution of the work provided for in said Contract, we agreeing and assenting that this undertaking shall be for the benefit of any subcontractor, material men, or laborer having a just claim, as well as for the Obligee herein, 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 claims hereunder shall in no event exceed the amount of this obligation as herein stated.

The said Surety hereby stipulates and agrees that no modifications, omissions, or additions, in or to the terms of said Contract or on or to the plans and specifications therefor shall in any way affect the obligation of said Surety or its Bond.

The said Surety shall inform the Owner thirty (30) days prior to expiration of this bond, by giving notice by registered mail.

Signed and sealed this _____ day of _____, 20___.

Principal must indicate whether corporation, partnership, company or individual.

_____

_____
Principal

The person signing shall, in his own handwriting, sign the principal's name, his own name and his title. Where a person signing for a corporation is other than the President or Vice President, he must, by affidavit as contained herein, show his authority to bind the corporation.

BY: _____
Name (Signature)

_____
Name (Print/Type)

TITLE: _____

(Affix Contractor's Corporate Seal)

ATTEST BY: _____
Name (Signature)

_____
Name (Print/Type)

TITLE: _____

(Affix Surety's Corporate Seal)

_____
Surety

BY: _____
Name (Signature)

_____
Name (Print/Type)

COUNTERSIGNED:

_____
Georgia Resident Agent

_____
Georgia Resident Agent (Print/Type)

_____
Georgia License Number

SAVANNAH AIRPORT COMMISSION

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that _____, as Principal, hereinafter called Contractor, and _____, _____ as Surety, hereinafter called Surety, are held and firmly bound unto the Mayor and Aldermen of the City of Savannah, Georgia, and the Savannah Airport Commission as Obligee, hereinafter called Owner, in the amount of _____ _____ dollars ($_____) for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated _____, 20___, entered into a Contract with Owner for **Cooling Tower No. 1 Upgrade,** in accordance with all of the construction plans and contract documents listed in the specifications prepared by the Savannah Airport Commission which Contract is by reference made a part hereof and is hereinafter referred to as the Contract.

NOW, THEREFORE, the condition of the above obligation is such that if the said Contractor shall well and faithfully perform the things agreed by him to be done and performed according to the terms of said Contract, and shall promptly make payments to all persons supplying labor, material, and supplies used directly or indirectly by the said Contractor, or subcontractor(s), in the prosecution of the work provided for in said Contract, we agreeing and assenting that this undertaking shall be for the benefit of any subcontractor, material men, or laborer having a just claim, as well as for the Obligee herein, 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 claims hereunder shall in no event exceed the amount of this obligation as herein stated.

The said Surety hereby stipulates and agrees that no modifications, omissions, or additions, in or to the terms of said Contract or on or to the plans and specifications therefor shall in any way affect the obligation of said Surety or its Bond.

The said Surety further stipulates and agrees that in the event of a default or deficiency on the part of the Contractor amounting to a breach of the Contract, the Owner may, by giving notice by registered mail to Contractor and Surety, require that such default or deficiencies be remedied within thirty (30) days from the date of such notice. Failure so to remedy or to take proper steps to remedy such defaults or deficiencies within said period shall be cause for the Owner to require that Surety take over and prosecute the work under the Contract and to take over all obligations pertaining thereto. In the event the work under the Contract is taken over by the Surety in a manner satisfactory to the Owner, the Owner will pay to the Surety henceforth all amounts due and to become due under the Contract, including amendments, less the balance of the Contract price previously paid to the Contractor and less liquidated

damages, if assessed. The Owners shall not be liable for any monies not due on the Contract and shall not be made a party to any dispute between Contractor and Surety.

If the Surety does not take over the work in a satisfactory manner within thirty (30) days after the notice of default or does not proceed with completing the work in accordance with the Contract, the Owner shall have full power and authority, without impairing the obligation of the Contract or the Contract Bond, to take over the completion of the work; to appropriate or use any or all material and equipment that may be suitable; to enter into agreements and provisions thereof; or to use such other methods as may be required for completion of the Contract. The Contractor and his Surety shall be liable for all costs incurred by the Owner in completing the work and for all liquidated damages in conformity with the terms of the Contract. If the sum of such liquidated damages and the expense so incurred by the Owner is less than the sum which would have been payable under this Contract if it had been completed by the Contractor or his Surety, the Contractor or his Surety shall be entitled to receive the difference; and if the sum of such expense and such liquidated damages exceeds the sum which would have been payable under the Contract, the Contractor and his Surety shall be liable and shall pay to the Owner the amount of such excess. Notice to the Contractor shall be deemed to have been served when delivered to the man in charge of any office used by the Contractor, his representative at or near the work, or by registered mail addressed to the Contractor at his last known place of business.

The said Surety further stipulates and agrees that this bond is also given and made as a guarantee insuring the Owner against loss resulting from costs of repairing, replacing, or reconstructing any portion of the work performed or equipment furnished under the Contract, because of failure to perform as specified or from being defective in any manner whatsoever. This bond shall remain in full force and effect for a period of one year after the date of written recommendation and of acceptance by the Engineer to the Owner.

The said Surety shall inform the Owner thirty (30) days prior to expiration of this bond, by giving notice by registered mail.

Signed and sealed this _____ day of _____, 20___.

Principal must indicate whether corporation, partnership, company or individual.

_____

_____
Principal

The person signing shall, in his own handwriting, sign the principal's name, his own name and his title. Where a person signing for a corporation is other than the President or Vice President, he must, by affidavit as contained herein, show his authority to bind the corporation.

BY: _____
Name (Signature)

_____
Name (Print/Type)

TITLE: _____

(Affix Contractor's Corporate Seal)

ATTEST BY: _____
Name (Signature)

_____
Name (Print/Type)

TITLE: _____

(Affix Surety's Corporate Seal)

_____
Surety

BY: _____
Name (Signature)

_____
Name (Print/Type)

COUNTERSIGNED:

_____
Georgia Resident Agent

_____
Georgia Resident Agent (Print/Type)

_____
Georgia License Number

SAVANNAH AIRPORT COMMISSION

BOND AFFIDAVIT

State of _____

County of _____

Before me, the undersigned authority, personally appeared _____ _____, who, being duly sworn, deposes and says that he is a duly authorized (resident) (nonresident) insurance agent, properly licensed under the laws of the State of _____ and the State of Georgia, to represent _____of _____, a company authorized to make corporate surety bonds under the laws of the State of Georgia.

Said _____ further certifies that as Attorney-in-fact for the said _____ he has signed the attached bond in the sum of _____ (U. S. $_____) on behalf of _____ covering Savannah/Hilton Head International Airport, Savannah Airport Commission, Savannah, Georgia for the following project: **Cooling Tower No. 1 Upgrade**.

Said _____ further certifies that the premium on the said bond is _____ which will be paid in full direct to him as Attorney-in-fact, and included in his regular accounts to the said _____, and that he will receive his regular commission of _____ percent as Attorney-in-fact for the execution of said Bond and that his commission will not be divided with anyone except as follows: _____ percent to _____, who is duly authorized resident insurance agent and properly licensed under the laws of the State of Georgia.

_____
Agent and Attorney-in-fact

COUNTERSIGNED:

_____
Georgia Resident Agent

_____
Georgia Resident Agent (Print/Type)

_____
Georgia License Number

Acknowledgement for Attorney-in-fact

Sworn to and subscribed before me this
_____ day of _____
_____, A. D. 20___.

_____
Notary Public,

State of _____

My Commission expires_____

ARCH
Revised June 2015

GENERAL CONDITIONS

1. SUMMARY OF WORK

a. This project consists of providing all labor and materials to refurbish Cooling Tower No. 1 which will include, but not be limited to, the addition of variable frequency drives, fill, motor, pump assembly, fan drive, flow sensors, and other items as noted in the plans and specifications.

b. The location of the project is at the Savannah/Hilton Head International Airport, Savannah, Georgia.

c. The Owner for whom this work shall be executed is the Savannah Airport Commission, 400 Airways Avenue, Savannah, Georgia 31408.

2. AIRPORT RULES AND REGULATIONS

Contractor(s) shall be responsible for informing all employees concerning pertinent airport and Federal Aviation Administration rules and regulations. Contractor(s) shall conform with all rules and regulations and directives issued either orally or in writing by the Owner or his representative. All pertinent local, state and federal safety requirements shall be observed by the Contractor(s) and Contractor(s)' personnel. Contractor(s) shall execute a Hold Harmless Agreement with the Savannah Airport Commission, which form shall be furnished by the Airport Commission.

3. BURNING

Burning is permitted on airport property by obtaining a permit from local government agencies.

4. ACCIDENTS

All accidents causing personal injury or property damage shall be reported to the Executive Director or his representative immediately. The contractor(s) shall provide, at the site, such equipment and medical facilities as are necessary to supply first aid service to anyone who may be injured in connection with the performance of the work, whether on or adjacent to the site, which causes death, personal injury, or property damage, giving full details and statements of witnesses. in addition, if death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone to the Executive Director or his representative and the Project Engineer.

5. SANITARY FACILITIES

The Contractor shall furnish temporary sanitary facilities for his employees.

6. NOTICE TO PROCEED

The Notice to Proceed shall state the date on which it is expected the Contractor will begin the work and from which date the contract time will be charged. The Contractor shall begin the work to be performed under the contract within ten (10) calendar days of the date written by the Owner in the Notice to Proceed, but in any event, he shall notify the Owner at least 24 hours in advance of the time actual construction operations will begin.

7. SEQUENCE OF WORK

Work shall be phased in a way to minimize impacts to the operation of aircraft-related activity. Prior to construction, the contractor shall submit a plan based on completion of the work in the following phasing order: Gates 2, 4, 6, 8, 10, 9, 7, 5, 3, 1. The plan shall be approved by the Savannah Airport Commission.

8. CONTRACT TIME AND LIQUIDATED DAMAGES

a. The number of calendar days for the completion of the project shall be sixty (60) calendar days from the date of the Notice to Proceed.

b. For each calendar day that any work remains uncompleted after the contract time (including all approved extensions in time and adjustments), the sum of $500 per calendar day as liquidated damages shall be deducted from any money due or to become due to the Contractor for his surety.

9. EXTENSION OF CONTRACT TIME

If the Contractor finds it impossible for reasons beyond his control to complete the work within the contract time as specified, the Contractor may, at any time prior to the expiration of the contract time, make a written request to the Owner for an extension of time, setting forth the reasons which he believes will justify the granting of his request. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Owner finds that the work was delayed because of conditions beyond the control and without the fault of the Contractor, the Owner may extend the time for completion in such amount as the conditions justify. The extended time of completion shall then be in full force and effect, the same as though it were the original time for completion.

10. PREVAILING WAGE RATES

The construction wage rates have been furnished and compiled by the City of Savannah and certified by the U. S. Department of Labor to be wages prevailing for construction of projects in the Chatham County area. In accordance with the terms of the Proposal, the Contractor agrees to pay to each employee of the corresponding craft at least the wage rate listed.

In addition to the basic hourly rates shown, certain crafts, trades or industries indicate health, welfare, pension, and other fringe benefits which are given employees pursuant to a bonafide Collective Bargaining Agreement for the respective craft, trade, or industry. In the absence of any such Agreement, the basic hourly rates plus the monetary equivalent for the fringe benefit payments indicated, less any legal deductions, shall be paid directly to the employees.

If the wage rate determination of the U. S. Department of Labor incorporated in the following page does not include rates for requested classifications, the Bidder is responsible for ascertaining the rates payable for such classifications and whether area practice requires their use in accomplishing the work. No inference concerning area practice is to be drawn from this omission. Further, the omission will not, per se, establish any liability for increased labor cost resulting from the use of such classifications.

The Contractor and Subcontractors at any tier shall make and submit a copy of, to the Savannah Airport Commission, within seven (7) days, a record of all payments for labor with an affidavit that the weekly wages paid are not less than the applicable wage rates contained in the wage determination incorporated into the contract and that the classifications set forth therein for each laborer and mechanic conforms with the work he/she performed. Such records shall contain the name of the individual, his/her classification, the hourly rate, the number of hours worked, and the total amount paid including any and all deductions/withholdings for all individuals who provided and were paid via any means for labor on this project. Records shall be made, and copies provided to the Owner with each pay request, of all payments of any kind (including cash, check, voucher, or any other type of remuneration) to any individual (including employees, subcontractors, independent contractors, day laborers, or anybody else) who performed labor on this project for any kind of compensation whatsoever. Every pay request shall also include a copy of a record of Workers' compensation paid for any and all persons paid in any manner for labor of any type on this project.

The Contractor shall post and maintain a copy of the wage determination at the Contractor's field office or any other location as directed by the Savannah Airport Commission.

General Decision Number: GA170129 04/28/2017 GA129

Superseded General Decision Number: GA20160129

State: Georgia

Construction Type: Building

County: Chatham County in Georgia.

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.20 for calendar year 2017 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, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.20 (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2017. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/06/2017
1	04/28/2017

BOIL0026-001 01/01/2013

	Rates	Fringes
BOILERMAKER	$ 24.91	19.69

ENGI0474-002 07/01/2013

	Rates	Fringes
POWER EQUIPMENT OPERATOR:		
Bobcat/Skid Steer/Skid Loader, Bulldozer, Forklift (under 15 tons), and Loader	$ 22.72	12.30
Crane (over 10 tons) and Forklift (15 tons and over)	$ 24.55	12.30
Crane (over 120 tons)	$ 25.55	12.30
Crane (over 250 tons)	$ 26.55	12.30
Oiler	$ 20.38	12.30

PLUM0188-001 08/01/2016

	Rates	Fringes
PIPEFITTER	$ 26.40	14.05
PLUMBER (Including HVAC Pipe Installation)	$ 26.40	14.05

* SFGA0669-001 04/01/2017

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers)	$ 28.54	15.84

SHEE0085-002 08/01/2012

	Rates	Fringes
SHEET METAL WORKER (Excluding HVAC Duct and Metal Roof Installation)	$ 28.34	11.55

SUGA2012-036 08/11/2012

	Rates	Fringes
BRICKLAYER	$ 16.00	0.00
CARPENTER	$ 18.50	0.35
CEMENT MASON/CONCRETE FINISHER	$ 15.90	2.66
ELECTRICIAN (Low Voltage Wiring)	$ 18.00	1.67
ELECTRICIAN, Excludes Low Voltage Wiring	$ 19.95	5.56
GLAZIER	$ 16.42	2.00
IRONWORKER, REINFORCING	$ 20.48	8.41
IRONWORKER, STRUCTURAL	$ 21.00	0.00
LABORER: Common or General	$ 11.81	1.15
LABORER: Mason Tender - Brick	$ 9.00	0.00
LABORER: Pipelayer	$ 12.00	0.23
LABORER: Plaster Tender	$ 11.00	0.00
OPERATOR: Backhoe/Excavator	$ 12.00	0.46
OPERATOR: Grader/Blade	$ 17.52	0.00
PAINTER: Brush, Roller and Spray	$ 16.00	1.62
PLASTERER	$ 16.00	0.00
ROOFER, Excludes Installation of Metal Roofs	$ 11.38	0.00
SHEET METAL WORKER (HVAC Duct Installation Only)	$ 16.88	2.53
SHEET METAL WORKER (Metal Roofs Installation)	$ 15.56	0.00

TILE FINISHER.....$ 10.31 0.00

TILE SETTER.....$ 14.00 0.54

TRUCK DRIVER: Dump Truck.....$ 13.61 0.00

TRUCK DRIVER: Lowboy Truck.....$ 17.41 0.00

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

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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 www.dol.gov/whd/govcontracts.

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 Regional Office for the area in which the survey was conducted because those Regional Offices have 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.

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END OF GENERAL DECISION

11. CONTRACTOR'S AND SUBCONTRACTOR'S RECORDS

a. The Contractor and all Subcontractors, at any tier, shall maintain for a period of not less than three (3) years from the date of final payment all books, records, documents, and papers pertaining to the contract.

b. The Contractor and all Subcontractors, at any tier, shall provide to the City of Savannah, the Savannah Airport Commission, the FAA, or any other Federal or State agency, the Comptroller General of the United States, or any of their duly authorized representatives access to all such books, documents, papers and records, pertaining to the contract for the purposes of examining, auditing and copying them.

12. INSURANCE REQUIREMENTS

The Contractor shall obtain and maintain with a company or companies authorized to do business in the State of Georgia, and approved by the Savannah Airport Commission, such insurance as will protect the Commission, and Contractor, from claims set forth below which may arise out of or result from Contractor's operations under the contract and for which the Contractor is legally liable, which includes operations by subcontractors, subcontractor's/subcontractors, or by any persons directly or indirectly employed by Contractor or Subcontractor.

a. Claims under workers' compensation, disability benefit, and other similar employee benefit acts. Further, Contractor shall relieve the Commission from any costs due to accidents or other liabilities mentioned in workers' compensation act. Contractor or subcontractors with either an insufficient number of employees or in certain excluded occupational classifications are required to maintain WORKERS' compensation coverage on a voluntary basis regardless of the statutory regulations. If the Contractor is from a state other than Georgia, before work begins he shall take whatever measures are necessary to eliminate conflicts regarding which state is responsible for WORKERS' compensation claims.

b. Claims for damages because of bodily injury, occupational sickness or disease, or death of his employees.

c. Claims for damages because of bodily injury, sickness or disease, or death of any person other than his employees.

d. Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the Contractor, or (2) by another person.

e. Claims for damages, other than to the work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom.

f. Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle.

The insurance required above, shall be written for not less than the following amounts, or greater if required by law:

a. Workers' Compensation:

Georgia Statutory

Employer's Liability, including all states

$1,000,000 - each accident
$1,000,000 - disease - policy limit
$1,000,000 - disease - each employee

b. Comprehensive General Liability: shall include all major divisions of coverage and be on a comprehensive basis including, but not limited to:

Premises, operations, including explosion, collapse and underground; Independent Contractors' Protective; Products and Completed Operations; Broad Form Property Damage including completed operations; Contractual Liability; Personal Injury Liability with employment exclusion deleted. Must include projects at airports.

Bodily Injury and Property Damage Limits: $1,000,000 combined single limit, each occurrence

Products and Completed Operations:
Insurance to be maintained for three (3) years
after issuance of the final certificate for payment.

c. Mobile Equip/Comprehensive Vehicle Liability:

(Owned, non-owned, and hired.)

Bodily Injury/Property Damage Combined:

$1,000,000 combined single limit, each occurrence

d. Umbrella/Excess Liability:

Umbrella/Excess Liability insurance covering all liability lines excess of the primary limits. The total limits of liability for each coverage including primary and umbrella coverages shall be no less than $5,000,000 combined single limit – each occurrence.

e. Builders Risk (Property Insurance):
(IF APPLICABLE TO THE TYPE OF CONSTRUCTION)
Shall be purchased and maintained by the Contractor covering the entire Work at the site to the full insurable value thereof, including stockpiled material at the construction site intended for incorporation into the project.

Also, such insurance shall be in a company or companies against which Commission has no reasonable objection, and shall include the interest of the Commission, the Contractor, and Subcontractors in the Work. Such insurance shall insure against the perils of Fire, Extended Coverage, Theft, Vandalism and Malicious Mischief, and all other risks. If the Commission is damaged by the failure of the Contractor to maintain such insurance and to so notify the Commission, then the Contractor shall bear all reasonable costs properly attributable thereto. If not covered under such insurance or otherwise provided in the contract documents applicable to constructions, the Contractor shall effect and maintain similar Property Insurance on the Work stored off the site or in transit when such portions of the work are to be included in an application for payment under the contract.

The insurance required above should include contractual liability insurance applicable to the Contractor's obligations.

Detailed Information Relating to Insurance:

a. The Savannah Airport Commission requires that ALL LIABILITY POLICIES must be **ENDORSED** to include **the Mayor and Aldermen of the City of Savannah and the Savannah Airport Commission, its officers, directors, agents and employees as ADDITIONAL INSURED**. This must be reflected on the Certificate of Insurance which shall be furnished to the Commission. The Certificate of Insurance shall evidence proper limits of coverage as set forth herein and that the policy or policies will not be cancelled or modified without thirty (30) days prior written notice thereof is given to the Savannah Airport Commission. The Certificate shall also reflect that all policies have been endorsed to include waivers of any and all subrogation. The Contractor shall also require its subcontractors and subcontractors/subcontractors to endorse their policies to include **the Mayor and Aldermen of the City of Savannah and the Savannah Airport Commission, its officers, directors, agents and employees as ADDITIONAL INSURED**.

b. The extent of coverage or limits of liability provided under the policies procured by the Contractor and/or Subcontractors shall not be construed to be a limitation on the nature or extent of the Contractor's obligations or to relieve the Contractor of any such obligations or representation by the Savannah Airport Commission as to the adequacy of the insurance to protect the Contractor against the obligations imposed on him by law or by this or any other contract. All policies shall be primary and non contributory.

c. Immediate notification must be given to the Savannah Airport Commission and/or its agent upon receiving any knowledge or notification of claim or litigation on which the Savannah Airport Commission may be named.

d. The Contractor shall indemnify, protect, defend, and hold completely harmless the Commission, and its officers, agents and employees from and against any and all liabilities, losses, suits, claims, judgments, fines, or demands arising by reason of injury or death of any person or damage to any property, including all reasonable costs for investigation and defense thereof (including but not limited to attorney fees, court costs, and expert fees), of any nature whatsoever arising out of or incident to this contract and/or the use of occupancy of the leased premises or the acts or omissions of Contractor's officers, agents, employees, contractors, subcontractors, licensees, or invitees, regardless of where the injury, death, or damage may occur, unless such injury, death or damage is caused by the sole negligence of the Commission. The Commission shall give to Contractor reasonable notice of any such claims or actions. The Contractor shall also use counsel reasonably acceptable to Commission in carrying out its obligations hereunder.

All policies shall be endorsed to include waivers of any and all subrogation.

13. SAFETY

a. Airport safety is an extremely important element of managing and operating today's airport. Specific rules, regulations, advisory circulars and guidelines are placed upon the airport owner/operator to improve safety on airports and to protect its users, tenants, and neighbors.

(1) Entry Into the Air Operations Area - Entry shall be by gate(s) designated by the Executive Director or his representative. The Contractor shall be responsible for gate security. No personal vehicles owned by Contractor's employees or subcontractors shall be allowed on the airfield at any time.

(2) Communications - Radio contact with the control tower must be maintained by all Contractor vehicles on the airfield. Vehicles must contact the control tower upon entering active runway, taxiway, or apron area where aircraft are moving or are subject to move; and if working within five hundred (500) feet of the centerline of any active runway or two hundred (200) feet of the centerline of any (active) taxiway, the Contractor shall maintain radio contact with the control tower at all times. If the Contractor has vehicles with no radio, then such vehicles shall form a convoy and follow a vehicle having two-way radio contact with the control tower. Contractors working in runway clear zones shall maintain constant radio contact with the control tower. The Contractor shall be responsible for supplying his own radios.

The Contractor shall reimburse the Airport Commission for the full amount of any fines placed on the Airport Commission due to an unauthorized crossing of an active runway or taxiway by the Contractor or any of his subcontractors.

(3) Flags - All vehicles, upon entering the Air Operations Area shall display an orange and white-checkered flag, staff mounted, of not less than three (3) feet square displayed on the vehicle. Cranes, backhoes, and similar equipment working within five hundred (500) feet of the centerline or runways and two hundred (200) feet of taxiways and in clear zones, shall display the same size and type of flag specified for vehicles attached to the boom. Crane booms shall be lowered when not in use.

(4) Storage Area

a. Material or personal vehicular storage area shall be assigned by the Executive Director or his representative.

b. Materials to be stored on airport property shall not create an obstruction to air navigation nor shall they interfere with the free unobstructed movement of aircraft.

c. Loose materials capable of causing damage to aircraft landing gears, propellers, or being ingested in jet engines, shall not be stored on or around active aircraft movement areas.

d. Stockpiled material will be constrained in a manner to prevent movement resulting from aircraft blast or wind conditions in excess of 10 knots. Stockpiled material shall be prominently marked with orange flags and lighted with flashing yellow lights during hours of restricted visibility.

e. The Contractor shall be responsible for the security of his material and equipment.

(5) Open Trenches

a. All open trenches, excavations within the Air Operations Area, shall be marked by lighted and flagged barricades. Barricades shall be alternate orange and white markings with flashing yellow lights and a maximum of 18 inches in height. Barricades adjacent to runways or taxiway pavement areas shall be required to be secured in such manner to prevent tipping over. Flags shall be orange and white, staff mounted, and not less than 20" x 20". All barricades shall be subject to approval by the Executive Director. The Contractor shall provide the name and phone number of two individuals to be on call 24 hours per day for emergency maintenance of barricade lighting.

b. All construction work closer than one hundred twenty-five (125) feet of the edge of a runway or eighty-five (85) feet from the edge of a taxiway will require temporary closing of the runway or taxiway. Temporarily closed taxiways shall be marked by lighted and weighted barricades as shown on the plans. Temporarily closed runways shall be marked with a cross placed on the runway numbers by the Savannah Airport Commission.

c. Prior to beginning any excavation within two hundred (200) feet of the centerline of any runway or taxiway, the Contractor shall notify the Executive Director or his representative. All trench excavation within the Air Operations Area shall be backfilled and compacted at the end of each work day.

d. Construction equipment or material shall not be stored within the Air Operations Area during hours of restricted visibility or darkness without the approval of the Executive Director or his representative.

e. Open flame welding or torch cutting operations are prohibited unless fire and safety precautions are provided in accordance with NFPA codes and approved by the Owner. Open flame welding or torch cutting will be permitted on Airport property by obtaining a permit from the Airport Fire Department.

Any use of oxygen'/acetylene welding equipment or open flame equipment shall require the Contractor to obtain a permit from the Airport Fire Chief.

(6) Motorized Vehicles

a. Vehicular traffic crossing active aircraft movement areas (runways, taxiways or aircraft parking aprons) shall be controlled either by two-way radio contact with the control tower, by escort, flagman, signal lights, or other appropriate means as approved by the FAA Control Tower Chief. After receiving clearance from the Control Tower, the driver's personal observation that no aircraft is approaching his position will be made before he makes any crossing of active taxiway or runway. **THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPLYING HIS OWN RADIOS.**

b. Contractor(s) shall post two (2) crossing guards, one (1) on each side of all active aircraft movement areas (runways, taxiways and aircraft movement areas (runways, taxiways and aircraft parking aprons). Each crossing guard shall be equipped with a portable two-way radio (121.90 MHz) and

maintain constant radio contact with the control tower. All vehicular traffic shall come to a complete stop at all active aircraft movement areas and shall not proceed into active aircraft movement areas without authorization from the control tower. **THE CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPLYING HIS OWN RADIOS.**

c. If it is desirable to clearly identify the vehicles for control purposes by either assigned initials or numbers, then the identifying symbol shall be of eight (8) inch minimum, block-style character of a color easily read. Symbols may be applied by use of tape or water soluble paint.

d. Motorized vehicles and equipment operating in the AOA shall not exceed fifteen (15) miles per hour.

e. Aircraft shall have priority over all motorized vehicles and equipment.

(7) Disposal of Debris

All construction debris shall be disposed of off airport property in accordance with all federal, state and local laws. All clean fill material shall remain the property of the Savannah Airport Commission and be disposed of on airport property as directed by the Savannah Airport Commission.

(8) NOTAMS - Construction NOTAMS shall be issued by the Executive Director or his representative. Construction causing runway or taxiway closures shall be kept to a minimum and scheduled closures shall be discussed with the Executive Director or his representative as far in advance as possible, but not less than forty-eight (48) hours in advance. Landing and taking off of scheduled airlines shall have priority.

(9) Erosion - Contractor(s) shall consider permanent means of control or prevention of soil erosion not only to preserve and protect the slopes, pavement and other facilities, but also to reduce potential sources of water pollution.

(10) All electrical and control cables shall be buried a minimum of thirty-six (36) inches below the surface of the ground.

14. SECURITY

Contractor shall be responsible for the security of his equipment and materials. He shall be responsible for the security of all perimeter security gates, terminal doors and hatches leading to secure areas utilized by him. As directed by the Executive Director, locks shall be placed on each gate used by the Contractor. The locks must be

marked in a manner showing company ownership and a key or combination provided to the Airport Public Safety Department. The gates shall be locked at all times or guards posted at the gates to control access through them. Gate guards shall have a radio or cellular phone which will enable them to call the Police to report security problems or the contractor to verify identities, etc. For joint use gates, if a lock is found unsecured, the company owning the lock is in violation of Airport Rules and Regulations. In addition, unauthorized entry to the Air Operations Area through the gates may result in the responsible party being cited for violating Airport Regulations.

a. The Transportation Security Administration Act 2002, 49 USC, 67FR8355, gives the Transportation Security Administration (TSA) authority to place a fine on any airport found to be in breach of a security requirement.

b. The Contractor shall reimburse the Airport Commission for the full amount of any fines placed on the Airport Commission due to negligence on the part of the Contractor. Fines may be placed on the Airport Commission for such things as security gates being unlocked, terminal doors not secure, fences torn down, and Air Operations Area not being properly secured. These are only examples of items causing fines and not limitations. There could be other related items.

c. It is the Contractor's responsibility to prevent any breach of security within his area of construction or any route of entry to area of construction.

d. Security Clearances - All personnel having unescorted access to any security restricted area shall wear valid Savannah International Airport identification badges so they are visible on their outer garments in such areas at all times to permit ready recognition by Airport Public Safety Officers. Contractors' employees may be issued any one of the below listed Security Identification, etc. badges.

1. The Airport Identification Badges are issued to approved personnel in several colors:

    a. Brown/Black – Issued to personnel requiring unlimited access inside the secured SIDA.

        1. Effective December 6, 2002, the TSA requires anyone requesting unescorted access to the SIDA shall be fingerprinted, a background check performed, and results returned prior to ID Badge being issued. **No exceptions.** This process takes 2 – 3 weeks. Anyone applying for badges shall submit application as soon as possible to ensure fingerprints / criminal history records are returned prior to start date of project.
        2. The cost for processing is $30.00 per person. Everyone receiving a blue/pink ID Badge must be fingerprinted.

b. Yellow – Issued to contractors working in the vicinity of the aircraft movement area in order to perform their required duties. Persons with yellow badges may NOT enter the secured SIDA.

c.. Red – Issued to contractors working in the 1542.203 area who do not need access in the vicinity of the aircraft movement area or taxiways to perform their required duties. Persons with red badges may NOT enter the secured SIDA.

d. Blue/Pink – Issued to general aviation and tenants who require incidental access to the 1542.203 areas. Persons with blue/pink badges may NOT enter the secured SIDA.

2. The color of the badge signifies the area on the airport where the badge holder may operate.

a. Identification badges must be controlled at all times. When personnel are terminated, upon completion of the construction project, and when badges expire, the Contractor is responsible for returning identification badges to the Airport Public Safety Department. Before a new badge is issued to any person, their expired or invalid badge must be returned to the Airport Public Safety Department.

Upon completion of a project, it will be the responsibility of the General Contractor to collect all badges issued under his contract. Subcontractors are responsible for collecting their badges. Before final payment is made on the project, a written notification from the Airport Public Safety Department will be given to the Director of Engineering. The written notice will state the number of badges issued and the number of badges returned.

b. A fee of $15.00 (without reader), $22.00 (with reader), payable in advance, is charged for each badge issued. Each Contractor and subcontractor shall make a cash deposit of $100 prior to receiving any badges. This deposit is refundable providing all badges have been returned. For each badge not returned by the Contractor or subcontractor, $100.00 will be deducted from any monies due the Contractor or his surety. All costs, i.e., ID Badge, fingerprint requirements, and deposit(s) shall be paid in advance.

c. The Contractor shall be required to comply with the Transportation Security Administration Amendment to Part 1542.209 prior to commencing work. All personnel hired after December 6, 2002, who have unescorted access to any area on the airport controlled for security reasons shall have background checks to the extent allowable by law, including at

a minimum, references and prior employment histories to the extent necessary to verify representations made by the employee/applicant relative to employment in the preceding ten (10) years. The Contractor shall certify to the Commission by using SAC Form 513 that such checks were conducted and are on file in the Contractor's office for inspection by the Transportation Security Administration (TSA) or Savannah Airport Commission representatives.

d. The Contractor shall designate a Signatory Authority and provide the name of the signatory to the Savannah Airport Commission. The Signatory Authority functions as the certification officer for the company and is required to fulfill the following additional requirements associated with Signatory Authority.

1. Initial Signatory Training.
11. Annual recurrent signatory training.
111. SIDA Training.
IV. Failure to designate a Signatory or failure of this Signatory to complete the training requirement will be cause for the SAC to cease issuing badges for the contractor.

e. SAC Form 513 shall be used by the Contractor whenever certifying identification badges. Only the Contractor Signatory Authority, who shall be designated in writing, shall sign SAC Form 513.

f. All badge requests and background forms shall be turned in forty-eight (48) hours in advance. Once approved, all badge holders shall attend SIDA Contractor's badge and/or airfield drivers training classes.

g. Any person found within any security restricted area without proper identification shall be in violation of Federal law and the Airport Rules and Regulations. All such persons shall be escorted off the Air Operations Area and may be cited by the Airport Public Safety Department. In addition, the person may have their identification badge revoked.

h. Any delay in construction of project due to violations of Federal or Airport Regulations shall be absorbed by the Contractor and not the Airport Commission.

15. AFFIDAVIT AND FINAL PAYMENT

Before any periodic pay estimate or the final payment under this contract is made, the Contractor shall submit to the Owner a Contractor's Affidavit of Payment of Debts and Claims and a Contractor's Affidavit of Release of Liens. (See Page GC-15 and GC-16.)

AFFIDAVIT

Contractor's Affidavit of Payment of Debts, Claims and Release of Liens.

Whereas a contract was entered into on _____, between the Savannah Airport Commission and _____ for construction of **Cooling Tower No. 1 Upgrade.**

The undersigned hereby certifies that all work under the above contract has been performed in accordance with the terms thereof, that all materialmen, subcontractors, mechanics, and laborers have been paid and satisfied in full, and that there are no outstanding claims of any character including disputed claims or any claims to which the contractor/party has or will asset any defense arising out of the performance of the contract which have not been paid and satisfied in full.

The undersigned further certifies that to the best of his knowledge and belief there are no unsatisfied claims for damages resulting from injury or death to any employees, subcontractors, or the public at large arising out of the performance of the contract, or any suits or claims for any other damage of any kind, nature, or description which might constitute a lien upon the property of the Owner.

The undersigned makes this affidavit as provided by law for the purpose of receiving payment for work performed during this contract of all claims against the Owner arising under or by virtue of this contract. Acceptance of such payment is acknowledged as a release of the Owner form any and all claims arising under or by virtue of this contract.

This pay period from _____ to _____

Signature _____

Title _____

Company _____

Personally appeared before me, the Undersigned Authority, _____ _____ who is known to me to be an official of the firm of _____ who after being duly sworn, stated of his oath that he had read the above statement and that the same is true and correct.

This _____ day of _____, 2017.

_____
Notary Public, State of

_____,

My Commission expires _____.

PERIODIC PAY REQUEST

AFFIDAVIT

Contractor's Affidavit of Payment of Debts, Claims and Release of Liens

Whereas a contract was entered into on _____, between the Savannah Airport Commission and _____ for construction of **Cooling Tower No. 1 Upgrade.**

The undersigned hereby certifies that all work under the above contract has been performed in accordance with the terms thereof, that all materialmen, subcontractors, mechanics, and laborers have been paid and satisfied in full, and that there are no outstanding claims of any character including disputed claims or any claims to which the contractor/party has or will asset any defense arising out of the performance of the contract which have not been paid and satisfied in full.

The undersigned further certifies that to the best of his knowledge and belief there are no unsatisfied claims for damages resulting from injury or death to any employees, subcontractors, or the public at large arising out of the performance of the contract, or any suits or claims for any other damage of any kind, nature, or description which might constitute a lien upon the property of the owner.

The undersigned makes this affidavit as provided by law for the purpose of receiving final payment in full settlement for work performed during this contract of all claims against the owner arising under or by virtue of this contract. Acceptance of such payment is acknowledged as a release of the owner from any and all claims arising under or by virtue of this contract.

This _____ day of _____, 2017.

Signature _____

Title _____

Company _____

Personally appeared before me, the Undersigned Authority, _____ who is known to me to be an official of the firm of _____ who after being duly sworn, stated of his oath that he had read the above statement and that the same is true and correct.

This _____ day of _____, _____.

_____
Notary Public, State of

_____,

My Commission expires _____.

FINAL PAY REQUEST

16. PAYMENT FOR MATERIALS ON HAND

a. Partial payments may be made to the extent of the delivered cost of non-perishable materials to be incorporated in the work, provided that such materials meet the requirements of the contract, plans, and specifications and are delivered to acceptable sites on the airport property or at other sites in the vicinity that are acceptable to the Owner. Such delivered costs of stored or stockpiled materials may be included in the next partial payment after the following conditions are met:

1. The materials have been stored or stockpiled in a manner acceptable to the Engineer at or an approved site.

2. The Contractor has furnished the Engineer with acceptable evidence of the quantity and quality of such stored or stockpiled materials.

3. The Contractor has furnished the Engineer with satisfactory evidence that the material and transportation costs have been paid.

4. The Contractor has furnished the Owner legal title (free of liens or encumbrances of any kind) to the material so stored or stockpiled, if requested.

5. The Contractor has furnished the Owner evidence that the material so stored or stockpiled is insured against loss by damage or to disappearance of such materials at any time prior to use in the work.

6. The value of the delivered material to be used in one item of work exceeds $3,000 and is not scheduled to be incorporated into the work within 60 days after delivery.

b. It is understood and agreed that the transfer of title and the Owner's payment for such stored or stockpiled materials shall in no way relieve the Contractor of his responsibility for furnishing and placing such materials in accordance with the requirements of the contracts, plans, and specifications.

c. In no case will the amount of partial payments for materials on-hand exceed the contract price for such materials or the contract price for the contract item in which the material is intended to be used.

d. No partial payments will be made for stored or stockpiled living or perishable plant materials.

e. The Contractor shall bear all costs associated with the partial payment of stored or stockpiled materials in accordance with the provisions of this subsection.

17. WARRANTIES AND GUARANTEES

The Contractor shall furnish to the Owner written warranties on all equipment and material furnished on this contract. The Contractor will guarantee to the Owner that he will replace, repair, and make good any and all failures of his work, including all labor and material required to repair or replace all failed work for a period of 12 months beginning at the date of written acceptance of the project. If an item fails or has to be replaced within that 12 month period, he will, upon replacement or repair, guarantee that item for an amount of time that will equal 12 months from the date of repair or replacement.

18. AS BUILT PLANS

The Contractor shall note on a set of plans any and all changes made to the plans, to include dimensions and reference points of the changes made. Any authorized changes made to the plans will be noted on the plans. all uncharted utilities or structures encountered during construction will be noted and located on the plans. This set of marked up as built plans will be submitted to the Owner prior to final payment being made on the project.

19. PROTECTION OF AIRPORT, CABLES, CONTROLS, NAVAIDS, AND WEATHER BUREAU FACILITIES

a. The Contractor is hereby informed that there are installed on the airport FAA Navaids, including, without limitation, ASR, UHF, and VHF receivers and transmitters; U.S. Weather Bureau facilities; airfield lighting systems; electric cables and controls relating to such Navaids and facilities. Such Navaids, Weather Bureau and other facilities, and electric fables must be fully protected during the entire construction time. Work under this contract can be accomplished in the vicinity of these facilities and cables only at approved periods of time.

Approval is subject to withdrawal at any time because of changes in the weather, emergency conditions on the existing airfield areas, anticipation of emergency conditions, and for any other reason determined by the Engineer acting under the orders and instructions of the airport management and the designated FAA representative. Any instructions to this Contractor to clear any given area, at any time, by the Engineer, the Airport Management, or the FAA Control Tower (by radio or other means) shall be immediately executed. Construction work will be commenced in the cleared areas only when additional instructions are issued by the Engineer.

20. CHANGE ORDERS

Any change to the scope of work that affects the price of the Contract shall be submitted in writing and approved by the Executive Director, Savannah Airport Commission, or his representative. If the change is an emergency and critical to the project, a verbal approval by the Executive Director may be given provided an estimated cost of the change is given prior to approval. Any work performed without approval of the Executive Director will be done at the Contractor's own expense, and no compensation will be made by the Savannah Airport Commission for such work.

21. PERMITS

The Contractor shall be responsible for obtaining any and all licenses and permits to conduct the work as may be prescribed by the federal government, State of Georgia, Chatham County or the City of Savannah. Any fee or expenses associated in obtaining any license or permit shall be paid by the Contractor.

22. INDEMNIFICATION

a. Governing Law

This Agreement shall be deemed to be made in and construed in accordance with the laws of the State of Georgia.

b. The Contractor shall protect, defend, and indemnify Commission and its officers, agents and employees from an against any and all liabilities, losses, suits, claims, judgments, fines or demands arising by reason of injury or death of any person, or damage to any property, including all reasonable costs for investigation and defense thereof (including but not limited to attorney fees, court costs, and expert fees), of any nature whatsoever arising out of or incident to this Agreement and/or the use or occupancy of the Premises or the acts or omissions of contractor's officers, agents, employees, contractors, subcontractors, licensees, or invitees, regardless of where the injury, death or damage may occur, unless such injury, death, or damage is caused by the sole negligence of the Commission. The Commission shall give to contractor reasonable notice of any such claims or actions. The Contractor shall also use counsel reasonably acceptable to Commission in carrying out its obligations hereunder. The provisions of this section shall survive the expiration or early termination of this Agreement.

23. TERMINATION OF CONTRACT

The provisions of this contract may be terminated by either party without cause, in which event at least thirty (30) days prior written notice of such termination shall be given to the other. In the event the Savannah Airport Commission causes abandonment, termination, or suspension of this Contract, or parts thereof, the Contractor shall be compensated for services rendered up to the time of such

abandonment, termination or suspension. Compensation to the Contractor shall be for any reasonable costs incurred by the Contractor up to the time of abandonment, termination or suspension. The Contractor shall submit full documentation of costs incurred.

24. PERFORMANCE BOND, PAYMENT BOND, LABOR AND MATERIALS BOND

The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall permit a copy to be made.

The Contractor shall be required to furnish in duplicate a Performance Bond and a Labor and Material Payment bond, each in the amount of one hundred percent (100%) of the Contract Sum, written by a surety company licensed to do business in the State of Georgia and approved by the Owner.

25. GOVERNING LAW

This Agreement shall be deemed to be made in and construed in accordance with the laws of the State of Georgia.

26. NONDISCRIMINATION

(As required by Title VI of the Civil Rights Act of 1964; Department of Transportation 49 CFR Part 21; and Section 520 of the Airport and Airway Improvement Act of 1982).

Contractor shall comply with and shall ensure that the following Non-Discrimination clause is inserted in all subcontracts, subleases, and other agreements at all tiers:

> "The Contractor assures that it will comply with pertinent statutes, Executive Orders and such rules as are promulgated to assure that no person shall, on the grounds of race, creed, color, national origin, sex, age, or handicap be excluded from participating in any activity conducted with or benefiting from Federal assistance."

SECTION 230500

MECHANICAL GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Included:
1. Submittals
2. Electrical Requirements
3. Painting
4. Cleaning
5. Testing

1.3 SUBMITTALS

A. The Contractor shall submit for review by the Architect data of materials and equipment to be incorporated in the work. Submittals shall be supported by descriptive material, catalogs, cuts, diagrams, performance curves, and charts published by the manufacturer to show conformance to specification and drawing requirements; model numbers alone will not be acceptable.

B. Refer to the individual sections for identified equipment and materials for which submittals are required.

C. Refer to the SHOP DRAWINGS, PRODUCT DATA AND SAMPLES Section for required procedures.

D. Mechanical Equipment Electrical Data
1. Prior to submitting data for equipment requiring electrical service, the Contractor shall verify that electrical characteristics of equipment submittals comply with electrical service provided for the specified items of equipment.
2. Upon receipt by the Contractor of reviewed submittals for equipment provided under this Division, the Contractor shall coordinate the electrical service requirements, i.e., motor horsepower and full load amps, electrical service characteristics (voltage and phase), and number of services for each item of equipment requiring electrical connections with the electrical drawings and specifications. The Contractor shall furnish to the Architect a complete typewritten list of electrical requirements for each item of equipment to be installed.

E. Items on or projecting through the ceiling shall be coordinated with other items.

1.4 QUALITY ASSURANCE

A. The mechanical equipment and installation shall conform to the following codes:
1. The International Building Code 2012 Edition, with Georgia Amendments.
2. The International Mechanical Code 2012 Edition with Georgia Amendments.
3. The International Plumbing Code, 2012 Edition, with Georgia Amendments.

B. The mechanical equipment and installation shall conform to the following standards:

1. Associated Air Balance Council (AABC):
   a. National Standard for Total System Balance.
2. National Fire Protection Association (NFPA):
   a. Standard 70, National Electric Code.
   b. Standard 90A, Installation of Air Conditioning and Ventilating Systems.
   c. Standard 101, Code for Safety to Life from Fire in Buildings and Structures.

C. Publication Dates: Where the date of issue of a Reference Standard is not specified, comply with the Standard effective as of Date of Contract Document.

D. Permits
1. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

E. Workmanship and Materials
1. The workmanship and materials covered by these specifications shall conform to all ordinances and regulations of the city, county and/or other authorities having jurisdiction.

1.5 OPERATION AND MAINTENANCE INSTRUCTIONS

A. Refer to Division 1 for Detail Requirements.

B. Printed Material: Provide required printed material for binding in operation and maintenance manuals.
1. Refer to the individual sections for identified equipment for which material is to be provided.
2. The Operations and Maintenance Manual shall include a section for certifications and project warranty data. Refer to individual sections for certifications. Warranties for equipment shall be included in the equipment section of the Operation and Maintenance Manual.

C. The Manuals shall be a 3 ring binder with tabs for each item listed in specifications. The manuals shall be submitted to the Architect for approval 30 days prior to instruction of Owner personnel. The manual shall include the following items:
1. Parts list
2. Lubrication requirements
3. Preventative maintenance requirements
4. Name, address, and telephone numbers for supplier of equipment.

D. Instructions of Owner personnel:
1. Before final inspection, at a time designated by the Architect, provide a competent representative to instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems under this division of the specifications. For equipment requiring seasonal operation, perform instructions for other seasons within six months unless requested otherwise.
2. Use operation and maintenance manuals as basis of instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
3. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.
4. The instructional demo shall be recorded on DVD. The DVD shall list project, time, date, Contractor and personnel involved.

1.6 SPARE PARTS

A. The Contractor shall prepare a typed written list of spare parts or equipment to be turned over to the Owner. The list shall indicate the equipment the parts are for, model numbers and quantity of parts. Refer to individual sections for the spare parts or equipment required by these specifications.

1.7 RECORD DOCUMENTS

A. Refer to Division 1 for record documents and related submittals.

1.8 CONTRACT DRAWINGS

A. Drawings are diagrammatic and indicate general arrangement of systems and work. Provide offsets, transitions, and fittings to coordinate the work of each trade with that of other trades, including HVAC, plumbing, fire protection, electrical, structural, and architectural.

B. Follow drawings in laying out work and check drawings of other disciplines relating to work to verify space conditions. Do not scale drawings.

C. Equipment layout is based on one manufacturer's product. Where equipment selected by the Contractor for use on the job differs from layout, the Contractor shall be responsible for coordinating space requirements and connection arrangements.

1.9 GUARANTY

A. See the General Conditions.

PART 2 - PRODUCTS

2.1 ELECTRICAL WORK

A. All electrical equipment furnished under this Division of these Specifications shall comply with the electrical system characteristics indicated on the electrical drawings.

B. Motors shall be as specified in the MOTORS Section.

C. Motor control components furnished as an integral part of the mechanical equipment shall conform to requirements of Division 26 - Electrical.

D. For all motors furnished under this Division of these Specifications for which motor controls are not specified to be integral with the equipment, the controls shall be provided under Division 26 - Electrical.

E. Power wiring (i.e., feeders to motors, water heaters, and electric heaters and tapes including final connection to equipment) shall be provided under Division 26 - Electrical.

F. Control wiring (i.e. 120 volt and below) including 120 volt control power to motor operated dampers valves, and variable volume boxes shall be provided under this division unless shown on the electrical drawings.

PART 3 - EXECUTION

3.1 PAINTING

A. Factory painted equipment that has been scratched or marred shall be repainted to match original color.

B. Steel equipment hangers, threaded rods, bolts, nuts, and supports and uninsulated black steel pipe exposed to sight inside the building which are not provided with a factory applied prime coat shall be cleaned of rust, grease and scale. After cleaning hangers, supports and pipe, a field-applied prime coat shall be provided. In addition, such items in finished spaces shall also be provided with two coats of finish paint in a color to match adjacent surfaces or as noted on the architectural drawings.

C. Steel equipment hangers and supports, uninsulated black steel pipe, and black steel pipe supports exposed to sight outside the building which are not provided with factory prime coat shall be cleaned of rust, grease and scale. After cleaning hangers, supports and pipe, a field-applied prime coat and two coats of bituminous aluminum paint shall be provided. Insulated pipes outside the building shall be cleaned of rust, grease and scale, and shall be provided with a field-applied prime coat before installing insulation.

3.2 CLEANING AND ADJUSTING

A. All equipment, pipe, valves, and fittings shall be cleaned of grease, oil, paint spots, metal cuttings, sludge, and construction debris.

B. Ducts, plenums and casings shall be cleaned of all debris and blown free of all particles of rubbish and dust before installing outlet faces.

C. Bearings shall be lubricated as recommended by the equipment manufacturer.

D. Temporary filters shall be provided for fans that are used during construction. Where supply, exhaust, or return fans (whether alone or part of mechanical equipment), are used, all return/exhaust inlets shall be covered with roll filter media. Media shall be taped in place to face of air inlet device or opening. At the time of starting the balancing of the air distribution system, new filters shall be installed.

3.3 TESTING PIPE AND DUCT SYSTEMS

A. General: Concealed piping and duct work and insulated piping and ductwork shall be tested in place before concealing or covering. Piping and ductwork located underground shall be tested before backfilling. Equipment, materials, and instruments for testing shall be furnished by the Contractor without additional cost to the Owner. System components not rated for the respective test pressure shall be isolated from the system during the test.

B. Observation: The contractor shall notify the owner's representative 5 days prior to a scheduled test. The owner's representative, at his option, has the right to witness the test.

C. Heating & Air Conditioning Piping System
1. All chilled water, condensate drain and condenser water piping shall be tested hydrostatically and proved tight at a pressure of not less than 100 psi (690 kPa) for a period of not less than 2 hours.
2. No loss in pressure will be permitted. Leaks detected shall be repaired by tightening, rewelding joints, or replacing pipe and fittings. Caulking of joints will not be permitted.

END OF SECTION

SECTION 230510 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Grout.
4. HVAC demolition.
5. Equipment installation requirements common to equipment sections.
6. Painting and finishing.
7. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.

4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
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 manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
1. Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Eclipse, Inc.
   d. Epco Sales, Inc.
   e. Hart Industries, International, Inc.
   f. Watts Industries, Inc.; Water Products Div.
   g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
1. Manufacturers:
   a. Capitol Manufacturing Co.

b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
1. Manufacturers:
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

2.5 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump

sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use **3000-psi (20.7-MPa)**, 28-day compressive-strength concrete.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.

2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:
1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 22 0523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings included in the contract documents apply to this Section.

B. General Provisions of the Contract, including "General and Supplementary Conditions" apply to this Section.

C. Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Globe valves.
5. Drain valves

B. Related Sections:
1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. The following are industry abbreviations:
1. CWP: Cold working pressure.
2. EPDM: Ethylene propylene diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene (Buna-N or nitrile) rubber.
4. NRS: Non-rising stem.
5. RS OS&Y: Outside screw and yoke.
6. RS: Rising stem.
7. SWP: Steam working pressure.

B. The following are definitions:
1. Lead Free: The wetted surfaces of the product shall contain no more than 0.25% lead by weighted average.

1.4 SUBMITTALS

A. Product Data: Provide product data for each the products indicated below. Include material descriptions, dimensions of individual components and profiles, and finishes.
1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Globe valves.
5. Drain valves

B. Operation and Maintenance Data: Provide operation and maintenance information for items indicated below. Include operation, and maintenance manuals.

1. Ball valves.
2. Butterfly valves.
3. Check valves.
4. Globe valves.
5. Drain valves

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
1. Maintain valve end protection.
2. Components received and stored on the job site shall be stored in dry storage spaces, (e.g. building, trailers, or sheds) whenever possible. Components shall be stored on wooden shipping skids or rails. Under no condition shall the material be stored in such a way that metal components are in direct contact with the ground or floor slabs.
3. Where it is not practical to store items within an enclosure, components may be stored on wooden shipping skids or rails outside.
4. Components shall be covered with 6 mil polyethylene sheet (taped in place) to protect the equipment from damage and the weather.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where specific manufacturers and/or model numbers are indicated, the following requirements apply for product selection:
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 manufacturers specified.

2.2 GENERAL REQUIREMENTS FOR VALVES

A. Valves shall have name or trademark of manufacturer and working pressure cast or stamped on valve body.

B. Gate Valves, globe valves, and swing check valves shall be the product of a single manufacturer.

C. All valves requiring packing shall be designed and constructed to allow repacking under pressure.

D. Valve discs shall be the manufacturer's standard material for the service in which the valve is used unless otherwise indicated under the individual type valve specification.

E. Valve hand wheels shall be malleable iron, steel, or cast iron and shall conform to ASTM A197.

F. Valves shall be manufactured in the United States.

G. Refer to valve schedule articles in Part 3 for applications of valves.

H. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

I. Valve Sizes: Same as upstream piping unless otherwise indicated.

J. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.

K. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

L. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

M. Valve Bypass and Drain Connections: MSS SP-45.

2.3 IRON BALL VALVES

A. Class 125, Iron Ball Valves:
1. Available Manufacturers: Subject to compliance with requirements, provide one of the following:

a.	Apollo Valves.	No. 6P
b.	Sure Flow Equipment Inc.	No. BV125IS
c.	Watts Regulator Company	No. G4000M1

2. Description:
a. Standard: MSS SP-72.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Split body.
d. Body Material: ASTM A 126, gray iron.
e. Ends: Flanged.
f. Seats: PTFE or TFE.

g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
1. Available Manufacturers: Subject to compliance with requirements, provide one of the following:

a.	Apollo Valves.	Series 215 w/ 316 ss disc
b.	Crane Valves.	
c.	Jenkins Valves.	
d.	Legend Valve Company	
e.	Milwaukee Valve Company.	
f.	Mueller Steam Specialty	
g.	Nibco Inc.	
h.	Red-White Valve Corporation.	
i.	Stockham Valves	Series LD/LG
j.	Sure Flow Equipment Inc.	
k.	Watts Regulator Company	

2. Description:
a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig (1035 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Nickel-plated **or -coated** ductile iron.
h. Handle: gear operator.

2.5 IRON SWING CHECK VALVES

A. Class 150, Iron Swing Check Valves with Metal Seats:
1. Available Manufacturers: Subject to compliance with requirements, provide one of the following:

a.	Apollo Valves.	No. 910F
b.	Crane Valves.	No. 373
c.	Hammond Valve.	No. IR1124
d.	Jenkins Valves.	No. 587J
e.	Legend Valve.	No. T-311
f.	Milwaukee Valve Company.	No. F2974A
g.	Nibco Inc.	No. F-918-B
h.	Powell Valves.	No. 559
i.	Stockham Valves	No. G-931
j.	Sure Flow Equipment Inc.	No. CSF125IB
k.	Watts Regulator Company	No. 411

2. Description:
a. Standard: MSS SP-71, Type I.
b. CWP Rating:
1) Pipe size NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig (1380 kPa).
2) Pipe size NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig (1035 kPa).
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Cap: Bolted.
f. Ends: Flanged.

g. Trim: Bronze.
h. Gasket: Asbestos free.

2.6 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
1. Available Manufacturers: Subject to compliance with requirements, provide one of the following:

a.	Mueller Steam Specialty	No. A-2600
b.	Nibco Inc.	No. F-918-B
c.	Powell Valves.	No. 559

2. Description:
a. Standard: MSS SP-71, Type I.
b. CWP Rating:
1) Pipe size NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 psig (1380 kPa).
2) Pipe size NPS 14 to NPS 24 (DN 350 to DN 600): 150 psig (1035 kPa).
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.
h. Closure Control: Factory-installed, exterior lever and spring.

2.7 IRON, CENTER-GUIDED CHECK VALVES

A. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
1. Available Manufacturers: Subject to compliance with requirements, provide one of the following:

a.	Muellar Steam Specialty	Series 101MDT
b.	OC Keckley Company	Series CW
c.	Sure Flow Equipment Inc.	Series CW150

2. Description:
a. Standard: MSS SP-125.
b. CWP Rating:
1) Pipe size NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 300 psig (2070 kPa).
2) Pipe size NPS 14 to NPS 24 (DN 350 to DN 600): 250 psig (1725 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Compact wafer.
e. Seat: Bronze.

B. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:
1. Available Manufacturers: Subject to compliance with requirements, provide one of the following:

a.	Metraflex Company	Series 900
b.	Muellar Steam Specialty	Series 105MDT
c.	OC Keckley Company	Series CG
d.	Sure Flow Equipment Inc.	Series CF150

2. Description:
a. Standard: MSS SP-125.
b. CWP Rating:
1) Pipe size NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 300 psig (2070 kPa).
2) Pipe size NPS 14 to NPS 24 (DN 350 to DN 600): 250 psig (1725 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

2.8 IRON, PLATE-TYPE CHECK VALVES

A. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:

1. Available Manufacturers: Subject to compliance with requirements, provide one of the following:

a.	Crane Company; Duo-Chek	Series G
b.	OC Keckley Company	Series DD

2. Description:
   a. Standard: API 594.
   b. CWP Rating:
      1) Pipe size NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 300 psig (2070 kPa).
      2) Pipe size NPS 14 to NPS 24 (DN 350 to DN 600): 250 psig (1725 kPa).
   c. Body Design: Wafer, spring-loaded plates.
   d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
   e. Check Plates: aluminum bronze
   f. Seat: Bronze.
   g. Spring: 316 stainless steel
   h. Ends: Flanged.

2.9 IRON GLOBE VALVES

A. Class 150, RS OSY&, Iron Globe Valves:

1. Available Manufacturers: Subject to compliance with requirements, provide one of the following:

a.	Apollo Valves.	No. 721F
b.	Crane Valves.	No. 21E
c.	Hammond Valve.	No. IR313
d.	Jenkins Valves.	No. 162J
e.	Milwaukee Valve Company.	No. F-2983M
f.	Nibco Inc.	No. F-768-B
g.	Stockham Valves	No. F532

2. Description:
   a. Standard: MSS SP-85, Type I.
   b. CWP Rating: 500 psig (3450 kPa).
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Bonnet: Bolted.
   e. Ends: Flanged.
   f. Trim: Bronze.
   g. Packing and Gasket: Asbestos free.

2.10 DRAIN VALVES

A. Angled Bronze Globe Valves with Brass Trim:

1. Available Manufacturers: Subject to compliance with requirements, provide one of the following:

a.	Apollo Valves.	No. 31-200
b.	Hammond Valve.	No. 710/712
c.	Nibco Inc.	No. 73-CL
d.	Red-White Valve Corporation.	No. 502

2. Description:
   a. CWP Rating: 200 psig (1380 kPa).
   b. Body Design: angled.
   c. Body Material: Forged bronze or brass.
   d. Inlet: Threaded ¾ inch .
   e. Outlet: ¾ inch hose thread
   f. Handwheel: Aluminum.

B. Bronze Ball Valves with cap and chain:

1. [Available]Manufacturers: Subject to compliance with requirements, provide one of the following:

a.	Crane Valves.	No. 9210-HC
b.	Jomar International, LTD.	No. T-100-HS
c.	Lance Valves	No. 21-4
d.	Milwaukee Valve Company.	No. BA-100HRH
e.	Nibco Inc.	No. T-585-70HC
f.	Red-White Valve Corporation.	No. 5586
g.	Stockham Valves	No. T-285 -HC

2. Description:
   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig (1035 kPa).
   c. CWP Rating: 600 psig (4140 kPa).
   d. Body Design: Two piece.
   e. Body Material: Forged bronze or brass.
   f. Inlet: Threaded.
   g. Outlet: 3/ 4 inch hose thread.
   h. Seats: PTFE or TFE.
   i. Stem: Bronze or brass.
   j. Ball: Chrome-plated brass.
   k. Port: Full.
   l. Handle: Carbon steel with plastic grip cover.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.
4. Inline Check Valves: In horizontal or vertical position.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

B. Adjust meter balancing valves to flow indicated.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
1. Shutoff Service: Ball, butterfly valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service, Water: Globe or butterfly valves.
4. Pump-Discharge Check Valves:
   a. NPS 2-1/2 (DN 65) and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
1. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
2. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.5 CONDENSER WATER VALVE SCHEDULE

A. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150 iron body with stainless steel ball.
3. Butterfly Valves:
   a. 200 CWP iron body, single flange with EPDM seat, ductile-iron disc.
4. Check Valves:
   a. Class 150 swing, iron body with bronze seats.
5. Globe Valves:
   a. Class 150 iron RS with bronze trim.

END OF SECTION 23 0523

SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING, DUCTWORK, AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings included in the contract documents apply to this Section.

B. General Provisions of the Contract, including "General and Supplementary Conditions" apply to this Section.

C. Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.3 SUBMITTALS

A. Product Data: Provide product data for each the products indicated below. Include material descriptions, and finishes.
1. Equipment Labels.
2. Pipe Labels.
3. Valve Tags.

B. Pipe Label Schedule: Include a listing of all piping types to be labeled with the proposed content for each type of label.

C. Equipment Label Schedule: Include a listing of all equipment types to be labeled with the proposed content for each type of label.

D. Valve numbering scheme: Include a listing of all valve types to be labeled with the proposed content for each type of label.

E. Operation and Maintenance Data:
1. Valve Schedules: For each valve to be labeled, on 8-1/2-by-11-inch (A4) bond paper, tabulate valve identification. Identification shall include valve number, valve location in system (e.g., water heater, chilled water pump, etc.) and its function (e.g., shut-off, balancing, drain, etc.).
2. Equipment Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper, tabulate equipment identification number and identify plus the Specification Section number and title where equipment is specified.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Components received and stored on the job site shall be stored in dry storage spaces, (e.g. building, trailers, or sheds) whenever possible. Components shall be stored on wooden shipping skids or rails. Under no condition shall the material be stored in such a way that metal components are in direct contact with the ground or floor slabs.

B. Where it is not practical to store items within an enclosure, components may be stored on wooden shipping skids or rails outside.

C. Components shall be covered with 6 mil polyethylene sheet (taped in place) to protect the equipment from damage and the weather.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where specific manufacturers and/or model numbers are indicated, the following requirements apply for product selection:
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 manufacturers specified.
2.

a.	Brady
b.	Emedco
c.	Marking Services
d.	Pipe Marker
e.	Seton/Setmark

2.2 EQUIPMENT LABELS

A. Metal Labels for Equipment:
1. Material and Thickness: Stainless steel, 0.018-inch (0.46-mm) minimum thickness, and having pre-drilled or stamped holes for attachment hardware.
2. Letter Color: Black.
3. Minimum Label Size: Length and width may vary as required for label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel rivets or self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's drawing designation and unique equipment number.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Pre-printed, color-coded, with lettering indicating service, and showing flow direction; conforming to ANSI A13.1.

B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to radius of pipe, extend full circumference of pipe, and to attach to pipe without fasteners or adhesive. For pipe/insulation outside diameters up to 5.875 inch (149mm), label shall be full 360 degree circumference of surface; for pipe/insulation outside diameters 6 in and over, label shall be partial diameter with nylon securing ties.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
1. Tag Material: Brass, 0.043-inch (1.09-mm) minimum thickness, and having pre-drilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on the hvac equipment listed below:
1. Pumps.

B. Metal Labels: Install metal labels on all designated exterior equipment.

C. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Pre-tensioned Pipe Label Application: Plastic pipe bands shall be wrapped around pipe or pipe covering under pressure so that no gaps or wrinkles occur. Bands on pipe or pipe covering larger than 6 inches (150 mm) shall be further secured at both ends with nylon ties.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.

C. Pipe Label Color Schedule:
1. Condenser-Water Piping:
   a. Background Color: Orange.
   b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
   a. Condenser Water: 1-1/2 inches (38 mm), round.
2. Valve-Tag Color:
   a. Condenser Water: Natural.
3. Letter Color:
   a. Condenser Water: Green.

3.5 SAFETY SIGNS AND LABEL INSTALLATION

A. Install safety signs at all medical vacuum discharge points from the building. Signs shall identify the equipment ventilated and the hazard type. All labels shall comply with NFPA 170.

B. Install safety signs or labels for all emergency eye wash, showers, and combination units in accordance with ANSI Z358.1.

END OF SECTION 23 0553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Balancing Hydronic Piping Systems:
   a. Constant-flow hydronic systems.
2. Testing, Adjusting, and Balancing Equipment:
   a. Motors.
   b. Cooling towers.
3. Testing, adjusting, and balancing existing systems and equipment.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within **30** days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within **30** days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within **30** days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. System Readiness Checklists: Within **30** days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:
1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by **AABC NEBB or TABB**.
1. TAB Field Supervisor: Employee of the TAB specialist and certified by **AABC NEBB or TABB**.
2. TAB Technician: Employee of the TAB specialist and certified by **AABC NEBB or TABB** as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.
1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

K. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:
1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
1. Hydronics:
   a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
   b. Piping is complete with terminals installed.
   c. Water treatment is complete.
   d. Systems are flushed, filled, and air purged.
   e. Strainers are pulled and cleaned.
   f. Control valves are functioning per the sequence of operation.
   g. Shutoff and balance valves have been verified to be 100 percent open.
   h. Pumps are started and proper rotation is verified.
   i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
   j. Variable-frequency controllers' startup is complete and safeties are verified.

k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in **inch-pound (IP)** units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.6 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.
1. Measure total water flow.
   a. Position valves for full flow through coils.
   b. Measure flow by main flow meter, if installed.
   c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.
2. Measure pump TDH as follows:
   a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
   b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
   c. Convert pressure to head and correct for differences in gage heights.
   d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
   e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.
3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.
1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.
1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:
1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:
1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:
1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

G. Verify that memory stops have been set.

3.7 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.8 PROCEDURES FOR COOLING TOWERS

A. Balance total condenser-water flows to towers. Measure and record the following data:
1. Condenser-water flow to each cell of the cooling tower.
2. Entering- and leaving-water temperatures.
3. Wet- and dry-bulb temperatures of entering air.
4. Wet- and dry-bulb temperatures of leaving air.
5. Condenser-water flow rate recirculating through the cooling tower.
6. Cooling-tower spray pump discharge pressure.
7. Condenser-water flow through bypass.
8. Fan and motor operating data.

3.9 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
1. Condenser-Water Flow Rate: **Plus or minus 10 percent**.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.
8. Motor Data:
    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave and amount of adjustments in inches.

E. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.
   d. Full-open flow rate in gpm.
   e. Full-open pressure in feet of head or psig.
   f. Final discharge pressure in feet of head or psig.
   g. Final suction pressure in feet of head or psig.
   h. Final total pressure in feet of head or psig.
   i. Final water flow rate in gpm.
   j. Voltage at each connection.
   k. Amperage for each phase.

F. Instrument Calibration Reports:
1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.11 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of **Owner**.

B. **Owner** shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:
1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
3. If the second verification also fails, **Owner** may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Insulation Materials:
      a. Cellular glass.
      b. Mineral fiber.
   2. Insulating cements.
   3. Adhesives.
   4. Mastics.
   5. Lagging adhesives.
   6. Sealants.
   7. Factory-applied jackets.
   8. Field-applied fabric-reinforcing mesh.
   9. Field-applied cloths.
   10. Field-applied jackets.
   11. Tapes.
   12. Securements.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Qualification Data: For qualified Installer.

C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Insulation received and stored on the job site shall be stored in dry storage spaces, (e.g. building, trailer, or shed) whenever possible. Insulation shall be stored on wooden rails, wooden pallets, or shipping skids. Under no condition shall the insulation be stored in such a way that components are in direct contact with the ground or floor slabs.

C. Where it is not practical to store items within an enclosure, insulation may be stored on wooden rails, wooden pallets, or shipping skids outside.

D. Insulation shall be covered with 6 mil polyethylene sheet (taped in place) to protect the equipment from damage and the weather. UV sensitive material such as PVC and PVDC insulation material shall be protected from sunlight to avoid exposure to UV light from the sun.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following]:
   a. Cell-U-Foam Corporation; Ultra-CUF.
   b. Pittsburgh Corning Corporation; Foamglas Super K.
   c. ASC Industries
2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied [**ASJ**] [**ASJ-SSL**]: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Johns Manville; Micro-Lok.
   c. Knauf Insulation; 1000 Pipe Insulation.
   d. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, **with factory-applied ASJ**. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied **ASJ** complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Insulco, Division of MFS, Inc.; Triple I.
   b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
1. Products: : Subject to compliance with requirements, provide one of the following:
   a. Insulco, Division of MFS, Inc.; SmoothKote.
   b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
   c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).
1. Products: : Subject to compliance with requirements, provide one of the following:
   a. Childers Products; CP-96.
   b. Foster Products Corporation, H. B. Fuller Company; 81-33/81-84.
2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive:
1. Products: : Subject to compliance with requirements, provide one of the following:
   a. Childers Products; CP-127/CP-82.
   b. Foster Products Corporation, H. B. Fuller Company; 85-60/85-20.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: : Subject to compliance with requirements, provide one of the following:
   a. Childers Products; CP-34.
   b. Foster Products Corporation, H. B. Fuller Company; 30-65.
   c. ITW TACC, Division of Illinois Tool Works; CB-50.
   d. Marathon Industries, Inc.; 590.
   e. Mon-Eco Industries, Inc.; 55-40.
   f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.03 perm at 45-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products; Encacel X/V.
   b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-90.
   c. Marathon Industries, Inc.; 570.
   d. Mon-Eco Industries, Inc.; 55-70.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products; CP-10/11.
b. Foster Products Corporation, H. B. Fuller Company; 46-50/35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
4. Color: White.

2.5 SEALANTS

A. Joint Sealants:
1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following
   a. Childers Products; CP-76.
   b. Foster Products Corporation, H. B. Fuller Company; 95-50/30-45.
   c. Pittsburgh Corning Corporation; Pittseal 444.
   d.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products; CP-76.
   b. <Insert manufacturer's name; product name or designation.>
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Reference: SCAQMD Rule #1168 VOC tables; category "Other"

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Products, Division of ITW; Metal Jacketing Systems.
   b. PABCO Metals Corporation; Surefit.

c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
   a. Factory cut and rolled to size.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Indoor Applications: **1-mil- (0.025-mm-)** thick, heat-bonded polyethylene and kraft paper.
   d. Moisture Barrier for Outdoor Applications: **3-mil- (0.075-mm-)** thick, heat-bonded polyethylene and kraft paper.
   e. Factory-Fabricated Fitting Covers:
      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
      b. Compac Corp.; 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches (75 mm).
   3. Thickness: 11.5 mils (0.29 mm).
   4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
      b. Compac Corp.; 120.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
      d. Venture Tape; 3520 CW.
   2. Width: 2 inches (50 mm).
   3. Thickness: 3.7 mils (0.093 mm).
   4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
   5. Elongation: 5 percent.
   6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.9 SECUREMENTS

A. Bands:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products; Bands.
      b. PABCO Metals Corporation; Bands.

c. RPR Products, Inc.; Bands.

2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, **1/2 inch (13 mm)** wide with **wing or closed seal**.

3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Wire: **0.080-inch (2.0-mm)** nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, provide one of the following:
   a. C & F Wire.
   b. Childers Products.
   c. PABCO Metals Corporation.
   d. RPR Products, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **2 inches (50 mm)** o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
   1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
   2. Pipe: Install insulation continuously through floor penetrations.
   3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for **50** Insert percentage percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
   a. Do not weld anchor pins to ASME-labeled pressure vessels.
   b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
   c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
   d. Do not overcompress insulation during installation.
   e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
   f. Impale insulation over anchor pins and attach speed washers.
   g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from [galvanized steel] [aluminum] [stainless steel], at least [**0.040 inch (1.0 mm)**] [**0.050 inch (1.3 mm)**] [**0.060 inch (1.6 mm)**] thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Condenser-Water Supply and Return:
1. All Pipe Sizes: Insulation shall be the following:
a. Cellular Glass: **2 inches (50 mm)** thick.

3.12 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Exposed:
1. Aluminum, Stucco Embossed: **0.020 inch (0.51 mm)** thick.

END OF SECTION

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Condenser-water piping.

B. Related Sections include the following:
   1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
   2. Division 23 Section "METERS AND GAGES FOR HVAC PIPING".

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 SUBMITTALS

A. Product Data: For each type of the following:
   1. Air control devices.
   2. Hydronic specialties.

B. Welding certificates.

C. Qualification Data: For Installer.

D. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. The interior of all pipe and fittings shall be kept free from dirt and foreign matter at all times.

B. Piping specialties received and stored on the job site shall be stored in dry storage spaces, (e.g. building, a storage trailer, or shed). Under no condition shall the units be stored in such a way that metal components are in direct contact with the ground.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Coupling Gasket Materials: EPDM Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. (Gaskets used for potable water applications shall be UL classified in accordance with ANSI/NSF-61 for potable water service.)

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
2. Factory-fabricated union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Factory-fabricated companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

2.4 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

2.5 AIR CONTROL DEVICES

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Hoffman
5. Taco.
6. Thrush
7. Watts

C. Manual Air Vents:
1. Body: Bronze.
2. Internal Parts: Nonferrous.

3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: **NPS 1/8 (DN 6)**.
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 225 deg F (107 deg C).

D. Automatic Air Vents:
1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: NPS 1/4 (DN 8).
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

2.6 HYDRONIC PIPING SPECIALTIES

A. Spherical, Rubber, Flexible Connectors:
1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).
6. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flex Hose
   b. Keflex
   c. Mason Industries
   d. Universal Metal Hose Flex Hose

B. Flexible couplings may be used in lieu of flexible connectors for vibration isolation at equipment connections. Three (3) couplings, for each connector, shall be placed in close proximity to the source of vibration.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Condenser-water piping, aboveground, shall be the following:
1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

P. Install flanges or couplings in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.

Q. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.3 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
3. NPS 1-1/4 (DN 32): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 1/2 inch (12 mm).

7. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (12 mm).
8. NPS 3-1/2 (DN 90): Maximum span, 13 feet (4 m); minimum rod size, 1/2 inch (12 mm).
9. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 5/8 inch (16 mm).
10. NPS 5 (DN 125): Maximum span, 16 feet (4.9 m); minimum rod size, 5/8 inch (16 mm).
11. NPS 6 (DN 150): Maximum span, 17 feet (5.2 m); minimum rod size, 3/4 inch (20 mm).
12. NPS 8 (DN 200): Maximum span, 19 feet (5.8 m); minimum rod size, 3/4 inch (20 mm).
13. NPS 10 (DN 250): Maximum span, 22 feet (6.7 m); minimum rod size, 7/8 inch (20 mm).
14. NPS 12 (DN 300): Maximum span, 23 feet (7 m); minimum rod size, 7/8 inch (20 mm).
15. NPS 14 (DN 350): Maximum span, 25 feet (7.6 m); minimum rod size, 1 inch (24 mm).

D. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.4 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel or groove plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.7 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:
1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Separately coupled, base-mounted, double-suction centrifugal pumps.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

D. Certificates:
1. Pump alignment reports by manufacturer's representative.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. 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.

D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

E. Standards
1. American National Standards Institute (ANSI):
a. Standard B16.1, Cast Iron Pipe Flanges and Flanged Fittings, 25, 125, and 800 pound.
b. Standard B15.1, Section 8
2. American Society for Testing and Materials (ASTM):
a. Standard B584, Specification for Copper Alloy Sand Castings for General Application.
3. Anti-Friction Bearing Manufacturers Association (AFBMA):
a. Standard 9, Load Ratings and Fatigue Life for Ball Bearings.
4. Hydraulic Institute Standards
a. HI-01 Standards for Centrifugal, Rotary and Reciprocating Pumps

1.6 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Pumps received and stored on the job site shall be stored in dry storage spaces, (e.g. building, trailers, or sheds) whenever possible. Pumps shall be stored on wooden shipping skids or rails. Under no condition shall the units be stored in such a way that metal components are in direct contact with the ground or floor slabs.

C. Where it is not practical to store items within an enclosure, pumps may be stored on wooden shipping skids or rails outside.

D. Pumps shall be covered with 6 mil polyethylene sheet (taped in place) to protect the equipment from damage and the weather.

E. .Retain protective covers for flanges and protective coatings during storage.

F. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

G. Comply with pump manufacturer's written rigging instructions.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Mechanical Seals: **One** mechanical seal(s) for each pump. The spare seal shall be packaged in the original carton from the factory and shall be delivered to the Owner at the time of the final inspection. Each spare seal shall be labeled to identify the seal by pump number

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SEPARATELY COUPLED, BASE-MOUNTED, DOUBLE-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide one of the following
1. American-Marsh Pumps.
2. Armstrong Pumps Inc.
3. Aurora Pump; Division of Pentair Pump Group.
4. Bell & Gossett; Div. of ITT Industries.
5. Buffalo Pumps, Inc.; an Ampco Pittsburgh Co.
6. Flowserve Corporation; Div. of Ingersoll-Dresser Pumps.
7. MEPCO (Marshall Engineered Products Co.).
8. PACO Pumps.
9. Patterson Pump Co.; a Subsidiary of The Gorman-Rupp Co.
10. Taco, Inc.
11. Weinman; Div. of Crane Pumps & Systems.

B. Description: Factory-assembled and -tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for **125-psig (860-kPa)** minimum working pressure and a continuous water temperature of **200 deg F (93 deg C)**.

C. Pump Construction:
1. Casing: **Horizontally** split, cast iron, with **replaceable bronze wear rings,** threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and ASME B16.1, Class **125** flanges. **Casing supports shall allow removal and replacement of impeller without disconnecting piping.**
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and **Buna-N** bellows and gasket.
5. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

D. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. **Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor EPDM coupling sleeve for variable-speed applications**.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

G. Motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

H. Capacities and Characteristics:
1. See schedule on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 23 Section "Common Work Results for HVAC."
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Re-use existing pump pad. Modify as needed for new pump.

3.3 PUMP INSTALLATION

A. Comply with **HI 1.4**.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.
1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches (19 to 38 mm) between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

E. After completion of installation rust and scale shall be removed from exposed - to - sight surfaces of pump shafts. After cleaning shaft surfaces, a protective spray coating of lubricant/rust inhibitor shall be applied to the exposed - to - sight shaft surfaces.

3.4 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

E. After completion of installation and realignment, each pump shall be checked by the pump manufacturer's representative for alignment and operation. Report of this inspection and approval of the installation by the manufacturer's representative shall be submitted to the Architect.

3.5 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check valve and throttling valve on discharge side of pumps.

F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

G. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

H. Install electrical connections for power, controls, and devices.

I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
   6. Start motor.
   7. Open discharge valve slowly.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 232923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes solid-state, PWM, variable frequency controllers for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. BMS: Building management system.

B. IGBT: Integrated gate bipolar transistor.

C. LAN: Local area network.

D. PID: Control action, proportional plus integral plus derivative.

E. PWM: Pulse-width modulated.

F. VFC: Variable frequency controller.

1.4 SUBMITTALS

A. Product Data: For each type of variable frequency controller. Include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.

B. Shop Drawings: For each variable frequency controller.
   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Each installed unit's type and details.
      b. Nameplate legends.
      c. Short-circuit current rating of integrated unit.
      d. Listed and labeled for series rating of overcurrent protective devices in combination controllers by an NRTL acceptable to authorities having jurisdiction.
      e. Features, characteristics, ratings, and factory settings of each motor-control center unit.
   2. Wiring Diagrams: Power, signal, and control wiring for variable frequency controllers. Provide schematic wiring diagram for each type of variable frequency controllers.

C. Qualification Data: For **manufacturer and testing agency**.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For variable frequency controllers, all installed devices, and components 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. Routine maintenance requirements for variable frequency controllers and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

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 Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain variable frequency controllers of a single type through one source from a single manufacturer.

C. 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.

D. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Variable frequency controllers received and stored on the job site shall be stored in dry storage spaces, (e.g. building) whenever possible. Variable frequency controllers shall be stored on wooden rails. Under no condition shall the units be stored in such a way that metal components are in direct contact with the ground or floor slabs. Store variable frequency controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect variable frequency controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover variable frequency controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

C. Variable frequency controllers shall be covered with 6 mil polyethylene sheet (taped in place) to protect the equipment from damage and the weather

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
1. Ambient Temperature: 0 to 40 deg C.
2. Humidity: Less than 90 percent (noncondensing).
3. Altitude: Not exceeding 3300 feet (1005 m).

B. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
1. Notify **Owner** no fewer than two days in advance of proposed interruption of electrical service.

2. Indicate method of providing temporary electrical service.
3. Do not proceed with interruption of electrical service without **Owner's** written permission.

1.8 COORDINATION

A. Coordinate layout and installation of variable frequency controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features of variable frequency controllers, installed units, and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each variable frequency controller and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
2. Indicating Lights: Two of each type installed.

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, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
2. Baldor Electric Company (Graham).
3. Danfoss Inc.; Danfoss Electronic Drives Div.
4. Eaton Corporation; Cutler-Hammer Products.
5. Emerson
6. General Electric Company; GE Industrial Systems.
7. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
8. Siemens Energy and Automation; Industrial Products Division.
9. Square D.
10. Toshiba International Corporation.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Description: NEMA ICS 2, IGBT, PWM, variable frequency controller; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
1. Provide unit suitable for operation of **premium**-efficiency motor as defined by NEMA MG 1.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

D. Unit Operating Requirements:
   1. Input ac voltage tolerance of **380 to 500 V, plus or minus 10** percent.
   2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
   3. Minimum Efficiency: 96 percent at 60 Hz, full load.
   4. Minimum Displacement Primary-Side Power Factor: 96 percent.
   5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
   6. Starting Torque: 100 percent of rated torque or as indicated.
   7. Speed Regulation: Plus or minus 1 percent.

E. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
   1. Electrical Signal: 4 to 20 mA at 24 V.

F. Internal Adjustability Capabilities:
   1. Minimum Speed: 5 to 25 percent of maximum rpm.
   2. Maximum Speed: 80 to 100 percent of maximum rpm.
   3. Acceleration: 2 to a minimum of 22 seconds.
   4. Deceleration: 2 to a minimum of 22 seconds.
   5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

G. Self-Protection and Reliability Features:
   1. Input transient protection by means of surge suppressors.
   2. Under- and overvoltage trips; inverter over temperature, overload, and overcurrent trips.
   3. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class **[10]** **[20]** **[30]** performance.
   4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
   5. Instantaneous line-to-line and line-to-ground overcurrent trips.
   6. Loss-of-phase protection.
   7. Reverse-phase protection.
   8. Short-circuit protection.
   9. Motor over temperature fault.

H. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.

I. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional auto-speed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

J. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.

K. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

L. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

M. Input Line Conditioning: VFDs 5 horsepower and larger shall have 3-5% DC link reactors or a separate AC line reactor

N. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

O. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control and elapsed time meter.

P. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (VDC).
9. Set-point frequency (Hz).
10. Motor output voltage (V).

Q. Control Signal Interface:
1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
   a. 0 to 10-V dc.
   b. 0-20 or 4-20 mA.
   c. Potentiometer using up/down digital inputs.
   d. Fixed frequencies using digital inputs.
   e. RS485.
   f. Keypad display for local hand operation.
3. Output Signal Interface:
   a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
      1) Output frequency (Hz).
      2) Output current (load).
      3) DC-link voltage (VDC).
      4) Motor torque (percent).
      5) Motor speed (rpm).
      6) Set-point frequency (Hz).
4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
   a. Motor running.
   b. Set-point speed reached.
   c. Fault and warning indication (over temperature or overcurrent).
   d. PID high- or low-speed limits reached.

R. Communications: Provide an RS485 interface allowing variable frequency controllers to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of variable frequency controllers to be programmed via BMS control. Provide capability for variable frequency controllers to retain these settings within the nonvolatile memory. BACNET shall be supplied.

S. Manual Bypass: Magnetic contactor arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable operation (starting, stopping, and running), with motor completely disconnected from controller (no load).

T. Bypass Controller: NEMA ICS 2, full-voltage, non-reversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.

U. Integral Disconnecting Means: **NEMA AB 1, instantaneous-trip circuit breaker** with lockable handle.

V. Isolating Switch: Non-load-break switch arranged to isolate variable frequency controller and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

W. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

2.3 ENCLOSURES

A. Weather proof

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Standard Displays:
1. Output frequency (Hz).
2. Set-point frequency (Hz).
3. Motor current (amperes).
4. DC-link voltage (VDC).
5. Motor torque (percent).
6. Motor speed (rpm).
7. Motor output voltage (V).

F. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

G. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested variable frequency controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive variable frequency controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before variable frequency controller installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each variable frequency controllers to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Anchor each variable frequency controller assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

C. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

3.4 IDENTIFICATION

A. Identify variable frequency controller, components, and control wiring according to Division 26 Section "Identification for Electrical Systems."

B. Operating Instructions: Frame printed operating instructions for variable frequency controllers, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of variable frequency controller units.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between variable frequency controllers and remote devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
3. Report results in writing.

C. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

D. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

E. Perform the following field tests and inspections and prepare test reports:
1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. 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.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

DIVISION 16 - ELECTRICAL

16010 - BASIC ELECTRICAL REQUIREMENTS

1.01 QUALITY ASSURANCE

A. All electrical work shall be in accordance with the following codes and agencies:

1. The National Electrical Code (NFPA-70), 2008 Edition with Georgia Amendments.
2. The National Electrical Safety Code (ANSI C-2), 2007 Edition with Georgia Amendments.
3. State and local ordinances governing electrical work.

B. All materials shall be new and shall conform to standards where such have been established for the particular material. All UL listed equipment shall bear the UL label.

1.02 PERMITS

A. Obtain all permits and inspections required for the work involved. Deliver to the owner all certificates of inspection.

1.03 WARRANTY

A. The contractor shall warrant to the owner that all work shall be free from defects and will conform to the contract documents. This warranty shall extend not less than one year from the date of beneficial occupancy.

1.04 DRAWINGS

A. The drawings indicate the general arrangement of electrical equipment, based on one manufacturer's product. Coordinate installation of equipment with all other trades. Do not scale drawings for connection locations. Bring all discrepancies to the immediate attention of the engineer.

B. Contractor shall install and circuit all electrical work as indicated on drawings unless specific construction requires a change or rerouting of this work. He shall keep a record of the location of all concealed work, including the underground utility lines. He shall document all changes.

1.05 EQUIPMENT REQUIRING ELECTRICAL SERVICE

A. Review all specification sections and drawings for equipment requiring electrical service. Provide service to and make connections to all such equipment.

B. Drawings are based on design loads of one manufacturer. If equipment actually furnished have loads, numbers of connections, or voltages other than those indicated on the drawings, then control equipment, feeders, and overcurrent devices shall be adjusted as required, at no additional cost to the owner. Such adjustments are subject to review by the architect.

C. Catalog numbers indicated with equipment are for convenience only. Errors or obsolescence shall not relieve the furnishing of items which meet the technical description given in specifications, noted, or required by function designated.

1.06 MECHANICAL SYSTEM INTERFACE

A. Coordinate with mechanical contractor to let him know that he is responsible for all controls. All control wiring for HVAC equipment shall be installed under Division 15000. Power wiring to all motors and motor controllers and between motors and controllers shall be provided under Division

16000. All motor controllers shall be furnished and installed under Division 16000 unless noted otherwise.

1.07 SCHEDULING OF OUTAGES

A. Electrical work requiring interruption of electrical power which would adversely affect the normal operation of other portions of the owner's property, shall be done at other than normal working hours. Normal working hours shall be considered 8:00 a.m. to 6:00 p.m., Monday through Friday. Schedule the interruption of electrical power three working days prior to actual shutdown with owners representative.

1.08 SITE INVESTIGATION AND RENOVATION CONDITIONS

A. Prior to submitting bids for the project, visit the site to become familiar with existing conditions. The project shall be restored to its existing condition, with the exception of work under this contract, prior to final payment.

B. Provide additions and alterations to existing work required to produce a complete electrical installation. Relocate existing electrical work for other trades required to complete the work and to maintain service. Provide for the removal, reinstallation, reconnection or relocation of existing circuit wiring, etc., necessitated by the new work. If any portion of an existing circuit is in an area where no new work is being done, but is made electrically discontinuous by the new work, it shall be recircuited to maintain electrical continuity. Trenching, cutting, channeling, chasing, or drilling of walls or other surfaces and support, or anchorage of conduit, or other electrical work, shall be done without damage to other piping or building equipment. Existing surfaces shall then be patched and painted to match the surrounding areas.

1.09 PRODUCT DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Provide a dry, weather tight space for storing materials. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact. Handle and store material in accordance with standards to prevent damage. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable. Replace damaged materials.

1.10 CLEANING AND PAINTING

A. Remove oil, dirt, grease and foreign materials from all equipment to provide a clean surface. Touch up scratched or marred surfaces of equipment enclosures with paint manufactured specifically for that purpose.

16100 - BASIC MATERIALS

2.01 RACEWAYS

A. The following specifications and standards are incorporated into and become a part of this specification:

1. Underwriter's Laboratory, Inc. Publications 1, 6, 467, 651, 797, 1242.
2. American National Standards Institute C-80.1, C-80.3.

B. Raceway is required for all wiring, unless specifically indicated or specified otherwise. The minimum size of conduit shall be 1/2", but shall not be less than size indicated on the drawings or required by the NEC.

C. Conduits shall be electrical metallic tubing (EMT) within interior dry spaces and for the following conditions shall be:

1. Conduits which penetrate the building roof or installed exterior exposed to the weather shall be galvanized rigid steel (GRS) or intermediate metal conduit (IMC).
2. Conduits installed in direct contact with earth shall be schedule 40, heavy wall PVC. Where transition is made from raceway in earth to any type of raceway out of earth, make transition with a rigid galvanized elbow
3. Use flexible conduit for connections to motors and all vibrating equipment.
   a. Length shall not exceed 18".
   b. Maintain ground continuity through flexible conduit with a green equipment grounding conductor.
   c. Liquid-tight flexible conduit shall be used in mechanical equipment rooms and exterior installations.

D. EMT conduit couplings and connectors shall be steel raintight type, compression type. All EMT connectors shall be insulated throat type. GRS and IMC fittings shall be standard threaded couplings, locknuts, bushings, and elbows. All GRS and IMC fittings shall be steel or malleable iron; set screw or non-threaded fittings are not permitted. Non-metallic conduit fittings shall be of the same material as the conduit furnished and shall be the product of the same manufacturer.

E. All conduit support parts and hardware shall be hot-dipped galvanized. Conduit straps shall be single hole cast metal type or two hole galvanized metal type. Conduit support channels shall be 1 ½" x 1 ½" – 14 gauge channel, with ¼" threaded steel rods used for suspension. Wire or chain is not acceptable for conduit hangers. Individual conduit hangers shall be galvanized spring steel specifically designed for the purpose. Individual conduit straps on metal studs shall be spring steel and should wrap around the entire face of the stud; tie wraps are not acceptable.

F. Conceal all conduits except in unfinished spaces such as equipment rooms or where indicated by symbol on the drawings. Complete raceway runs prior to installation of wires or cables. Deformed conduits shall be replaced. Protect conduits against dirt, plaster, and foreign debris with conduit plugs.

G. Fasten conduit support devices to structure with wood screws on wood, toggle bolts on hollow masonry, expansion anchors on solid masonry or concrete, and machine bolts or clamps on steel. Nails are not acceptable. Seal all conduits penetrating building exterior with insulating electrical putty to prevent entrance of moisture.

H. Conduit shall be run parallel or at right angles to walls, ceilings, and structural members. Support branch circuit conduits at intervals not exceeding 10 feet, and within 3 feet of each box or change of direction. Restore the fire rating of all wall and floor penetrations. Provide an expansion and deflection coupling where conduits cross a building expansion joint.

2.02 WIRES AND CABLES

A. The following specifications and standards are incorporated into and become a part of this specification:

1. Underwriter's Laboratories, Inc. Publications 44, 83, 486, 493.
2. Insulated Cable Engineers Association Standards S-61-402, S-66-524.
3. National Electrical Manufacturer's Standards WC-5, WC-7.

B. Conductors shall be electrically continuous and free from short circuits or grounds.

C. All open, shorted, or grounded conductors and any with damaged insulation shall be removed and replaced with new material free from defects.

D. Conductor size shall be minimum of No. 12 AWG, unless larger size is required by the drawings or the NEC. Insulation voltage level rating shall be 600 volts. All wire and cable shall bear the UL label.

E. Conductors No. 10 and smaller shall be solid copper, 75 degrees C, type THW or THWN/THHN. Conductors larger than No. 10 shall be stranded copper, 75 degrees C, type THW, THWN/THHN, or XHHW.

F. VFD cables shall be 600V/1000V rated with tinned copper conductors, shielded and suitable for use with variable frequency drives.

1. Insulation shall be 90 degrees C wet/dry.
2. Cable shall be suitable for use in wet/dry locations, indoors and outdoors, in cable trays, in conduits, trenches, and in underground ducts and direct burial.
3. The cable assembly shall be shielded by applying helically two 2-mil copper tapes (100% coverage) or by applying an 80% minimum coverage tinned copper braid shield used in conjunction with an aluminum foil shield tape.
4. The jacket shall be resistant to abrasion, rated for direct burial, sunlight resistant and flame resistant in accordance with UL 1277.

G. Color code all conductors. No. 10 and smaller shall have solid color compound or coating. No. 8 and larger shall have solid color compound or colored phase tape; tape shall be installed on conductors in every box, termination point, cabinet, or enclosure. Coding shall be as follows:

1. 208Y/120 volt three phase four wire wye system: Phase A-black, Phase B-red, PhaseC-blue, neutral-white.
2. 480Y/277 volt three phase four wire wye system: Phase A-brown, Phase B-orange, Phase C-yellow, neutral-grey.
3. Grounding conductors shall be green or green traced.

H. Maintain phase rotation established per N.E.C. at service equipment throughout entire project.

I. Group and lace with nylon tie straps all conductors within enclosures. Make splices in conductors only within junction boxes, wiring troughs, or other NEC approved enclosures. Do not splice conductors in pull boxes, witchboards, panelboards, safety switches, or motor control enclosures. Identify each conductor as to circuit connection in all boxes and enclosures.

J. Terminate stranded conductors No. 10 AWG and smaller with crimp-type lug or stud. Crimp terminal shall be the configuration type suitable for terminal point.

K. Torque each terminal connection to the manufacturer's recommended torque value. A calibrated torquing tool shall be used to insure proper torque application.

2.03 BOXES

A. The following specifications and standards are incorporated into and become a part of this specification:

1. Underwriter's Laboratories, Inc. Publications 50, 467, 514.

B. Boxes shall be hot-dipped galvanized steel sheet metal, unless rustproof cast metal is specified or required by the NEC.

C. Dimensions of pull and junction boxes shall not be less than those required by the NEC for the number, size, and position of conductors entering the box. Wood supports within pull boxes are not acceptable. Provide box covers for all boxes.

D. All boxes shall be completely accessible and as required by the NEC. Provide access panels in all non-accessible spaces to permit access to boxes. Box sizes shall be as required by Article 314 of the NEC.

E. Support every box from structure. Secure to wood with wood screws, hollow masonry with toggle bolts, metal with sheet metal screws, solid masonry or concrete with expansion anchors, metal studs with spring steel clamp, and structure with threaded steel rod when suspended.

F. Remove only knockouts as required and plug all unused openings. After completion, using indelible ink wide tip marker, indicate on the cover of each junction and pull box the designation of each circuit contained therein.

2.04 SUPPORTING DEVICES

A. Provide and install supporting devices which comply with manufacturer's standard materials, design, and construction in accordance with published standards and as required for complete installation.

B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices. Install hangars, supports, clamps, and attachments to support piping properly from building structure only. Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form water-tight seal.

2.05 ELECTRICAL IDENTIFICATION

A. Install engraved plastic - laminate sign on each major unit of electrical equipment. Provide a single line of text, 1/2" high lettering on 1 1/2" high sign (or 2" high sign if 2 lines required). Provide signs for each unit of the following:

1. Variable Frequency Drives
2. Electrical cabinets and enclosures
3. Motor controllers
4. Disconnect switches

16400 - DISTRIBUTION EQUIPMENT

3.01 GROUNDING SYSTEMS

A. Equipment grounding system shall be established with equipment ground conductors. The use of metallic raceways for equipment grounding is not acceptable. Unless indicated otherwise, provide equipment ground the same size as phase conductors.

B. The following specifications and standards are incorporated into and become a part of this specification:

1. Underwriter's Laboratories, Inc. Publications 44, 83, 467, 486, 493.
2. National Electrical Manufacturer's Association Standards WC-5, WC-7.

C. Equipment grounding conductors shall be green insulated type THW, THWN, or XHHW sized as indicated on the drawings. Where sizes are not indicated, grounding conductor shall be sized in accordance with NEC Article 250.

D. Provide a conductor termination grounding lug bonded to the enclosure of electrical equipment.

E. Ground all non-current carrying parts of the electrical system, i.e., wireways, equipment enclosures and frames, junction and outlet boxes, machine frames, and other conductive items in close proximity with electrical circuits.

F. Grounding conductors shall be provided in all branch circuit raceways and cables, including flexible conduit. Grounding conductors shall be the same AWG size as branch circuit conductors.

G. Equipment grounding conductors shall terminate on panel board, switchboard, or motor control center grounding bus only. Do not terminate on neutral bus.

END OF SECTION