County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph 217.384.3720

BROOKENS POD 200
2 MULTI-ZONE RTU REPLACEMENT PROJECT

AT

CHAMPAIGN COUNTY ADMINISTRATIVE SERVICES
1776 EAST WASHINGTON STREET
URBANA, ILLINOIS 61801

FOR

COUNTY OF CHAMPAIGN
URBANA, ILLINOIS 61802

PROJECT MANUAL
ITB #2017-002

May 4, 2017

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph217.384.3720

TABLE OF CONTENTS

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph217.384.3720

INDEX OF DRAWINGS

END OF TABLE OF CONTENTS 00 0100

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph 217.384.3720

May 4, 2017

BID: County of Champaign, Illinois
Brookens Pod 200 – 2 Multi-Zone RTU Replacement Project
THURSDAY, JUNE 1, 2017
2:00 P.M., Public Opening
Lyle Shields Conference Room
Brookens Administrative Center
1776 East Washington
Urbana, Illinois 61802-4581

Dear Bidder:

The County of Champaign is inviting the submission of sealed bids for Brookens Pod 200 – 2 Multi-Zone RTU Replacement Project located at 1776 East Washington Street, Urbana, Illinois.

Specifications are prepared with the intent of offering equal opportunity to all bidders. No oral interpretations will be given to any bidder as to the meaning of the specifications. Requests for clarification must be submitted **in writing** via mail, fax or email to:

GHR Engineers and Associates, Inc.
Attn.: John Meerdink
1615 South Neil Street
Champaign, IL 61820
Fax: (217) 356-1092
Email: jmeerdink@ghrinc.com

Clarification requests must be received no later than Tuesday, May 30, 2017, 12:00 noon to be considered.

Documents can be procured through Dean's Superior Blueprint Online Planroom.

Pursuant to the Illinois Prevailing Wage Act (820 ILCS 130/1 et seq.), not less than the prevailing rate of wages as determined by the Illinois Department of Labor, County of Champaign, or court on review shall be paid by the vendor/contractor to all laborers, workers and mechanics performing work under this purchase order.

All bids are to be sealed and in the hands of the undersigned by the due date and time stated above, at which time bids will be publicly opened. There will be no bids accepted after said date and time. Your bid is to be submitted on the bid form provided. The envelope containing your bid is to be sealed and marked in the lower left-hand corner: **"Sealed Bid: Brookens Pod 200 – 2 Multi-Zone Replacement Project".** Bids will not be accepted by FAX mail.

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
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The Champaign County Board reserves the right to reject any or all bids, to accept the bids, or to waive any irregularities should it deem to be in the best interest of the County of Champaign to do so. The bids will be awarded to the lowest responsible bidder meeting specifications as determined by the Champaign County Board.

Sincerely,

Dana Brenner
Facilities Director

END OF NOTICE TO BIDDERS 00 0200

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph 217.384.3720

DOCUMENT 00 1116 - INVITATION TO BID - #2017-002

1.1 PROJECT INFORMATION

A. Notice to Bidders: Qualified bidders are invited to submit bids for Project as described in this Document.

B. Project Identification: **Brookens Pod 200 – 2 Multi-Zone RTU Replacement Project.**

1. Project Location:

Champaign County Administrative Services
1776 East Washington Street
Urbana, Illinois 61801

C. Owner: County of Champaign

1. Owner's Representative:

Dana Brenner, Facilities Director
1776 East Washington
Urbana, IL 61802-4581
Phone: (217) 384-3765
Fax: (217) 384-3896
Email: dbrenner@co-champaign.il.us

D. Project Design Team: GHR Engineers and Associates, Inc.

E. Project Description: Project consists of:

1. Project consists of:

a. Removing two existing roof mounted multi-zone air handling units on Pod 200.
b. Install (2) new high efficiency triple deck multi-zone rooftop units with DDC controls in the same location.
c. Integrate new multi-zone unit and zone controls into existing Alpha building control system.

F. Certification Contract: Bids will be received for the following Work:

1. Single Prime Contract

1.2 BID SUBMITTAL AND OPENING

A. Owner will receive sealed bids until the bid time and date at the location indicated below. Owner will consider bids prepared in compliance with the Contract Documents issued by Owner, and delivered as follows:

1. **Bid Date: Thursday, June 1, 2017.**
2. **Bid Time: 2:00 p.m., local time.**

Location:
Lyle Shields Meeting Room
Brookens Administration Center
1776 East Washington
Urbana, IL 61802

B. Bids will be thereafter opened in the presence of the bidders and read aloud.

1.3 BID SECURITY

A. Bid security in the form of a bank draft/cashier's check, certified check, U.S. money order, or bid bond **payable to County of Champaign** shall be submitted with each bid in the amount of **ten (10) percent** of the bid amount. No bids may be withdrawn for a period of **sixty (60) days** after opening of bids. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.

1.4 PREBID CONFERENCE / SITE VISIT

A. A vendor prebid conference for all bidders will be held at **Lyle Shields Conference Room, Brookens Administration Center, 1776 East Washington Street, Urbana, Illinois** on Wednesday, May 17, 2017 at 2:00 pm, local time. Meet at front entrance. Prospective bidders are not required, but advised, to attend.

B. Building access for additional site visits may be made by contacting Owner's Representative.

Dana Brenner, Facilities Director
Phone: 217-384-3765
Fax: 217-384-3896
E-mail: dbrenner@co-champaign.il.us

1.5 DOCUMENTS

A. Documents can be procured through Dean's Superior Blueprint Online Planroom: https://www.deansplanroom.com/.

1.6 TIME OF COMPLETION

A. Bidders shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time.

1. Anticipated Award of Contract: Board Meeting, **June 23, 2017**.
2. Anticipated Letter of Notice of Award: On or about **June 24, 2017.**
3. Pre-Construction/Pre-Installation Meeting: TBD.
4. **Substantial Completion: September 26, 2017.**
5. Punch List: Issued on or about **September 27, 2017**.
6. **Final Completion: October 10, 2017.**

1.7 BIDDER'S QUALIFICATIONS

A. Bidders must be properly licensed under the laws governing their respective trades and be able to obtain insurance and bonds required for the Work. **A Performance Bond, a separate Labor and Material Payment Bond, and Insurance in a form acceptable to Owner will be required of the successful Bidder.**

1.8 EXAMINATION

A. Bidders shall tour the project location to familiarize themselves with the locations of existing equipment to include all the cost of demo and new work as shown on the drawings.

END OF DOCUMENT 00 1116

County of Champaign, Illinois
1776 East Washington
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DOCUMENT 00 2213 - SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

1.1 SUPPLEMENTARY INSTRUCTIONS TO BIDDERS - BIDDER'S REPRESENTATIONS

A. The Bidder has investigated all required fees, permits, and regulatory requirements of authorities having jurisdiction and has properly included in the submitted bid the cost of such fees, permits, and requirements not otherwise indicated as provided by Owner.

1. Permit Application: Complete building permit application and file with authorities having jurisdiction within five days of the Notice of Award.

B. The Bidder is a properly licensed Contractor according to the laws and regulations of The State of Illinois and meets qualifications indicated in the Procurement and Contracting Documents.

C. The Bidder has incorporated into the Bid adequate sums for work performed by installers whose qualifications meet those indicated in the Procurement and Contracting Documents.

1.2 BIDDING DOCUMENTS

A. Interpretation or Correction of Procurement and Contracting Documents:

1. Submit Bidder's Requests for Interpretation as outlined in the Notice to Bidders.

B. Submit Requests for Substitution on form provided. Substitution requests shall be in advance of bid.

C. Addenda:

1. Addenda may be issued at any time prior to the receipt of bids.

2. Owner may elect to waive the requirement for acknowledging receipt of Addenda as follows:

a. Information received as part of the Bid indicates that the Bid, as submitted, reflects modifications to the Procurement and Contracting Documents included in an unacknowledged Addendum.

b. Modifications to the Procurement and Contracting Documents in an unacknowledged Addendum do not, in the opinion of Owner, affect the Contract Sum or Contract Time.

1.3 BIDDING PROCEDURES

A. Preparation of Bids:

1. The Bid shall include unit prices when called for by the Procurement and Contracting Documents. Owner may elect to consider unit prices in the determination of award. Unit prices will be incorporated into the Contract.

2. Owner may elect to disqualify a bid due to failure to submit a bid in the form requested, failure to bid requested alternates or unit prices, failure to complete entries in all blanks in the Bid Form, or inclusion by the Bidder of any alternates, conditions, limitations or provisions not called for.

Retail sales tax will NOT be included in the bid amount. The Owner is exempted by Section 3 of the Illinois Use Tax Act (Section 3, House Bill 1610, approved July 31, 1961, Illinois Revised Statutes 1967, Chapter 120, Section 439.3) from paying any of the taxes imposed by the Act and sales to Owner are exempt by Section 2, House Bill 1609, approved July 31, 1961, Illinois Revised statutes 1967, Chapter 120, Section 441) from any of the taxes imposed by the Act. The Department of Revenue of the State of Illinois under Rule No. 15, issued August 9, 1961, has declared that sales of materials to construction contractors for conversion into real estate for schools, governmental bodies, agencies and instrumentalities are not taxable retail sales. **The Contractor shall be responsible for any sales, consumer, use and similar taxes for the Work.**

3. Owner is not responsible for any costs incurred by a Contractor in the preparation or delivery of bids. The Contractor shall be responsible for the actual delivery of bids during business hours to the address indicated. Any bid received after the delivery deadline will be disqualified.

4. Owner reserves the right to obtain clarification of any point in a Contractor submittal or to obtain additional information.

FOIA: As an independent Contractor of the District, records in the possession of the Contractor related to this Agreement may be subject to the Illinois Freedom of Information Act ("FOIA"), 5 ILCS 140/5-1 et seq.; 5 ILCS 140/7(2). The Contractor shall immediately provide the District with any such records

requested by the District in order to timely respond to any FOIA request received by the District.

B. Subcontractors, Suppliers, and Manufacturers List Bid Supplement:

1. Provide list of major subcontractors, suppliers, and manufacturers furnishing or installing products no later than **ten (10) business days** following Notice to Proceed. Do not change subcontractors, suppliers, and manufacturers from those submitted without approval of Owner.

1.4 CONSIDERATION OF BIDS

A. Rejection of Bids:

Owner reserves the right to reject a bid based on Owner's and Design Team's evaluation of qualification information submitted following opening of bids. Owner's evaluation of the Bidder's qualifications will include: status of licensure and record of compliance with licensing requirements, record of quality of completed work, record of Project completion and ability to complete, record of financial management including financial resources available to complete Project and record of timely payment of obligations, record of Project site management including compliance with requirements of authorities having jurisdiction, record of and number of current claims and disputes and the status of their resolution, and qualifications of the Bidder's proposed Project staff and proposed subcontractors.

1.5 PERFORMANCE BOND AND PAYMENT BOND

A. Both a Performance Bond and a Payment Bond will be required, each in an amount equal to 100 percent of the Contract Sum.

B. The Bidder shall deliver the required bonds to Owner no later than **ten (10)** days after the date of Notice of Intent to Award and no later than the date of execution of the Contract, whichever occurs first. Owner may deem the failure of the Bidder to deliver required bonds within the period of time allowed a default.

C. Bonds shall be executed and be in force on the date of the execution of the Contract.

1.6 INSURANCE

GENERAL The successful bidder shall maintain for the duration of the contract and any extensions thereof, at bidder's expense, insurance that includes "Occurrence" basis wording and is issued by a company or companies qualified to do business in the State of Illinois that are acceptable to the County, which generally requires that the company(ies) be assigned a Best's Rating of A or higher with a Best's financial size category of Class A-/VII or higher, in the following types and amounts:

1. Commercial General Liability in a broad form, to include, but not limited to, coverage for the following where exposure exists: Bodily Injury and Property Damage, Premises/Operations, Independent contractors, Products/Completed Operations, Personal Injury and Contractual Liability; limits of liability not less than: $1,000,000 per occurrence and $2,000,000 in the aggregate, and inclusion of a waiver of subrogation in favor of Champaign County;
2. Business Auto Liability to include, but not be limited to, coverage for the following where exposure exists: Owned Vehicles, Hired and Non-Owned Vehicles and Employee Non-Ownership; limits of liability not less than: $1,000,000 per occurrence, combined single limit for: Bodily Injury Liability and Property Damage Liability;
3. Workers' Compensation Insurance to cover all employees and meet statutory limits in compliance with applicable state and federal laws. The coverage must also include Employer's Liability with minimum limits of $500,000 for each incident, $500,000 for each disease and $500,000 aggregate, and a waiver of subrogation in favor of Champaign County.

B. EVIDENCE OF INSURANCE The successful bidder agrees that with respect to the above required insurance that:

1. The County of Champaign shall be provided with Certificates of Insurance evidencing the above required insurance, prior to commencement of the contract and thereafter with certificates evidencing renewals or replacements of said policies of insurance at least fifteen (15) days prior to the expiration or cancellation of any such policies;
2. The contractual liability arising out of the contract shall be acknowledged on the Certificate of Insurance by the insurance company;
3. The County of Champaign shall be provided with thirty (30) days prior notice, in writing, of Notice of Cancellation or material change and said notification requirement shall be stated on the Certificate of Insurance;
4. Subcontractors, if any, shall execute the Subcontractor Agreement provided by Champaign County, and comply with the same insurance requirements as contractors.

5. In addition to being named as an additional insured on the Certificate of Insurance, each liability policy shall contain an endorsement naming the County of Champaign as an additional insured. A copy of the endorsement shall be provided to Champaign County along with the Certificate of Insurance; and,
6. Champaign County must be named as an additional insured, on a primary and noncontributory basis, and the address for certificate holder must read exactly as: County of Champaign, a body politic 1776 East Washington Street, Urbana, IL 61802
7. Insurance Notices and Certificates of Insurance shall be provided to: Champaign County, Insurance Specialist, Administrative Services Department, 1776 East Washington Street, Urbana, IL 61802

1.7 STANDARD CONTRACT CONDITIONS

A. This contract shall be governed in all aspects as to validity, construction, capacity, performance, or otherwise by the laws of the State of Illinois.

B. Contractors shall comply with the Civil Rights Act of 1964, as amended, all applicable State and Federal non-discrimination laws including but not limited to the Family and Medical Leave Act, the Americans with Disabilities Act, the Age Discrimination in Employment Act and shall comply with the provisions of the Illinois Human Rights Act.

C. Contractors shall not assign, transfer, convey, sublet, or otherwise dispose of this contract, including any or all of it right, title or interest therein, or its power to execute such contract to any person, company or corporation, without prior written consent of The County of Champaign.

D. By submitting a bid the Contractor certifies that the Contractor is not barred from bidding on this contract as a result of a violation of either the bid-rigging or bid-rotating provisions of Article 33E of the Criminal Code of 1961, as amended.

By submitting a bid, the Contractor, having 25 or more employees, does hereby certify pursuant to Section 3 of the Illinois Drug-Free Workplace Act (30 ILCS 580/3) that it shall provide a drug-free workplace for all employees engaged in the performance of work under the contract by complying with the requirements of the Illinois Drug-Free Workplace Act and, further certifies, that it is not ineligible for award of this contract by reason of debarment for a violation of the Illinois Drug-Free Workplace Act.

E. By submitting a bid, the Contractor does hereby certify pursuant to Section 2-105 of the Illinois Human Rights Act (775 ILCS 5/2-105) that it has a written sexual harassment policy that includes, at a minimum, the following information: (i) the illegality of sexual harassment; (ii) the definition of sexual harassment under State law; (iii) a

description of sexual harassment, utilizing examples; (iv) an internal complaint process including penalties; (v) the legal recourse, investigative and complaint process available through the Department of Human Rights and Human Rights Commission; (vi) direction on how to contact the Department of Human Rights and Human Rights Commission; and (vii) protection against retaliation.

1.8 STATEMENT OF NON-DISCRIMINATION

A. The Illinois Human Rights Acts prohibits discrimination on the basis of: "race, color, religion, sex, national origin, ancestry, age, order of protection status, marital status, physical or mental disability, military status, sexual orientation, or unfavorable discharge from military service in connection with employment, real estate transactions, access to financial credit, and the availability of public accommodations." It also prohibits sexual harassment and discrimination in employment on the basis of citizenship status.

1.9 PREVAILING WAGE

A. This contract calls for the construction of a "public work" within the meaning of the Illinois Prevailing Wage Act, 920 ILCS 130/.01. The Act requires contractors and subcontractors to pay all laborers, workers and mechanics performing services on public works projects no less than the "prevailing rate of wages" (hourly cash wages plus fringe benefits) in the county where the work is performed. Each Contractor and Subcontractor rendering services under this contract must comply with all requirements of this Act. Each Contractor and Subcontractor shall keep records of the prevailing wages paid to their employees, submit a monthly certified payroll to County of Champaign, and make such records available to County of Champaign for inspection upon seven business days notice.

B. For information regarding the current prevailing wage rates for Champaign County, Illinois can be found at:

http://www.illinois.gov/idol/laws-rules/conmed/pages/rates.aspx.

C. Prevailing Wage Rates change periodically. Contractor shall verify and revise the prevailing wages on a regular basis.

1.10 FAILURE TO FULFILL CONTRACT

A. When any Contractor fails to provide a service or provides a service which does not conform to the specifications, County of Champaign may, at its sole discretion, annul

and set aside the contract entered into with said Contractor, either in whole or in part, and make and enter into a new contract for the same services in such manner as seems to County of Champaign to be to its best advantage. Any failure to furnish services by reason of the failure of the Contractor, as stated above, shall be a liability against such Contractor and his sureties. County of Champaign reserves the right to cancel, without penalty, any services which the successful Contractor may be unable to furnish because of economic conditions, governmental regulations or other similar causes beyond the control of the Contractor provided satisfactory proof is furnished to County of Champaign if requested.

Without Cause Termination: The County may terminate its contract with the Contractor without cause after providing the Contractor with thirty (30) days written notice.

1.11 EXECUTION OF THE CONTRACT

A. Subsequent to the Notice of Intent to Award, and within **ten (10) business days** after the prescribed Form of Agreement is presented to the Awardee for signature, the Awardee shall execute and deliver the Agreement to Owner through Engineer, in such number of counterparts as Owner may require.

B. Owner may deem as a default the failure of the Awardee to execute the Contract and to supply the required bonds and insurance when the Agreement is presented for signature within the period of time allowed.

C. Unless otherwise indicated in the Procurement and Contracting Documents of the executed Agreement, the date of commencement of the Work shall be the date of the executed Agreement.
In the event of a default, Owner may declare the amount of the Bid security forfeited and elect to either award the Contract to the next responsible bidder or re-advertise for bids.

1.12 INDEMNITY

A. To the fullest extent permitted by law, Contractor shall indemnify and hold harmless the Owner from and against claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or resulting from performance of the work provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property, but only to the extent caused by the negligent acts or omissions of the Contractor, a subcontractor, anyone directly or indirectly employed by them or anyone for whose

acts they may be liable, regardless of whether or not such claim damage, loss or expense is caused in part by a party indemnified hereunder.

END OF DOCUMENT 00 2213

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph 217.384.3720

DOCUMENT 00 4113 - BID FORM - STIPULATED SUM (SINGLE-PRIME CONTRACT)

1.1 BID INFORMATION

A. Bidder: _____.

B. Project Name: **Brookens Pod 200 – 2 Multi-Zone RTU Replacement Project**

C. Project Location: Champaign County Administrative Services
1776 East Washington Street
Urbana, Illinois 61801

D. Owner: County of Champaign

E. Building Design Team: GHR Engineers and Associates, Inc.

1.2 CERTIFICATIONS AND BASE BID

A. Base Bid, Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by the Design Team, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:

Base Bid
1. _____Dollars ($_____).

1.3 BID GUARANTEE

A. The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within **ten (10)** days after a written Notice of Award, if offered within **sixty (60)** days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached bank draft/cashier's check, certified check, U.S. money order, or bid bond **payable to County of Champaign**, as liquidated damages for such failure, in an amount constituting **ten percent (10%)** of the Base Bid amount:

Base Bid

1. _____Dollars ($_____).

B. In the event Owner does not offer Notice of Award within the time limits stated above, Owner will return to the undersigned the bank draft/cashier's check, certified check, U.S. money order, or bid bond.

1.4 SUBCONTRACTORS AND SUPPLIERS

A. The following companies shall execute subcontracts for the portions of the Work indicated:

1. General Work:_____.
2. Electrical Work:_____.
3. Plumbing Work:_____.
4. Fire Protection Work:_____.

1.5 TIME OF COMPLETION

A. The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issued by Owner, and shall fully complete the Work as indicated in the Invitation to Bid.

1.6 ACKNOWLEDGEMENT OF ADDENDA

A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:

1. Addendum No. 1, dated _____.
2. Addendum No. 2, dated _____.
3. Addendum No. 3, dated _____.

1.7 CONTRACTOR'S LICENSE

A. The undersigned warrants that he/she is duly authorized to bind contractually the entity submitting this bid, to fully perform all duties and to deliver all services in accordance with the terms and conditions set forth herein. All signatures to be sworn before a Notary Public.

1.8 SUBMISSION OF BID

Respectfully submitted this ____ day of _____, 2017.

Submitted By: _____
(Name of bidding firm or corporation)

Authorized Signature: _____
(Handwritten signature)

Signed By: _____
(Type or print name)

Title: _____
(Owner/Partner/President/Vice President)

Witness By: _____
(Handwritten signature)

Attest: _____
(Handwritten signature)

By: _____
(Type or print name)

Subscribed and sworn to before me this

_____Day of _____, 2017.

_____, Notary Public

(Affix Notary Seal Here)

END OF DOCUMENT 00 4113

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph 217.384.3720

DOCUMENT 00 4313 - BID SECURITY FORMS

1.1 BID FORM SUPPLEMENT

A. A completed bid bond form is required to be attached to the Bid Form.

1.2 BID BOND FORM

A. AIA Document A310, "Bid Bond," is the recommended form for a bid bond. A bid bond acceptable to Owner, is required to be attached to the Bid Form as a supplement.

B. Copies of AIA standard forms may be obtained from The American Institute of Architects; www.aia.org/contractdocs/purchase/index.htm; email: docspurchases@aia.org; (800) 942-7732.

END OF DOCUMENT 00 4313

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
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SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.1 PROJECT INFORMATION

A. Project Identification: **Brookens Pod 200 – 2 Multi-Zone RTU Replacement Project**

Project Location:
Champaign County Administrative Services
1776 East Washington Street
Urbana, Illinois 61801

B. Owner: County of Champaign

C. Design Team: GHR Engineers and Associates, Inc.

D. Project consists of:

1. Removing two existing roof mounted multi-zone air handling units on Pod 200.
2. Install (2) new high efficiency triple deck multi-zone rooftop units with DDC controls in the same location.
3. Integrate new multi-zone unit and zone controls into existing Alpha building control system.

1.2 WORK RESTRICTIONS

A. Contractor's Use of Premises: During construction, Contractor will have limited use of site and building indicated. Contractor's use of premises is limited only by Owner's right to perform work or employ other contractors on portions of Project and as follows:

1. First subparagraph below contains an example of limitations on Contractor's use of premises; delete if not applicable. Insert other descriptions of areas or types of limited use, requirements for cooperation with Owner's personnel, noninterference with Owner's or public use, and other necessary restrictions if required.
2. Owner will occupy premises during construction. Perform construction only during normal working hours 8 AM to 5 PM Monday thru Friday, other than holidays, unless otherwise agreed to in advance by Owner. Clean up work areas and return to usable condition at the end of each work period.

3. Limits: Limit site disturbance.
4. Driveways, Walkways, and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 8 AM to 5 PM, Monday through Friday, unless otherwise indicated.

1. Weekend Hours: As permitted by Owner. Coordinate with Owner.
2. Early Morning Hours: 7 AM or as permitted by Owner. Coordinate with Owner.

C. Nonsmoking Building: Smoking is not permitted within the building or on the project site.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

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SECTION 01 2000 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 PAYMENT PROCEDURES

A. Submit a Schedule of Values at least **seven (7)** days before the initial Application for Payment. Break down the Contract Sum into at least one line item for each Specification Section in the Project Manual table of contents. Coordinate the schedule of values with Contractor's construction schedule.

1. Arrange schedule of values consistent with format of AIA Document G703.
2. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
3. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
4. Provide separate line items in the schedule of values for initial cost of materials and for total installed value of that part of the Work.
5. Provide a separate line item in the schedule of values for each allowance.

B. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 forms for Applications for Payment.

1. Anticipated Application for Payment Schedule:

   a. Application for Payment No. 01: once material is delivered to project site
   b. Application for Payment No. 02: upon completion of installation
   c. Application for Payment No. 03: Final payment upon completion of punch list, receipt of all close-out documents and completion of owner training

C. Submit **three (3)** copies of each application for payment according to the schedule established in Owner/Contractor Agreement.

1. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor.
2. With each Application for Payment, Contractor shall include the Contractor’s waiver of lien for the full amount and partial waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

3. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

   a. Include insurance certificates, proof that taxes, fees, and similar obligations were paid, and evidence that claims have been settled.
   b. Include affidavit of payment of debts and claims on AIA Document G706.
   c. Include affidavit of release of liens on AIA Document G706A.
   d. Include consent of surety to final payment on AIA Document G707.

4. Certified Payroll Statements: The Contractor shall submit Certified Payroll Statements pursuant to Illinois Law-Public Act 94-0515 with each payment application. The *Certified Transcript of Payroll* statement forms are available through the Illinois Department of Labor website: http://www.state.il.us/agency/idol/forms/pdfs/IL452CM02.pdf. Certified payroll statements are required from the Contractor and each Subcontractor. The statements are to include the time period of the payment application. Payment Applications will not be processed without accompanying Certified Payroll Statements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2000

County of Champaign, Illinois
1776 East Washington
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SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUBSTITUTION PROCEDURES

A. Substitutions include changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

B. Substitution Requests: Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles. Substitutions will NOT be considered after bidding.

1. Substitution Request Form: Use facsimile of form provided in the Project Manual.
2. Submit requests by noon on May 31, 2017.
3. Identify product to be replaced and show compliance with requirements for substitutions. **Include a detailed comparison of significant qualities of proposed substitution with those of the Work specified**, a list of changes needed to other parts of the Work required to accommodate proposed substitution, and any proposed changes in the Contract Sum or the Contract Time should the substitution be accepted.
4. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

    a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. **Indicate deviations, if any, from the Work specified.**
    d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

e. Samples, where applicable or requested:

1) All samples shall be clearly labeled with product information and Vendor contact information.

f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

C. Engineer will review proposed substitutions and notify Contractor of their acceptance or rejection via Addendum. If necessary, Engineer will request additional information or documentation for evaluation.

1. Use product specified if Engineer does not issue a decision on use of a proposed substitution within time allocated.

D. Do not submit unapproved substitutions on Shop Drawings or other submittals.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph217.384.3720

SUBSTITUTION REQUEST FORM

Project: Brookens Pod 200 – 2 Multi-Zone RTU Replacement Project

Request No.:

Date:

Location (provide room number(s):

Name of Material, Product or Equipment item specified:

Name of Material, Product or Equipment item submitted as substitution:

Specification Section:

Qualities that differ from specified product or system:

Name of Manufacturer / Fabricator:

Address

City, State and Zip **Phone:**

Name of Vendor / Supplier Requesting Change	Address	Contact Name	Phone:

Reason for requesting substitution request:

Substitution affects other materials or systems, such as dimensional revisions, redesign of structure or modifications to other work:

_____NO

_____YES; describe requirements:

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph217.384.3720

If substitution requires modifications to dimensions indicated on drawings, are such modifications clearly indicated on attached data?

_____YES

_____NO; if NO, explain:

Substitution has an affect on Construction Schedule:

_____NO

_____YES; describe affect on schedule:

Savings or Credit to Contract Amount for accepting substitute:

_____Dollars ($_____).
Note: Show bid amount in both words and figures.

The attached data is furnished herewith for evaluation of the substitution:

_____Product Data _____Drawings _____Samples _____Tests _____Reports

_____Other Information; describe:

The undersigned hereby certifies:

1. The proposed substitution has been fully investigated and is equal or superior to specified product.
2. The same or better warranty will be furnished for proposed substitution as for specified material, product or equipment.
3. All changes in the work resulting from the use of this substitution, if approved, will be coordinated and completed in all respects and all costs, including, but not limited to, those for additional services rendered by the Owner are the responsibility for this Contractor at no additional cost to the Contract.

_____ _____
Contractor Signed by

_____
Address

_____
City, State and Zip

END OF SUBSTITUTION FORM 01 2500a

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph 217.384.3720

SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 CONTRACT MODIFICATION PROCEDURES

A. Design Team will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

B. Owner-Initiated Proposal Requests: Design Team will issue a detailed description of proposed changes in the Work.

1. Proposal Requests are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time.

C. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Design Team.

D. On Owner's approval of a Proposal Request, Design Team will issue a Change Order for signatures of Owner and Contractor, for all changes to the Contract Sum or the Contract Time.

E. Design Team may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

F. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph 217.384.3720

SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 PROJECT MANAGEMENT AND COORDINATION

A. Subcontract List: Submit a written summary identifying individuals or firms proposed for each portion of the Work.

B. Key Personnel Names: Within ten (10) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. List e-mail addresses and telephone numbers.

C. Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work.

D. Requests for Information (RFIs): On discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI. Use forms acceptable to Design Team and Owner.

E. Schedule and conduct (2) progress meetings at Project site, coordinated with the Design Team and Owner. **Notify Owner of meeting dates and times.** Require attendance of each subcontractor or other entity concerned with current progress or involved in planning, coordination, or performance of future activities.

1.2 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

1. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
2. Submit two copies of each action submittal. Design Team will return one copy.
3. Submit one copy of each informational submittal. Design Team will not return copies.
4. Design Team will discard submittals received from sources other than Contractor.

B. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with unique identifier, including project identifier, Specification Section number, and revision identifier.
3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Design Team.

C. Identify options requiring selection by Design Team.

D. Identify deviations from the Contract Documents on submittals.

E. Contractor's Construction Schedule Submittal Procedure:

1. Submit required submittals in the following format:

a. PDF electronic file.

2. Coordinate Contractor's construction schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections.

1. Submit electronic submittals via email as PDF electronic files to Shannon Hicks at GHR Engineers and Associates, Inc.: shicks@ghrinc.com.

a. Design Team will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2.2 ACTION SUBMITTALS

A. Submit two paper copies of each submittal unless otherwise indicated. Design Team will return one copy.

B. Product Data: Mark each copy to show applicable products and options. Include the following:

1. Manufacturer's written recommendations, product specifications, and installation instructions.
2. Wiring diagrams showing factory-installed wiring.
3. Printed performance curves and operational range diagrams.
4. Testing by recognized testing agency.
5. Compliance with specified standards and requirements.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Submit on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches. Include the following:

1. Dimensions and identification of products.
2. Fabrication and installation drawings and roughing-in and setting diagrams.
3. Wiring diagrams showing field-installed wiring.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.

2.3 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Submit one paper copy of each submittal unless otherwise indicated. Design Team will not return copies.

B. Qualification Data: Include lists of completed projects with project names and addresses, names and addresses of Design Team and owners, and other information specified.

C. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

PART 3 - EXECUTION

3.1 SUBMITTAL REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Design Team.

B. Design Team will review each action submittal, make marks to indicate corrections or modifications required, will stamp each submittal with an action stamp, and will mark stamp appropriately to indicate action.

C. Informational Submittals: Design Team will review each submittal and will not return it, or will return it if it does not comply with requirements. Design Team will forward each submittal to appropriate party.

D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 3000

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph 217.384.3720

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

B. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to Design Team for a decision.

C. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum. The actual installation may exceed the minimum within reasonable limits. Indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Design Team for a decision.

D. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, notices, receipts for fee payments, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

F. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated; and where required by authorities having jurisdiction, that is acceptable to authorities.

G. Retesting / Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced work that failed to comply with the Contract Documents.

H. Testing Agency Responsibilities: Cooperate with Design Team and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Design Team and Contractor of irregularities or deficiencies in the work observed during performance of its services.
2. Do not release, revoke, alter or increase requirements of the Contract Documents or approve or accept any portion of the work.
3. Do not perform any duties of Contractor.

I. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

J. Tests and Inspections: Owner will engage a qualified inspector to conduct inspections required by authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

B. Contractor will maintain a safe work site at all times. When the project is complete, Contractor shall return the work site and the surrounding areas to the same condition as they were prior to the beginning of the project.

END OF SECTION 01 4000

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph 217.384.3720

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

B. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced.

1. Show compliance with requirements for comparable product requests.
2. Design Team will review the proposed product and notify Contractor of its acceptance or rejection.

C. Basis-of-Design Product Specification Submittal: Show compliance with requirements.

D. Compatibility of Options: If Contractor is given option of selecting between two or more products, select product compatible with products previously selected.

E. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Deliver products to Project site in manufacturer's original sealed container or packaging, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
3. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
4. Store materials in a manner that will not endanger Project structure.
5. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

F. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers

and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. Provide products that comply with the Contract Documents, are undamaged, and, unless otherwise indicated, are new at the time of installation.

1. Provide products complete with accessories, trim, finish, and other devices and components needed for a complete installation and the intended use and effect.
2. Where products are accompanied by the term "as selected," Owner will make selection.
3. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Where the following headings are used to list products or manufacturers, the Contractor's options for product selection are as follows:

1. Products:

   a. Where requirements include "one of the following," provide one of the products listed that complies with requirements.
   b. Where requirements do not include "one of the following," provide one of the products listed that complies with requirements or a comparable product.

2. Manufacturers:

   a. Where requirements include "one of the following," provide a product that complies with requirements by one of the listed manufacturers.
   b. Where requirements do not include "one of the following," provide a product that complies with requirements by one of the listed manufacturers or another manufacturer.

3. Basis-of-Design Product: Provide the product named, or indicated on the Drawings, or a comparable product by one of the listed manufacturers.

2.2 COMPARABLE PRODUCTS

A. Design Team will consider Contractor's request for comparable product in advance of Bidding only when the following conditions are satisfied:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications.
3. List of similar installations for completed projects, if requested.
4. Samples, where applicable.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph 217.384.3720

SECTION 01 7000 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 EXECUTION REQUIREMENTS

A. Cutting and Patching:

1. Structural Elements: When cutting and patching structural elements, notify Design Team of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.2 CLOSEOUT SUBMITTALS

A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

B. Certified List of Incomplete Items: Final submittal at Final Completion.

C. Operation and Maintenance Data: Submit two (2) copies of manual.

D. PDF Electronic File: Assemble manual into a composite electronically indexed file. Submit two (2) copies on digital media.

E. Record Product Data: Submit two (2) paper copies and annotated PDF electronic files and directories of each submittal.

1.3 SUBSTANTIAL COMPLETION PROCEDURES

A. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.

B. Submittals Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:

1. Submit closeout submittals specified in other sections, including project record documents, operation and maintenance manuals, similar final record information, warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
2. Submit maintenance material submittals specified in other sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner.
3. Submit test/adjust/balance records.

C. Procedures Prior to Substantial Completion: Before requesting Substantial Completion inspection, complete the following:

1. Complete startup and testing of systems and equipment.
2. Perform preventive maintenance on equipment used prior to Substantial Completion.
3. Remove temporary facilities and controls.
4. Complete final cleaning requirements, including touchup painting.
5. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer will proceed with inspection or advise Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.

1.4 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting inspection for determining final completion, complete the following:

1. Submit a final Application for Payment.

2. Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved.

B. Submit a written request for final inspection for acceptance. On receipt of request, Design Team will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare final Certificate for Payment after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

PART 2 - PRODUCTS

2.1 MATERIALS

A. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

2.2 OPERATION AND MAINTENANCE DOCUMENTATION

A. Directory: Prepare a single, comprehensive directory of operation and maintenance data and materials, listing items and their location to facilitate ready access to desired information.

B. Organization: Unless otherwise indicated, organize manual into separate sections for each system and subsystem, and separate sections for each piece of equipment not part of a system.

1. Dividers: Provide heavy paper dividers with celluloid-covered tabs for each separate Section. Mark each tab to indicate contents. Provide a typed description of the product and major parts of equipment included in the Section on each divider.

C. Organize data into three-ring binders with identification on front and spine of each binder, and envelopes for folded drawings. Identify each binder on the front and spine with the printed title “OPERATION AND MAINTENANCE MANUAL”, Project title or name, year and subject matter covered. Indicate volume number for multiple volume sets of manuals. Include the following:

1. Manufacturer's operation and maintenance documentation.
2. Maintenance and service schedules.
3. Maintenance service contracts. Include name and telephone number of service agent.
4. Emergency instructions.
5. Spare parts list and local sources of maintenance materials.
6. Wiring diagrams.
7. Copies of warranties. Include procedures to follow and required notifications for warranty claims

2.3 RECORD DRAWINGS

A. Record Prints: Maintain a set of prints of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued. Mark to show actual installation where installation varies from that shown originally. Accurately record information in an acceptable drawing technique.

1. Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings.

1. Format: Annotated PDF electronic file.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Verify compatibility with and suitability of substrates.
2. Examine roughing-in for mechanical and electrical systems.
3. Examine walls, floors, and roofs for suitable conditions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Take field measurements as required to fit the Work properly. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication.

D. Verify space requirements and dimensions of items shown diagrammatically on Drawings.

3.2 CONSTRUCTION LAYOUT

A. Before proceeding to lay out the Work, verify layout information shown on Drawings.

3.3 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Conceal wiring in finished areas unless otherwise indicated.
3. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations.

C. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

D. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed.

E. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Owner.

F. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

G. Use products, cleaners, and installation materials that are not considered hazardous.

3.4 CUTTING AND PATCHING

A. Provide temporary support of work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

D. Cutting: Cut in-place construction using methods least likely to damage elements retained or adjoining construction.

1. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

E. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will minimize evidence of patching and refinishing.

2. Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance.
3. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

3.5 CLEANING

A. Clean Project site and work areas daily, including common areas. Dispose of materials lawfully.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
3. Remove debris from concealed spaces before enclosing the space.

B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion:

1. Clean Project site and grounds, in areas disturbed by construction activities. Sweep paved areas; remove stains, spills, and foreign deposits. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
2. Sweep paved areas broom clean. Remove spills, stains, and other foreign deposits.
3. Remove labels that are not permanent.
4. Clean transparent materials, including mirrors. Remove excess glazing compounds.
5. Clean exposed finishes to a dust-free condition, free of stains, films, and foreign substances. Sweep concrete floors broom clean.
6. Vacuum carpeted surfaces.
7. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and foreign substances. Clean plumbing fixtures. Clean light fixtures, lamps, globes, and reflectors.

3.6 OPERATION AND MAINTENANCE MANUAL PREPARATION

A. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

B. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are unavailable and where the information is necessary for proper operation and maintenance of equipment or systems.

C. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams.

3.7 DEMONSTRATION AND TRAINING

A. Contractor to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Include a detailed review of the following:

1. Include instruction for basis of system design and operational requirements, review of documentation, emergency procedures, operations, adjustments, troubleshooting, maintenance, and repairs.

B. Contractor shall train Owner’s teaching faculty on the online monitoring functionality of new system.

END OF SECTION 01 7000

County of Champaign, Illinois
1776 East Washington
Urbana, IL 61801
Ph 217.384.3720

SECTION 01 7419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL (Not Used)

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Review locations established for recycling and disposal.

3.2 RECYCLING WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Sort and stack reusable members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
2. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
3. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Metals: Separate metals by type.

3.3 DISPOSAL OF WASTE

A. Except for items or materials to be recycled or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

B. Recycle recyclable materials off-site.

C. Do not burn waste materials.

END OF SECTION 01 7419

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Base Bid

1. HVAC Contractor: Work includes the following:

a. Equipment installation requirements common to equipment sections.
b. Painting and finishing.
c. Supports and anchorages.

1.2 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-dieneterpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Welding certificates.

1.4 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.

1.5 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.

1.6 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."

1.7 HAZARDOUS MATERIALS

A. No asbestos-containing materials may be used anywhere on this project.

B. No lead-based materials may be used anywhere on this project.

1.8 LOCATION OF EQUIPMENT

A. The approximate location of all equipment and pipe is shown on the drawings.

B. Architect / Engineer may change the location of any equipment or piping 5' in any direction without these changes being made the subject of an extra charge provided such changes are made before final installation.

C. Where offsets in piping, additional fittings, necessary drains, minor valves, traps, devices, etc., are required to complete the installation, to clear obstructions or the work of other Contractors or for the proper operation of the system, these shall be deemed to be included in the Contract and shall be furnished and installed complete by the Contractor at no additional charge.

PART 2 - PRODUCTS (DOES NOT APPLY)

PART 3 - EXECUTION

3.1 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.

3.2 SPACE PREFERENCE

A. Coordinate the location and elevation of all work. Verify with all other Contractors to avoid conflicts.

B. In case of conflicts, the following installation priorities shall prevail:

1. Recessed electric fixtures
2. Sanitary / vent and storm drainage
3. Low pressure ductwork
4. Domestic water lines
5. Sprinkler lines
6. Electric conduits

C. No other work shall have preference over plumbing lines below fixtures.

D. No other work shall have preference over bus duct or conduit above or below electric switchgear and panels.

E. No piping conveying fluids shall be installed directly over electrical or elevator equipment.

3.3 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.

3.4 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.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Base Bid

1. HVAC Contractor: 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.

1.2 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 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: Separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

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

G. Insulation: Class F.

H. Code Letter Designation:

1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

I. 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.

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, 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

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Base Bid

1. HVAC Contractor: Work includes:

a. Balancing Air Systems:

1) Constant-volume air systems.

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

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

E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

A. Qualification Data: Within 45 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Certified TAB reports.

C. 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.

1.4 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by the Engineer.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.5 PROJECT CONDITIONS

A. Partial Using Agency Occupancy: Using Agency may occupy completed areas of building before Substantial Completion. Cooperate with Using Agency during TAB operations to minimize conflicts with Using agency's operations.

1.6 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, engage one of the following:

1. Airdronics (815) 561-0339.
2. Balancing Precision, Inc. (800) 347-6315.
3. Certified Test (217) 632-3479.
4. Thermodynamic Balance, Inc. (309) 365-2520.

3.2 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 systems for installed 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 accessible.

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

D. 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.

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

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

G. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

H. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

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

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

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

L. 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.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 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", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" 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 Division 23 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC 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.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

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

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

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

D. 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.

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

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

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

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

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

K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

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. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

3.8 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent .
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Cooling-Water Flow Rate: Plus or minus 10 percent.
4. Heat Pump Closed Loop Flow Rate: Plus or minus 10 perent.

3.9 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.

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

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. 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 contractor.
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. Duct, outlet, and inlet sizes.
3. Balancing stations.
4. Position of balancing devices.

E. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. 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.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

F. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

G. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.10 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by the Engineer.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of the Engineer.
3. The Engineer 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.
4. 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."
5. 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.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. 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, Using Agency may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and Bidding and Contract Provisions, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDES

A. Temperature Control Subcontractor: Work includes control equipment and components for heating and cooling systems. Integrate new rooftop units into existing DDC temperature control system.

B. Provide graphics, trends and alarms for a browser-based control system that provides remote access to the building system including the following:

1. Text alarms sent to cell phones and / or e-mail accounts.
2. Build a main graphics splash screen that indicates equipment alarm status.
3. Provide historical trend data to determine when, where, what and how the system was operating.
4. Provide click and drag scheduling of equipment for week days, holidays and special events.

C. Related Sections include the following:

1. Section 23 0993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

D. Owner will maintain IT system to support browser-based graphics.

1.3 DEFINITIONS

A. Stand alone electric control.

B. I/O: Input/output.

C. PID: Proportional plus integral plus derivative.

D. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

a. Space Temperature: Plus or minus 1 deg F.
b. Ducted Air Temperature: Plus or minus 1 deg F.
c. Outside Air Temperature: Plus or minus 2 deg F.
d. Dew Point Temperature: Plus or minus 3 deg F.
e. Temperature Differential: Plus or minus 0.25 deg F.

f. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
g. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
h. Air Pressure (Space): Plus or minus 0.01-inch wg.
i. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
j. Carbon Dioxide: Plus or minus 50 ppm.
k. Electrical: Plus or minus 5 percent of reading.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Engineered control drawings.
2. Bill of materials of equipment indicating quantity, manufacturer, and model number.
3. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
4. Wiring Diagrams: Control wiring.
5. Schedule of new dampers including size, leakage, and flow characteristics.
6. Schedule of new valves including flow characteristics.
7. Controlled Systems:

a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
b. Written description of sequence of operation including schematic diagram.

C. Qualification Data: For Installer and manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals. Include the following:

1. Maintenance instructions and lists of spare parts for each type of control device.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

1.7 COORDINATION

A. Coordinate location of thermostats and other exposed control sensors with existing room details and Owner before installation. Note ADA mounting requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Proprietary specification Alpha Controls and Services. Contact Jason vogelbaugh, business 217-529-3111. Alpha Controls digital control systems already exist.

2.2 CONTROL SYSTEM

A. BACnet compatible.

B. Manufacturers:

1. Alpha Controls

C. Provide and install network controllers for browser-based Building Automation Systems.

D. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation shall permit interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

E. Control system shall be accessible via the web with password protection.

F. All provisions necessary to integrate new systems into the existing DDC systems in this building shall be included in the contract.

2.3 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. Enclosure: Dustproof rated for operation at 32 to 120 deg F.
4. BACnet.

2.4 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:

    a. BEC Controls Corporation.
    b. Ebtron, Inc.
    c. Heat-Timer Corporation.
    d. I.T.M. Instruments Inc.
    e. MAMAC Systems, Inc.
    f. RDF Corporation.

2. Accuracy: Plus or minus 0.5 deg F at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
5. Averaging Elements in Ducts: 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft..
6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Concealed.
    b. Set-Point Indication: Exposed.
    c. Thermometer: Red-reading glass.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:

1. Manufacturers:

    a. BEC Controls Corporation.
    b. MAMAC Systems, Inc.
    c. RDF Corporation.

2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 8 inches or 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
5. Averaging Elements in Ducts: 48 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:

    a. BEC Controls Corporation.
    b. General Eastern Instruments.
    c. MAMAC Systems, Inc.
    d. ROTRONIC Instrument Corp.
    e. TCS/Basys Controls.

2. Accuracy: 5 percent full range with linear output.

3. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
4. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 22 to plus 185 deg F.
5. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Manufacturers:

   a. BEC Controls Corporation.
   b. General Eastern Instruments.
   c. MAMAC Systems, Inc.
   d. ROTRONIC Instrument Corp.
   e. TCS/Basys Controls.

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

   a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
   b. Output: 4 to 20 mA.
   c. Building Static-Pressure Range: 0- to 0.25-inch wg.
   d. Duct Static-Pressure Range: 0- to 5-inch wg.

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

F. MN-S3 Room Sensor (i.e., room thermostats) Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Exposed.
2. Set-Point Indication: Exposed.
3. Room sensors (i.e., thermostats) in hallways, entries shall be sensor-only and shall not have indication or adjustment.
4. Room sensor accessories include the following:

   a. Insulating Bases: For sensors located on exterior walls.
   b. Adjusting Key: As required for calibration and cover screws.
   c. Programmable over-ride pushbutton on thermostats installed in classrooms and offices.

2.5 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg or current sensors.

B. Status Inputs for Pumps: Current sensors.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

2.6 CARBON DIOXIDE GAS DETECTION EQUIPMENT

A. Manufacturers:

1. B. W. Technologies.
2. CEA Instruments, Inc.
3. Ebtron, Inc.
4. Gems Sensors Inc.
5. Greystone Energy Systems Inc.
6. Honeywell International Inc.; Home & Building Control.
7. INTEC Controls, Inc.
8. I.T.M. Instruments Inc.
9. MSA Canada Inc.
10. QEL/Quatrosense Environmental Limited.
11. Sauter Controls Corporation.
12. Sensidyne, Inc.
13. TSI Incorporated.
14. Vaisala.
15. Vulcain Inc.

B. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output;, for wall mounting.

2.7 THERMOSTATS

A. Manufacturers:

1. Same as direct digital controller manufacturer or as provided by rooftop unit manufacturer.

B. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.
3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.

6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

C. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

D. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.

E. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

F. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic- reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet.
2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

2.8 HUMIDISTATS

A. Manufacturers:

1. MAMAC Systems, Inc.
2. ROTRONIC Instrument Corp.
3. Schneider Electric.

B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.9 ACTUATORS

A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Manufacturers:

a. Belimo Aircontrols (USA), Inc.
b. Schneider Electric.
c. Duff-Norton.

2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers: Size by Control Subcontractor.

2.10 CONTROL VALVES

A. Sizing by Control Subcontractor.

B. Manufacturers:

1. Schneider Electric
2. Siemens.

C. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

D. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.

3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.

   a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
   b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.

4. Sizing: 3-psig maximum pressure drop at design flow rate or the following:

   a. Two Position: Line size.
   b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
   c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.

5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

2.11 DAMPERS

A. Re-use existing dampers. Clean them and adjust linkage for proper operation. Report all defects to Engineer.

2.12 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Section 27 1500 "Communications Horizontal Cabling."

2.13 DDC EQUIPMENT

A. Operator Workstation: Use Owner's existing workstation.

1. Printer: Use Owner's existing printer.
2. Application Software:

   a. I/O capability from operator station.

b. System security for each operator via software password and access levels.
c. Automatic system diagnostics; monitor system and report failures.
d. Database creation and support.
e. Automatic and manual database save and restore.
f. Dynamic color graphic displays with up to 10 screen displays at once.
g. Custom graphics generation and graphics library of HVAC equipment and symbols.
h. Alarm processing, messages, and reactions. Text alarms sent to cell phones and / or e-mail accounts.
i. Trend logs retrievable in spreadsheets and database programs. Provide historical trend data to determine when, where, what and how the system was operating.
j. Alarm and event processing.
k. Object and property status and control.
l. Automatic restart of field equipment on restoration of power.
m. Data collection, reports, and logs. Include standard reports for the following:

1) Current values of all objects.
2) Current alarm summary.
3) Disabled objects.
4) Alarm lockout objects.
5) Logs.

n. Custom report development.
o. Utility and weather reports.
p. Workstation application editors for controllers and schedules.
q. Maintenance management.

3. Custom Application Software:

a. English language oriented.
b. Full-screen character editor/programming environment.
c. Allow development of independently executing program modules with debugging/simulation capability.
d. Support conditional statements.
e. Support floating-point arithmetic with mathematic functions.
f. Contains predefined time variables.

B. Diagnostic Terminal Unit: Use Owner's existing portable notebook-style, PC-based microcomputer terminal capable of accessing system data by connecting to system network with minimum configuration.

C. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.
b. Discrete/digital, analog, and pulse I/O.
c. Monitoring, controlling, or addressing data points.
d. Software applications, scheduling, and alarm processing.
e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:

    a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
    b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
    c. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
    d. Remote communications.
    e. Maintenance management.
    f. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. BACnet protocol.

D. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
4. BACnet protocol.

E. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

F. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.

3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

G. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

A. Connect and configure equipment and software to achieve sequence of operation specified.

B. Verify location of thermostats, humidistats, and other exposed control sensors with Owner before installation.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

C. Room stats / sensors accessible / adjustable by the occupants shall have their top no higher than 48" to comply with ADA. Sensors in public areas will not be accessible to the occupants and therefore are not ADA-regulated.

D. Install guards on thermostats in the following locations (existing guards may be re-used if they are appropriately sized):

1. Gymnasiums.
2. Hallways.
3. Shop areas.
4. Cafeteria.

E. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install electronic and fiber-optic cables according to Section 27 1500 "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Section 27 0528 “Pathways for Communications Systems”.

B. Install building wire and cable according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Section 27 1500 "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install cable in wiremold where exposed in finished spaces or in EMT in mechanical rooms.
3. All wiring concealed above accessible ceilings shall be plenum rated cable. Cable in ceiling cavities does not need to be in raceway. Use support rings listed for network cable. Tie-wraps not acceptable.
4. Bundle and harness cable in place of single cables where several cables follow a common path.
5. Number-code cables for future identification and service of control system, except local individual room control cables.
6. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL / TESTING / COMMISSIONING

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

C. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.

b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
c. Check digital inputs using jumper wire.
d. Check digital outputs using ohmmeter to test for contact making or breaking.
e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION / OWNER TRAINING

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

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 control sequences for HVAC systems, subsystems, and equipment.

B. Related Sections include the following:

1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

A. DDC: Direct digital control.

1.4 MULTI-ZONE HEATING AND COOLING SYSTEMS - ROOFTOP UNITS

A. Integrate new multi-zone units into the existing BAS. Map data points and alarm point to view on control graphics.

B. The unit shall be designed for continuous blower operation during occupied hours. The unit shall only operate to satisfy unoccupied zone setpoints. Provide remote access for OFF-AUTO unit control by BAS to program occupancy schedules..

C. On a rise in temperature above the cooling set point of a zone's temperature control, the zone's damper must modulate toward the full cooling position. When at least one zone is calling for full cooling, the chilled water control valve shall modulate open to cold deck setpoint to satisfy the load in the conditioned space. The cooling section leaving air temperature setpoint is 55°F (adjustable).

D. When outside air as determined by a dry bulb outside air changeover control is available for cooling (economizer), it must be used as the first stage of cooling and the chilled water cooling used when outside air does not satisfy the load. When the economizer is disabled during occupied mode the OA damper shall return to the minimum position.

E. On a fall in temperature below the heating set point of a zone's temperature control, the zone's damper shall modulate toward the full heating position. When at least one zone is calling for full heating, the heating section shall be activated to satisfy the heating load in the conditioned space. Hot water heating supply temperature is based on outdoor reset. Provide a freezestat on leaving side of the coil with a 39°F (adjustable) cut-out temperature. On cut-out, the controller will stop the unit and close the OA damper. An alarm shall be sent to maintenance staff.

F. Unit shall have a morning warm up cycle activated at the end of the daily operating cycle of the unit. On activation, the outside air dampers shall remain closed until the return air temperature exceeds the setting (adjustable) of the factory mounted and wired morning warm up cycle sensor located in

the return air opening of the unit. When the return air temperature rises above the setting of the return air sensor, the outside air dampers shall return to their normal automatic operating mode.

G. Demand control ventilation shall modulate OA damper open once CO_2 set point of 1,000 ppm has been exceeded in any one zone or the return air. OA damper open position shall be limited based on discharge air temperature maximum and minimum set point. The maximum OA open position shall not exceed 30% of the total supply airflow unless in economizer mode.

H. Triple Deck Damper

1. During full cooling demand, the cold deck damper shall be 100% open, neutral and hot deck dampers shall be closed. If cooling demand decreases in a zone, cold deck damper shall modulate towards closed position, neutral deck damper shall modulate to open position in proportion to cold deck damper. Hot deck damper shall remain closed.
2. During full heating demand, hot deck damper shall be 100% open, neutral and cold deck dampers shall be closed. If heating demand increases in a zone, hot deck damper shall modulate towards open position, neutral deck damper shall modulate to closed position, in proportion to hot deck damper. Cold deck damper shall remain closed.
3. The damper operation shall be reversed in the event that heating demand decreases and cooling demand increases. Hot deck and cold deck dampers shall not be open at the same time. Simultaneous heating and cooling shall not be allowed. If there is no demand for heating or cooling, the associated hot and cold deck dampers shall be closed and neutral deck damper shall be 100% open.
4. A single, manually adjustable damper is provided between the hot deck and cold deck of the unit to restrict the airflow to the bypass (neutral) deck to create pressure drop required for the VSD to slow the fan speed. The manual damper must be set to minimum outside air requirements by the air balancing contractor.

I. Supply Air Blower - The supply air blower will run continuously in occupied mode. The supply air blower will be a variable air volume type controlled by variable speed drive. The input to the VSD shall be via a pressure transducer located in the supply air plenum. This transducer will send a control signal to the controller that will in turn send a signal to the drive. The drive will ramp the speed of the supply air blower to maintain a constant supply air plenum pressure (approx. set point = 2.5" W.C., adjustable). There shall be a manual reset high pressure safety switch located in the supply air plenum to de-energize the supply air blower in the event that the supply air plenum pressure becomes excessive (set point = 3.5" W.C., adjustable). The VSD incorporates a manual bypass which allows the supply air blower to run independent of the VSD in case of any failure (repair) in the VSD.

J. Exhaust Air Fan - Exhaust fan shall stay off unless the unit is economizer mode. Once the outside air damper opens above 30%, exhaust fan shall energize. Exhaust fan VSD shall modulate to maintain building differential pressure setpoint.

K. Humidity sensor in the return shall monitor humidity levels.

L. Any equipment alarms shall send a text and e-mail notification to the Owner Maintenance Staff.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 0993

Brookens Pod 200 -- 2 Multi-Zone
RTU Replacement - 7058

DDC INPUT/OUTPUT SUMMARY TABLE (Points List)

Building: **Brookens**

Occupied Time: 24 hours

HARDWARE

Systems	OUTPUT Digital: Start/Stop	Enable/Disable	Open/Close	Hand/Off/Auto	Status Light	OUTPUT Analog: Control	Manual Override	Set Point Adjustment	INPUT Digital: Status	Status Light	Alarm	INPUT Analog: Temperature	Pressure	Flow	Humidity	CO^2
RTU's		X						X	X		X	X			X	X
Disch Air											X	X				
Existing Thermostats								X				X				X

SOFTWARE

Systems	ALARM Digital: Equipment Alarm	ALARM Analog: High Limit	Low Limit	Run Time	APPLICATION PROGRAMS: Failure Mode *	Scheduled Start/Stop	Optimal Start/Stop	Duty Cycling	Demand Limiting	Night Setback	Economizer	CFM Control	Cold Deck Reset	Hot Deck Reset	Chilled Water Reset	Hot Water Reset	Cond Water Reset	Chiller Sequencing	Smoke Control	Lead / Lag	Global Data Sharing	Color Graphics	Totalization	Trend	Point History
RTU's	X	X	X			X					X											X		X	
Disch Air		X	X							X												X		X	
Existing Thermostats		X	X																			X		X	

NOTES:	1. Adjustable at BAS only	2.	3.	4.	C. Last command	F. Off/Closed	H. High Value	O. On/Open

SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Base Bid

1. HVAC Contractor: Work includes:

a. Sheet metal materials.
b. Sealants and gaskets.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.3 SUBMITTALS

A. Product Data: For each type of the following products:

1. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Fittings.
4. Reinforcement and spacing.
5. Seam and joint construction.
6. Equipment installation based on equipment being used on Project.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
10. VOC: Maximum 395 g/L.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

PART 3 - EXECUTION

3.1 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.2 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.3 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.4 DUCT SCHEDULE

A. Supply Ducts:

1. Ducts Connected to Rooftop Units:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

B. Return Ducts:

1. Ducts Connected to Rooftop Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Base Bid

1. HVAC Contractor: Work includes:

a. Manual volume dampers.
b. Control dampers.
c. Flange connectors.
d. Turning vanes.
e. Flexible connectors.
f. Duct accessory hardware.

B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

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

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. Flexmaster U.S.A., Inc.
d. McGill AirFlow LLC.
e. METALAIRE, Inc.
f. Nailor Industries Inc.
g. Pottorff; a division of PCI Industries, Inc.
h. Ruskin Company.
i. Trox USA Inc.
j. Vent Products Company, Inc.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.

4. Frames:

    a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

    a. Oil-impregnated bronze or molded synthetic.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

2.3 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.4 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.5 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.6 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

D. Where damper operators occur above non-accessible ceilings, extend operator down to ceiling and terminate with a concealed damper regulator.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install opposed-blade volume dampers in each and every zone duct downstream of multi-zone units.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstreamand downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from all manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream and downstream from turning vanes.
9. Control devices requiring inspection.
10. Elsewhere as indicated.

I. Install flexible connectors to connect ducts to equipment.

J. Connect diffusers boots to ducts directly or with maximum 48 inch lengths of flexible duct clamped or strapped in place.

K. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Inspect turning vanes for proper and secure installation.
4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install air conditioning equipment as indicated on the drawings and as specified. Air conditioning equipment shall include but not be limited to the following.

B. Custom Replacement Multizone Air Handling Units.

1.2 RELATED SECTIONS

A. Section 23 0500: Basic Mechanical Requirements

B. Section 23 3113: Metal Ducts

C. Section 23 3300: Air Duct Accessories

D. Section 23 0993: Temperature Control Systems

E. Section 23 0593: Testing, Adjusting and Balancing

1.3 SUBMITTALS

A. Make submittals in accordance with provisions of Section 15010: Basic Mechanical Requirements.

1.4 INSTRUCTIONS AND MAINTENANCE DATA

A. Contractor shall provide instructions on equipment operation and maintenance procedure, as required, before or during completion test, to following District Personnel:

1. District Mechanical Inspector of project.
2. District Area HVAC Maintenance Supervisor
3. School Custodian, Plant Manager, or Principal

B. Instructions shall be entrusted to a qualified and experienced person, who has been adequately trained and is able to demonstrate correct operation and maintenance of equipment and related components.

PART 2 - PRODUCTS-APPROVED MANUFACTURERS

1. SEASONS FOUR-BASIS OF DESIGN
2. SCOTT SPRINGFIELD (CANADA)
3. BUFFALO AIR HANDLING
4. NO SUBSTITUTIONS

2.1 MANUFACTURER DATA

A. Replacement HVAC units shall be specifically designed, engineered and manufactured for exact replacement. Units shall be factory manufactured for installation on the existing roof curb without the use of a curb adapter, transitions or modifications to the existing ductwork.

B. Units shall be run tested at factory and operation of all functions, safeties, devices, etc, shall be verified. Operational test sheets shall be provided upon request. Units shall be ETL listed as a complete unit and shall bear the ETL label. All parts shall be available at the local wholesaler level, therefore no OEM parts will be allowed.

C. Unit(s) shall be provided with one (1) year parts warranty and fifteen (15) year cabinet warranty. Labor warranty provided by Contractor.

2.2 UNIT REPLACEMENT DATA.

A. Unit shall match the existing curbs and supply duct connections. The use of curb adapters is not acceptable. Units shall match the existing roof curb without the use of a curb adapter, transitions, or modifications to the roof support. Roof curb gasket shall be provided and shipped loose with the unit. Units shall match existing duct connections and require minimal field time to reconnect and seal. Units shall match existing gas and electrical power connections and shall require only minimal field time to reconnect.

B. Prior to fabrication of the equipment, a factory engineer shall visit the jobsite, measure the unit, and become familiar with the exact requirements of the project. A local manufacturer's representative shall not be considered as a substitute. The factory employee shall also be present at the installation to assist / supervise the unit installation and unit start up. The responsibility of these functions shall not be transferred to the local manufacture's representative. A factory technician shall submit a check test start-up report after field installation and start-up.

2.3 MULTIZONE ROOF TOP/ INDOOR AIR CONDITIONING UNITS

A. Equipment:

1. Replacement roof mounted air conditioning units with dimensions, capacities and electrical characteristics to match that of the existing units shall be provided. The equipment must comply with the requirements and terms of ETL's Listing, Labeling and Follow-up Service Agreement and the complete unit must bear the ETL Label.
2. The replacement unit must have improved reliability; it must have higher efficiency than the unit being replaced; and, it must comply with the ventilation standards as listed on the equipment schedule. Therefore, the specified unit may be slightly higher, wider, or longer than the unit being replaced. The new replacement unit must be designed to match the existing roof opening, number of zones, and avoid obstructions adjacent to the unit being replaced. The new unit shall be designed to provide a minimum interior height of 56" and full height access doors on the fan, filters for ease of maintenance.

B. Exterior Casing and Frame:

1. All exterior panels must be fabricated from pre-painted embossed aluminum alloy. Color finish to be Kynar (epoxy based) for increased corrosion protection. Color selected by Engineer / Owner.
2. Aluminum panels shall be fastened to the frame with stainless steel screws. Panels must be isolated from the steel frame with dielectric gaskets to prevent galvanic corrosion. The roof of the unit must be pitched to provide positive drainage. Top seams must be covered with cap strips to prevent water leakage into the unit and the floor of each section shall have a galvanized steel deck to

isolate the entire unit from the building. All seams must be caulked with silicone inside and out to prevent air and water leakage.

3. Access doors must be provided for all sections housing components requiring routine maintenance. Doors shall be supported on full-length continuous aluminum hinges and have and have single handle, multiple latch closures. Access doors shall have stainless steel "hold back" latches to prevent door closure during the performance of service procedures. When obstructions on the roof will interfere with hinged access doors, provide lift off panels held in place by a minimum of four Allegis Cam action handles.
4. All walls, roof, and doors in the air-handling compartment shall be double wall construction enclosing 2" foam injected insulation (R-13). Aluminum liners shall be to protect the insulation during routine service and maintenance operations. The floor of the air handling sections must be insulated underneath with 1" fiberglass. The floor of the air handling sections is insulated with 1" foil faced fiberglass and 4" batt type insulation.
5. All doors in the air handling section shall open against the pressure or shall include an additional number of latches equal to 50% of the number of latches used on the same size doors that open with the pressure.

C. Chilled Water Cooling Coil Section:

1. Cooling coils must be installed downstream of the supply air blower and parallel with the heating section. Coils shall be water cooling type and constructed of seamless copper tubes expanded into copper fins and encased in a galvanized steel coil casing. All control valves and valve operators shall be provided and field installed by Temperature Control Contractor within the unit.

   All valves and the operators are provided and installed by others at the job site.

2. Each coiling coil shall be provided with a positive draining IAQ type double pitched, stainless steel drain pan. The drain for the main drain pan must be metal and extend through the side of the unit.

D. Heating Section (Hot Water Coil):

1. Unit shall include hot water coils installed in the heating deck with capacity as shown in this submittal. Coils have copper tubes expanded into aluminum fins. Coils must be rated for 250 PSIG working pressure. All control valves and valve operators shall be provided and field installed by Temperature Control Contractor within the unit.

E. Multi-zone Damper Section Triple Deck:

1. Unit shall have factory mounted multi-zone dampers in the hot, bypass, and cold deck. Dampers must be linked together to provide individual zone control, with each zone having its own field mounted and wired operator provided and installed by the Temperature Control Contractor. The cold deck and hot deck must not allow mixing of cold deck and the hot deck air. In no case may air from the cold deck mix with air from the hot deck. The multizone dampers shall be spring-loaded such that when the hot and bypass decks are modulating, the cold deck shall be closed. When the cold and bypass deck are modulating, the hot deck shall be closed. The cold deck, bypass, and hot deck must be separated by double wall insulated dividers. Damper shafts shall be mounted in permanently

lubricated nylon bearings to assure smooth operation. Damper blades must operate without clatter or binding.

F. Supply Air Blower Section:

1. The supply air blower wheel shall be a single width/single inlet airfoil plenum type of aluminum construction, secured to a machined, ground and polished solid steel shaft. The shaft shall be coated with a rust inhibitor and supported by two outboard bearings. The complete blower assembly must be dynamically balanced. Bearings shall be self-aligning ball bearing pillow block type and be designed for an L-50 life of 200,000 hours.
2. Blower drive shall include a fixed pitch motor sheave with multiple V-belts shall have a minimum service factor of 150%. Motors shall be premium efficiency heavy-duty open drip proof 3-phase, 1800 rpm, mounted on a heavy-duty sliding base. Motor and blower assembly shall be mounted on a heavy duty steel frame supported by 2 " deflection springs designed for 90-98% isolation efficiency. In addition to the spring isolators, the blower assembly shall have seismic restraints. The supply fan shall be supplied with a factory mounted VFD.

G. Power Exhaust Section

1. The exhaust air blower wheel shall be a double width/double inlet forward curved type, secured to a machined, ground and polished steel shaft. The shaft shall be coated with a rust inhibitor and supported by two outboard bearings. The complete blower assembly must be dynamically balanced. Bearings shall be self-aligning ball bearing pillow block type and be designed for an L-50 life of 200,000 hours.
2. Blower drive shall include a fixed pitch motor sheave with multiple V-belts shall have a minimum service factor of 150%. Motors shall be premium efficiency heavy-duty open drip proof 3-phase, 1800 rpm, mounted on a heavy-duty sliding base. Motor and blower assembly shall be mounted on a heavy duty steel frame supported by 2 " deflection springs designed for 90-98% isolation efficiency. In addition to the spring isolators, the blower assembly shall have seismic restraints. The exhaust fan shall be supplied with a factory mounted VFD.

H. Filter Section:

1. The filter section shall include UL Class 2, 2" thick, MERV 8 efficiency panel type filters. Access for filter maintenance shall be through a full height service door on the side of the unit. Filter support rails must include slide out "pulls" to facilitate removal of the filters.

I. Return Air/Outside Air/Exhaust Air Section:

1. The unit shall have an outside air (ventilation) intake on one side of the unit and an exhaust air discharge on the opposite side. Outside air and exhaust air openings on the same side of the unit are not acceptable. Outside air intake shall have storm-proof louvers or hoods sized to prevent entrainment of rainwater into the unit and must include an aluminum bird screen.
2. Outside and return air dampers shall have factory-mounted operators. Damper shafts shall be mounted in permanently lubricated nylon bearings to assure smooth operation. Damper blades must operate without clatter or binding. Motorized dampers shall be low leakage type limiting leakage to 6 CFM/ft2 at a pressure differential of 4 inches.

3. Exhaust dampers shall be gravity relief type sized to balance the building pressure during economizer operation. Dampers shall include a louver to divert rain from the face of the dampers.

J. Main Control Panel:

1. The unit shall have a single point electrical power connection in the same location as the unit being replaced. The new unit must be able to utilize the same power wiring as the unit being replaced. The main control panel must include a disconnect switch mounted in a weatherproof enclosure on the side or the end of the unit.
2. All components shall be identified with nametags and wired in accordance with the National Electric Code. The main control panel must include the following:

    a. A terminal block for single point power supply with fuses for all branch circuits.
    b. A 24-volt control transformer and 24-volt field wiring control terminal strip. Terminals shall be numbered for field connection of all controls in accordance with the wiring diagram.
    c. All wiring must be numbered and color-coded.
    d. A phase failure and low voltage protection relay.
    f. Temperature control components as required for the system described below in the "Temperature Control Sequence".
    g. Wiring diagrams must be laminated to the control panel door.
    h. A service light with switch and a 115 volt 10 amp ground fault convenience outlet factory mounted and wired to its own transformers.
    i. Fan motor starters with three-phase overloads factory mounted and wired.

3. The above components are in addition to electrical components associated with other sections required to accomplish the sequence of control specified below.

K. Temperature Controls:

1. The unit zone DDC temperature control system including control of the mechanical cooling and heating, room temperature controls, economizer controls, and damper operators provided by the Temperature control Contractor. The DDC control must be capable of Bacnet protocols for interface with the building management system. When programming of the controls is required, it must be included with the unit. Smoke detectors and magnahelic gauges shall be provided by the manufacturer and be factory installed.
2. The new unit shall utilize demand control ventilation based on occupancy load. The Temperature Control Contractor shall provide CO_2 sensors and humidity sensors for humidity control.

L. Other Controls:

1. Unit must have terminal strips and interlocking relays factory mounted and wired to interlock with other components of the building. It is the responsibility of the control contractor to advise the HVAC unit manufacturer of any requirement for any additional interlocks not covered in this specification.
2. Provide a photoelectric type smoke detector mounted and wired in the supply section to the unit. Upon detection of smoke, fans shall stop and a signal must be sent to the building fire alarm system.

3. Provide a Magnehelic differential pressure gauge for each bank of filters. Gauge shall be mounted in the main unit control panel.

M. Installation: The manufacturer must send an installation expert to the jobsite to advise on proper rigging and alignment of the equipment. The installing contractor should become familiar with the manufacturer's rigging and installation instructions.

N. Check, Test, and Startup: Unit must be checked out, tested, and placed into operation by the installing contractor under the supervision of an authorized representative of the factory.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine areas under which the work of this Section will be performed. Correct conditions detrimental to proper and timely completion of this work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 EQUIPMENT DESIGN AND INSTALLATION

A. Units shall be designed to fit on existing curbs.

B. Uniformity: Unless otherwise specified, equipment of same type of classification shall be product of same manufacturer.

C. Application: No piece of equipment shall be installed in an application not recommended by manufacturer, or not approved by the District or the Engineer.

D. Equipment Installation: Equipment installation shall be strictly in accordance with these specifications, and instructions of manufacturers. Erect equipment in a neat and workmanlike manner, properly aligned, leveled and adjusted for satisfactory operation.

E. Install seismic anchorage of units as required.

F. Install so that connecting and disconnecting of piping and accessories can be readily accomplished, and so that all parts are readily accessible for inspection, service and repair. Space shall be provided to readily remove filters, coils, compressors and fan wheels. All access doors shall be hinged and have cam lock door handles.

3.3 FIELD TESTS AND INSPECTION

A. General: Perform all field inspections, field tests, and trial operations as specified in Section 10010. Provide all labor, equipment, and incidentals required for testing. The District Inspector shall have the right to witness all field tests and trial operations.

B. Equipment and Material: Equipment and material certified as having been successfully tested by manufacturer, in accordance with referenced specifications and standards, will not require re-testing before installation. Equipment and materials not tested at the place of manufacture will be tested before or after installation, as applicable or necessary, to determine compliance with reference specifications and standards.

C. Start-Up and Operational Test: Systems shall be started up and initially operated with all components operating. Adjust safety and automatic control instruments as necessary to place them in proper operation.

D. Extent of Field Tests: After installation and before acceptance, work of this Section shall be subjected to all necessary field tests.

E. Operation and Maintenance Data: Provide required operation and maintenance data.

END OF SECTION

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. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. Belden Inc.
3. Cerro Wire LLC.
4. Cooper Industries, Inc.
5. Encore Wire Corporation.
6. General Cable Technologies Corporation.
7. General Cable; General Cable Corporation.
8. Senator Wire & Cable Company.
9. Service Wire Co.
10. Southwire Company.
11. Thomas & Betts Corporation, A Member of the ABB Group.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. 3M.
2. AFC Cable Systems, Inc.
3. Gardner Bender.
4. Hubbell Power Systems, Inc.

5. Ideal Industries, Inc.
6. ILSCO.
7. NSi Industries LLC.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.
9. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
1. Expandable steel spring and polypropylene body type connectors and wire nuts for wire sizes up to an including No. 10 AWG.
2. Bolt type connectors or mechanical compression crimp type for wire sizes No. 8 AWG and larger. Cover connectors with three layers of 600 volt tape or heat shrinkable insulation equivalent to 150% conductor insulation.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

B. Minimum wire size shall be No. 12 except for internal fixture wire which shall be minimum size of No. 14 type SF, SFF, PF, PFF or TFN, 600 volt.

C. All branch circuit wiring and feeder cables for circuits over 20 amps shall be sized as noted on the drawings. If size is not specifically noted, size all branch circuit wiring and feeder cables in accordance with the National Electrical Code.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Splices and taps in conductors shall be as few in number as practicable.

D. Splices and taps shall be so made that they have an electrical resistance not in excess of that of 2’ of the conductor.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

B. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

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 grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning & Grounding.
7. ILSCO.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.
9. Robbins Lightning, Inc.
10. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits. Separate grounding conductors are not shown on the drawings but shall be included in all raceways as set forth on the drawings.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

C. Grounding system will be considered defective if it does not pass tests and inspections.

END OF SECTION

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. Metal conduits, tubing, and fittings.
2. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For raceways.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a part of Atkore International.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. FSR Inc.

6. O-Z/Gedney; a brand of Emerson Industrial Automation.
7. Patriot Aluminum Products, LLC.
8. Picoma Industries, Inc.
9. Republic Conduit.
10. Robroy Industries.
11. Southwire Company.
12. Thomas & Betts Corporation, A Member of the ABB Group.
13. Western Tube and Conduit Corporation.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. EMT: Comply with ANSI C80.3 and UL 797.

E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: Setscrew.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.
2. Cooper Technologies Company.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman; a brand of Pentair Equipment Protection.
7. Hubbell Incorporated.
8. Kraloy.
9. Milbank Manufacturing Co.
10. MonoSystems, Inc.
11. Oldcastle Enclosure Solutions.
12. O-Z/Gedney; a brand of Emerson Industrial Automation.
13. RACO; Hubbell.
14. Robroy Industries.
15. Spring City Electrical Manufacturing Company.
16. Stahlin Non-Metallic Enclosures.
17. Thomas & Betts Corporation, A Member of the ABB Group.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
3. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Boxes and Enclosures: NEMA 250, Type 1.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Conduits and raceways shall not be supported from plumbing lines, ductwork or supports for equipment provided by other trades.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Support conduit within 12 inches of enclosures to which attached.

H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

I. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

J. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

K. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

M. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

N. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

END OF SECTION

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. Identification for conductors.
2. Equipment identification labels, including arc-flash warning labels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

2.3 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:

a. For signs up to 20 sq. inches, minimum 1/16-inch-.
b. Engraved legend with black letters on white face.

c. Self-adhesive.
d. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

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

C. Verify identity of each item before installing identification products.

D. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

E. Apply identification devices to surfaces that require finish after completing finish work.

3.3 IDENTIFICATION SCHEDULE

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.

b. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.

3) Phase C: Yellow.
4) Neutral: White.
5) Ground: Green with yellow stripe.

c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

B. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
b. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
c. Attach labels with screws and not adhesives.

2. Equipment To Be Labeled:

a. Enclosed switches.

END OF SECTION