



UNIVERSITY
OF KENTUCKY

Purchasing Division

Request for Proposal

UK-2227-22

Proposal Due Date – 02/09/22

Custom Air Handling Units (AHU)

UK Healthcare Facilities

Pavilion A – 12th Floor Fit-out

Project # 2402.16



UNIVERSITY OF KENTUCKY

Purchasing Division

REQUEST FOR PROPOSAL (RFP)

ATTENTION: This is not an order. Read all instructions, terms and conditions carefully.

PROPOSAL NO.:	UK-2227-22	RETURN ORIGINAL COPY OF PROPOSAL TO:
Issue Date:	01/19/2022	UNIVERSITY OF KENTUCKY
Title:	Custom Air Handling Units	PURCHASING DIVISION
Purchasing Officer:	Pavilion A – 12th Floor Fit Out	411 S LIMESTONE
Phone:	Ken Scott	ROOM 322 PETERSON SERVICE BLDG.
	859-257-9102/Kenneth.scott@uky.edu	LEXINGTON, KY 40506-0005

IMPORTANT: PROPOSALS MUST BE RECEIVED BY: 02/09/2022 3 P.M. LEXINGTON, KY TIME.

NOTICE OF REQUIREMENTS

- The University's General Terms and Conditions and Instructions to Bidders, viewable at www.uky.edu/Purchasing/terms.htm, apply to this RFP. When the RFP includes construction services, the University's General Conditions for Construction and Instructions to Bidders, viewable at www.uky.edu/Purchasing/ccphome.htm, apply to the RFP.
- Contracts resulting from this RFP must be governed by and in accordance with the laws of the Commonwealth of Kentucky.
- Any agreement or collusion among offerors or prospective offerors, which restrains, tends to restrain, or is reasonably calculated to restrain competition by agreement to bid at a fixed price or to refrain from offering, or otherwise, is prohibited.
- Any person who violates any provisions of KRS 45A.325 shall be guilty of a felony and shall be punished by a fine of not less than five thousand dollars nor more than ten thousand dollars, or be imprisoned not less than one year nor more than five years, or both such fine and imprisonment. Any firm, corporation, or association who violates any of the provisions of KRS 45A.325 shall, upon conviction, be fined not less than ten thousand dollars or more than twenty thousand dollars.

AUTHENTICATION OF BID AND STATEMENT OF NON-COLLUSION AND NON-CONFLICT OF INTEREST

I hereby swear (or affirm) under the penalty for false swearing as provided by KRS 523.040:

- That I am the offeror (if the offeror is an individual), a partner, (if the offeror is a partnership), or an officer or employee of the bidding corporation having authority to sign on its behalf (if the offeror is a corporation);
- That the attached proposal has been arrived at by the offeror independently and has been submitted without collusion with, and without any agreement, understanding or planned common course of action with, any other Contractor of materials, supplies, equipment or services described in the RFP, designed to limit independent bidding or competition;
- That the contents of the proposal have not been communicated by the offeror or its employees or agents to any person not an employee or agent of the offeror or its surety on any bond furnished with the proposal and will not be communicated to any such person prior to the official closing of the RFP;
- That the offeror is legally entitled to enter into contracts with the University of Kentucky and is not in violation of any prohibited conflict of interest, including, but not limited to, those prohibited by the provisions of KRS 45A.330 to .340, and 164.390;
- That the offeror, and its affiliates, are duly registered with the Kentucky Department of Revenue to collect and remit the sale and use tax imposed by Chapter 139 to the extent required by Kentucky law and will remain registered for the duration of any contract award;
- That I have fully informed myself regarding the accuracy of the statement made above.

SWORN STATEMENT OF COMPLIANCE WITH CAMPAIGN FINANCE LAWS

In accordance with KRS 45A.110 (2), the undersigned hereby swears under penalty of perjury that he/she has not knowingly violated any provision of the campaign finance laws of the Commonwealth of Kentucky and that the award of a contract to a bidder will not violate any provision of the campaign finance laws of the Commonwealth of Kentucky.

CONTRACTOR REPORT OF PRIOR VIOLATIONS OF KRS CHAPTERS 136, 139, 141, 337, 338, 341 & 342

The contractor by signing and submitting a proposal agrees as required by 45A.485 to submit final determinations of any violations of the provisions of KRS Chapters 136, 139, 141, 337, 338, 341 and 342 that have occurred in the previous five (5) years prior to the award of a contract and agrees to remain in continuous compliance with the provisions of the statutes during the duration of any contract that may be established. Final determinations of violations of these statutes must be provided to the University by the successful contractor prior to the award of a contract.

CERTIFICATION OF NON-SEGREGATED FACILITIES

The contractor, by submitting a proposal, certifies that he/she is in compliance with the Code of Federal Regulations, No. 41 CFR 60-1.8(b) that prohibits the maintaining of segregated facilities.

SIGNATURE REQUIRED: This proposal cannot be considered valid unless signed and dated by an authorized agent of the offeror. Type or print the signatory's name, title, address, phone number and fax number in the spaces provided. Offers signed by an agent are to be accompanied by evidence of his/her authority unless such evidence has been previously furnished to the issuing office.

DELIVERY TIME:	NAME OF COMPANY:	DUNS #
PROPOSAL FIRM THROUGH:	ADDRESS:	Phone/Fax:
PAYMENT TERMS:	CITY, STATE & ZIP CODE:	E-MAIL:
SHIPPING TERMS: F. O. B. DESTINATION PREPAID AND ALLOWED	TYPED OR PRINTED NAME:	WEB ADDRESS:
FEDERAL EMPLOYER ID NO.:	SIGNATURE:	DATE:

Table of Contents

1.0 DEFINITIONS	6
2.0 GENERAL OVERVIEW.....	7
2.1 Intent and Scope	7
2.2 Background Information	7
2.3 University Information.....	7
2.4 Supplier Diversity and Procurement.....	9
3.0 PROPOSAL REQUIREMENTS.....	10
3.1 Key Event Dates.....	10
3.2 Offeror Communication	10
3.3 Pre-Proposal Conference	11
3.4 Offeror Presentations	11
3.5 Preparation of Offers	11
3.6 Proposed Deviations from the RFP	11
3.7 Proposal Submission and Deadline	11
3.8 Modification or Withdrawal of Offer.....	12
3.9 Acceptance or Rejection and Award of Proposal.....	12
3.10 Rejection	13
3.11 Addenda.....	13
3.12 Disclosure of Offeror's Response	13
3.13 Restrictions on Communications with University Staff	13
3.14 Cost of Preparing Proposal.....	14
3.15 Disposition of Proposals	14
3.16 Alternate Proposals	14
3.17 Questions	14
3.18 Section Titles in the RFP	14
3.19 No Contingent Fees.....	14
3.20 Proposal Addenda and Rules for Withdrawal.....	14
3.21 Requirement To Perform Vendor Onboarding and Registration.....	15
4.0 PROPOSAL FORMAT AND CONTENT	15
4.1 Proposal Information and Criteria	15

4.2 Signed Authentication of Proposal and Statements of Non-Collusion and Non-Conflict of Interest Form	15
4.3 Transmittal Letter	16
4.4 Executive Summary and Proposal Overview	16
4.5 Criteria 1 - Offeror Qualifications	17
4.6 Criteria 2 – Services Defined	18
4.7 Criteria 3 – Financial Proposal.....	18
4.8 Criteria 4 – Evidence of Successful Performance and Implementation Schedule	18
4.9 Criteria 5 – Other Additional Information.....	18
5.0 EVALUATION CRITERIA PROCESS.....	19
6.0 SPECIAL CONDITIONS.....	20
6.1 Scope	20
6.2 Effective Date	20
6.3 Competitive Negotiation	20
6.4 Appearance Before Committee	20
6.5 Additions, Deletions or Contract Changes	20
6.6 Contractor Cooperation in Related Efforts	21
6.7 Entire Agreement	21
6.8 Governing Law	21
6.9 Kentucky’s Personal Information Security and Breach Investigation Procedures and Practices Act	21
6.10 Termination for Convenience.....	22
6.11 Termination for Non-Performance	22
6.12 Funding Out	23
6.13 Prime Contractor Responsibility.....	23
6.14 Assignment and Subcontracting	23
6.15 Permits, Licenses, Taxes.....	23
6.16 Attorneys’ Fees	23
6.17 Royalties, Patents, Copyrights and Trademarks	24
6.18 Indemnification	24
6.19 Method of Award	24
6.20 Reciprocal Preference	24
6.21 Confidentiality.....	25
6.22 Conflict of Interest	25

6.23 Personal Service Contract Policies 25

6.24 Copyright Ownership and Title to Designs and Copy 26

6.25 University Brand Standards 26

6.26 Printing Statutes 27

6.27 Payment Terms 27

7.0 SCOPE OF SERVICES 28

 7.1 Detailed Services Defined 28

A. Shipping & Schedule Requirements: 29

B. Submittal/Training Requirements: 29

C. Project Coordination: 30

D. Schedule of Values: 30

E. Changes in Work: 30

F. Sales Tax: 31

G. Warranty: 31

8.0 FINANCIAL OFFER SUMMARY 31

8.1 FINANCIAL OFFER SUMMARY 31

 8.1 Equipment Pricing 31

 8.2 Equipment Delivery (FOB Jobsite – after storage period) 31

 8.3 Drawings / Manuals 31

 8.4 General Information - splits, weights, dimensions 32

 8.5 Start-up, Training, Spare Parts, & Additional Services 32

 8.6 Optional Extended Maintenance / Support 32

Drawings

M203A Level 3 Mechanical Plan Area A

M203B Level 3 Mechanical Plan Area B

M203C Level 3 Mechanical Plan Area C

M804 Air Handler Details

M901 Mechanical Schedules

Specifications

20 0513 Motors

23 0550 Vibration Isolation

23 0902 Control Dampers

23 2116 Pipe and Pipe Fittings

23 2118 Valves

23 3400	Fans
23 4114	Filters
23 7328	Factory Fabricated Custom Air Handling Units
23 8216	Coils
23 8413	Humidification Equipment
26 0519	Low-Voltage Electrical Power Conductors and Cables
26 0533	Raceway and Boxes for Electrical Systems
26 2726	Wiring Devices
26 2816	Enclosed Switches and Circuit Breakers
26 2913	Enclosed Controllers

1.0 DEFINITIONS

The term "addenda" means written or graphic instructions issued by the University of Kentucky prior to the receipt of proposals that modify or interpret the RFP documents by additions, deletions, clarifications and/or corrections.

The term "competitive negotiations" means the method authorized in the Kentucky Revised Statutes, Chapter 45A.085.

The terms "offer" or "proposal" mean the offeror's/offers' response to this RFP.

The term "offeror" means the entity or contractor group submitting the proposal.

The term "contractor" means the entity receiving a contract award.

The term "purchasing agency" means the University of Kentucky, Purchasing Division, Room 322 Peterson Service Building, Lexington, KY 40506-0005.

The term "purchasing official" means the University of Kentucky's appointed contracting representative.

The term "responsible offeror" means a person, company or corporation that has the capability in all respects to perform fully the contract requirements and the integrity and reliability that will assure good faith performance. In determining whether an offeror is responsible, the University may evaluate various factors including (but not limited to): financial resources; experience; organization; technical qualifications; available resources; record of performance; integrity; judgment; ability to perform successfully under the terms and conditions of the contract; adversarial relationship between the offeror and the University that is so serious and compelling that it may negatively impact the work performed under this RFP; or any other cause determined to be so serious and compelling as to affect the responsibility of the offeror.

The term "solicitation" means RFP.

The term "University" means University of Kentucky.

2.0 GENERAL OVERVIEW

2.1 Intent and Scope

This Request for Proposals (RFP) is for the Purchase of CUSTOM Air Handling Equipment that will serve new construction at the University.

Two (2) air handlers for Chandler Hospital Pavilion A 12th Floor with the following characteristics:

1. BT-51AW is a 40,000 cfm unit that serves the west side of the 12th floor.
2. BT-51AE is a 40,000 cfm unit that serves the east side of the 12th floor.

The scope of services is further defined in Section 7.0 (Scope of Work) and in the attached drawings and specifications.

2.2 Background Information

The 12th Floor Fit-out at the University of Kentucky Medical Center- Pavilion A was designed by GBBN Architects, Inc. A portion of the original facility was constructed as shell space for future fit out. This RFP will provide the custom air handling units (AHU) for conditioning the 12th floor, as part of the planned fit-out project.

AHUs will be owner provided, to be installed by others (OFCI).

2.3 University Information

Since his arrival, President Eli Capilouto has set forth an ambitious agenda to extend and enhance our role as Kentucky's land-grant and flagship research university. By focusing on infrastructure growth and improvement; creating opportunities for innovative teaching, learning, and academic excellence; fostering a robust research and creative scholarship enterprise; providing life-saving subspecialty care; empowering communities through service and outreach; and encouraging a transparent and shared dialogue about institutional priorities; the University of Kentucky will ensure a new century of promise for the people we impact.

Founded in 1865 as a land-grant institution adjacent to downtown Lexington, UK is nestled in the scenic heart of the beautiful Bluegrass Region of Kentucky. From its early beginnings, with only 190 students and 10 professors, UK's campus now covers more than 918 acres and is home to more than 30,000 students and approximately 14,500 employees, including more than 2,300 full-time faculty. UK is one of a small number of universities in the United States that has programs in agriculture, engineering, a full complement of health colleges including medicine and pharmacy, law and fine arts on a single campus, leading to groundbreaking discoveries and unique interdisciplinary collaboration. The state's flagship university consists of 17 academic and professional colleges where students can choose from more than 200 majors and degree programs at the undergraduate and graduate levels. The colleges are Agriculture, Food and Environment; Arts and Sciences; Business and Economics; Communication and Information; Dentistry; Design; Education; Engineering; Fine Arts; Graduate School; Health Sciences; Law; Medicine; Nursing;

Pharmacy; Public Health; and Social Work. These colleges are supported by a modern research library system.

Research at the University of Kentucky is a dynamic enterprise encompassing both traditional scholarship and emerging technologies, and UK's research faculty, staff and students are establishing UK as one of the nation's most prolific public research universities. UK's research enterprise attracted \$285 million in research grants and contracts from out-of-state sources, which generated a \$580 million impact on the Kentucky economy. Included in this portfolio is \$153 million in federal awards from the National Institutes of Health, non-NIH grants from the Department Health and Human Services, the National Science Foundation, Department of Energy, Department of Agriculture and NASA, among others. The National Science Foundation ranks UK's research enterprise 44th among public institutions.

With more than 50 research centers and institutes, UK researchers are discovering new knowledge, providing a rich training ground for current students and the next generation of researchers, and advancing the economic growth of the Commonwealth of Kentucky. Several centers excel in the services offered to the public. The Gluck Equine Research Center is one of only three facilities of its kind in the world, conducting research in equine diseases.

The Center for Applied Energy Research is pursuing groundbreaking discovery across the energy disciplines. CAER staff are pioneering new ways to sustainably utilize Kentucky natural resources through carbon-capture algae technology, biomass/coal to liquid products and the opening of UK's first LEED-certified research lab to support the development of Kentucky's growing alternative energy industry. Among the brightest examples of UK's investment in transformative research is the Markey Cancer Center. As a center of excellence and distinction at UK, Markey's robust research and clinical enterprise is the cornerstone of our commitment to Kentucky – fundamental to our success in uplifting lives through our endeavors and improving the general health and welfare of our state – burdened by the nation's highest rate of cancer deaths per 100,000 people. In 2013, Markey earned the prestigious National Cancer Institute-designation (NCI) – one of 68 nationally and the only one in Kentucky.

The University of Kentucky was awarded a \$20 million Clinical Translational Sciences Award (CTSA) from the National Institutes of Health (NIH). As one of only 60 institutions with this research distinction, UK was awarded the CTSA for its potential in moving research and discovery in the lab into practical field and community applications. The CTSA and NCI are part of a trifecta of federal research grants that includes an Alzheimer's Disease Center. UK is one of only 22 universities in the country to hold all three premier grants from NIH.

Established in 1957, the medical center at UK is one of the nation's finest academic medical centers and includes the University's clinical enterprise, UK HealthCare. The 569-bed UK Albert B. Chandler Hospital and Kentucky Children's Hospital, along with 256 beds at UK Good Samaritan Hospital, are supported by a growing faculty and staff providing the most advanced subspecialty care for the most critically injured and ill patients throughout the Commonwealth and beyond. Over the last several years, the number of patients served by the medical enterprise has increased from roughly 19,000 discharges to more than 36,000 discharges in 2014.

UK Chandler Hospital includes the only Level 1 Trauma Center for both adult and pediatric patients in Central and Eastern Kentucky. In addition, UK HealthCare recently opened one of the country's largest robotic hybrid operating rooms and the first of its kind in the region.

While our new patient care pavilion is the leading healthcare facility for advanced medical procedures in the region, our talented physicians consult with and travel to our network of affiliate hospitals so Kentucky citizens can receive the best health care available close to their home and never need to leave the Bluegrass for complex subspecialty care.

UK's agenda remains committed to accelerating the University's movement toward academic excellence in all areas and gain worldwide recognition for its outstanding academic programs, its commitment to students, its investment in pioneering research and discovery, its success in building a diverse community and its engagement with the larger society. It is all part of the University's fulfillment of our promise to Kentucky to position our state as a leader in American prosperity.

SUSTAINABILITY

Sustainability is an institution-wide priority for the University of Kentucky. We strive to ensure that all activities are ecologically sound, socially just, and economically viable, and that they will continue to be so for future generations. This commitment also prioritizes the integration of these principles in curricula, research, athletics, health care, creative works, and outreach. This principled approach to operational practices and intellectual pursuits is intended to prepare students and empower the campus community to support sustainable development in the Commonwealth and beyond. The UK Sustainability Strategic Plan guides these efforts (<https://www.uky.edu/sustainability/sustainability-strategic-plan>).

2.4 Supplier Diversity and Procurement

The University of Kentucky is committed to serve as an advocate for diverse businesses in their efforts to conduct business. Diverse Business Enterprises (DBE) consist of minority, women, disabled, veteran and disabled veteran owned business firms that are at least fifty-one percent owned and operated by an individual(s) of the aforementioned categories. Also included in this category are disabled business enterprises and non-profit work centers for the blind and severely disabled.

The University is committed to increasing the amount of goods and services acquired from businesses owned and controlled by diverse persons to 10% of all procurement expenditures. The University expects its suppliers to support and assist in this effort.

Among the University's goals for DBE participation in procurement are:

- To ensure the absence of barriers that reduce the participation of diverse suppliers
- Educate vendors on "how to" do business with the University
- Support diverse vendors seeking to do business with the University in the areas of goods, services, construction, and other areas of procurement
- Encourage participation of qualified diverse vendors by directing them to agencies that can benefit from their product or service
- Provide resources for diverse vendors
- Sponsor events to assist diverse vendors in becoming active, responsible, and responsive participants in the University's purchasing opportunities

For additional information regarding how diverse suppliers may participate in this Request for Proposal, submit any questions to the Purchasing Officer as indicated in Section 3.2 by the Deadline for Written Questions date.

3.0 PROPOSAL REQUIREMENTS

3.1 Key Event Dates

Release of RFP	01/19/22
Deadline for Written Questions	3 p.m. Eastern Time on 01/26/22
RFP Proposals Due	3 p.m. Eastern Time on 02/09/22

3.2 Offeror Communication

To ensure that RFP documentation and subsequent information (modifications, clarifications, addenda, Written Questions and Answers, etc.) are directed to the appropriate persons within the offeror's firm, each offeror who intends to participate in this RFP is to provide the following information to the purchasing officer. Prompt, thorough compliance is in the best interest of the offeror. Failure to comply may result in incomplete or delayed communication of addenda or other vital information. Contact information is the responsibility of the offeror. Without the prompt information, any communication shortfall shall reside with the offeror.

- Name of primary contact
- Mailing address of primary contact
- Telephone number of primary contact
- Fax number of primary contact
- E-mail address of primary contact
- Additional contact persons with same information provided as primary contact

This information shall be transmitted via fax or e-mail to:

Ken Scott
Purchasing Division
University of Kentucky
322 Peterson Service Building
Lexington, KY 40506-0005
Phone: (859) 257-9102
Fax: (859) 257-1951
E-mail: kenneth.scott@uky.edu

All communication with the University regarding this RFP shall only be directed to the purchasing officer listed above.

3.3 Pre-Proposal Conference

A pre-proposal conference will **NOT** be held for this RFP.

3.4 Offeror Presentations

All offerors whose proposals are judged acceptable for award may be required to make a presentation to the evaluation committee.

3.5 Preparation of Offers

The offeror is expected to follow all specifications, terms, conditions and instructions in this RFP.

The offeror will furnish all information required by this solicitation.

Proposals should be prepared simply and economically, providing a description of the offeror's capabilities to satisfy the requirements of the solicitation. Emphasis should be on completeness and clarity of content. All documentation submitted with the proposal should be bound in the single volume except as otherwise specified.

An electronic version of the RFP, in .PDF format only, is available through the University of Kentucky Purchasing Division website at: <https://purchasing.uky.edu/bid-and-proposal-opportunities>.

3.6 Proposed Deviations from the RFP

The stated requirements appearing elsewhere in this RFP shall become a part of the terms and conditions of any resulting contract. Any deviations therefrom must be specifically defined in accordance with the transmittal letter, Section 4.3 (d). If accepted by the University, the deviations shall become part of the contract, but such deviations must not be in conflict with the basic nature of this RFP.

Note: Offerors shall not submit their standard terms and conditions as exceptions to the University's General Terms and Conditions. Each exception to the University's General Terms and Conditions shall be individually addressed.

3.7 Proposal Submission and Deadline

Offeror must provide the following materials prior to 3 p.m. (Lexington, KY time) on the date specified in Section 3.1 and addressed to the purchasing officer listed in Section 3.2:

- **Technical Proposal:** One (1) copy on an electronic storage device (CD or USB) (1 copy per storage device) each clearly marked with the proposal number and name, firm name and what is included (Technical Proposal) and one (1) printed copies in a single package, separate from the Financial Proposal.

- **Financial Proposal:** One (1) copy on an electronic storage device (CD or USB) (1 copy per storage device) each clearly marked with the proposal number and name, firm name and what is included (Financial Proposal) and one (1) printed copies in a single package, separate from the Technical Proposal.

Note: Proposals received after the closing date and time will not be considered. In addition, proposals received via fax or e-mail are not acceptable.

The University of Kentucky accepts deliveries of RFPs Monday through Friday from 8 a.m. to 5 p.m. Lexington, KY time. However, RFPs must be received by 3 p.m. Lexington, KY time on the date specified on the RFP in order to be considered.

Proposals shall be enclosed in sealed envelopes to the above referenced address and shall show on the face of the envelope: the closing time and date specified, the solicitation number and the name and address of the offeror. The technical proposal shall be submitted in a sealed envelope and the financial proposal shall be submitted in a sealed envelope under separate cover. Both sealed envelopes shall have identical information on the cover, with the addition that one will state "Technical Information," and the other, "Financial Proposal."

Note: In accordance with the Kentucky Revised Statute 45A.085, there will be no public opening.

3.8 Modification or Withdrawal of Offer

An offer and/or modification of offer received at the office designated in the solicitation after the exact hour and date specified for receipt will not be considered.

An offer may be modified or withdrawn by written notice before the exact hour and date specified for receipt of offers. An offer also may be withdrawn in person by an offeror or an authorized representative, provided the identity of the person is made known and the person signs a receipt for the offer, but only if the withdrawal is made prior to the exact hour and date set for receipt of offers.

3.9 Acceptance or Rejection and Award of Proposal

The University reserves the right to accept or reject any or all proposals (or parts of proposals), to waive any informalities or technicalities, to clarify any ambiguities in proposals and (unless otherwise specified) to accept any item in the proposal. In case of error in extension or prices or other errors in calculation, the unit price shall govern. Further, the University reserves the right to make a single award, split awards, multiple awards or no award, whichever is in the best interest of the University.

3.10 Rejection

Grounds for the rejection of proposals include (but shall not be limited to):

- Failure of a proposal to conform to the essential requirements of the RFP.
- Imposition of conditions that would significantly modify the terms and conditions of the solicitation or limit the offeror's liability to the University on the contract awarded on the basis of such solicitation.
- Failure of the offeror to sign the University RFP. This includes the Authentication of Proposal and Statement of Non-Collusion and Non-Conflict of Interest statements.
- Receipt of proposal after the closing date and time specified in the RFP.

3.11 Addenda

Any addenda or instructions issued by the purchasing agency prior to the time for receiving proposals shall become a part of this RFP. Such addenda shall be acknowledged in the proposal. No instructions or changes shall be binding unless documented by a proper and duly issued addendum.

3.12 Disclosure of Offeror's Response

The RFP specifies the format, required information and general content of proposals submitted in response to this RFP. The purchasing agency will not disclose any portions of the proposals prior to contract award to anyone outside the Purchasing Division, the University's administrative staff, representatives of the state or federal government (if required) and the members of the committee evaluating the proposals. After a contract is awarded in whole or in part, the University shall have the right to duplicate, use or disclose all proposal data submitted by offerors in response to this RFP as a matter of public record.

Any submitted proposal shall remain valid six (6) months after the proposal due date.

The University shall have the right to use all system ideas, or adaptations of those ideas, contained in any proposal received in response to this RFP. Selection or rejection of the proposal will not affect this right.

3.13 Restrictions on Communications with University Staff

From the issue date of this RFP until a contractor is selected and a contract award is made, offerors are not allowed to communicate about the subject of the RFP with any University administrator, faculty, staff or members of the board of trustees except: the purchasing office representative, any University purchasing official representing the University administration, others authorized in writing by the purchasing office and University representatives during offeror presentations. If violation of this provision occurs, the University reserves the right to reject the offeror's proposal.

3.14 Cost of Preparing Proposal

Costs for developing the proposals and any subsequent activities prior to contract award are solely the responsibility of the offerors. The University will provide no reimbursement for such costs.

3.15 Disposition of Proposals

All proposals become the property of the University. The successful proposal will be incorporated into the resulting contract by reference.

3.16 Alternate Proposals

Offerors may submit alternate proposals. If more than one proposal is submitted, all must be complete (separate) and comply with the instructions set forth within this document. Each proposal will be evaluated on its own merits.

3.17 Questions

All questions should be submitted by either fax or e-mail to the purchasing officer listed in Section 3.2 no later than the date listed in Section 3.1.

3.18 Section Titles in the RFP

Section titles used herein are for the purpose of facilitating ease of reference only and shall not be construed to infer the construction of contractual language.

3.19 No Contingent Fees

No person or selling agency shall be employed or retained or given anything of monetary value to solicit or secure this contract, except bona fide employees of the offeror or bona fide established commercial or selling agencies maintained by the offeror for the purpose of securing business. For breach or violation of this provision, the University shall have the right to reject the proposal, annul the contract without liability, or, at its discretion, deduct from the contract price or otherwise recover the full amount of such commission, percentage, brokerage or contingent fee or other benefit.

3.20 Proposal Addenda and Rules for Withdrawal

Prior to the date specified for receipt of offers, a submitted proposal may be withdrawn by submitting a written request for its withdrawal to the University purchasing office, signed by the offeror. Unless requested by the University, the University will not accept revisions or alterations to proposals after the proposal due date.

3.21 Requirement To Perform Vendor Onboarding and Registration

As a condition of award, and for any renewals performed during the life of the contract, successful Contractor agrees to register their company with PaymentWorks, Inc., the University's vendor onboarding application. Registration information will be provided by the Purchasing Division as part of the award process. During the vendor registration process, successful Contractor agrees to provide any applicable information pertaining to diversity demographics for their company. Further, should any company or diversity information change during the life of the contract, successful Contractor agrees to update this information in PaymentWorks as applicable.

4.0 PROPOSAL FORMAT AND CONTENT

4.1 Proposal Information and Criteria

The following list specifies the items to be addressed in the proposal. Offerors should read it carefully and address it completely and in the order listed to facilitate the University's review of the proposal.

Proposals shall be organized into the sections identified below. The content of each section is detailed in the following pages. It is strongly suggested that offerors use the same numbers for the following content that are used in the RFP.

- Signed Authentication of Proposal and Statement of Non-Collusion and Non-Conflict of Interest Form
- Transmittal Letter
- Executive Summary and Proposal Overview
- Criteria 1 - Offeror Qualifications
- Criteria 2 - Services Defined
- Criteria 3 - Financial Proposal
- Criteria 4 - Evidence of Successful Performance and Implementation Schedule
- Criteria 5 - Other Additional Information

4.2 Signed Authentication of Proposal and Statements of Non-Collusion and Non-Conflict of Interest Form

The Offeror will sign and return the proposal cover sheet and print or type their name, firm, address, telephone number and date. The person signing the offer must initial erasures or other changes. An offer signed by an agent is to be accompanied by evidence of their authority unless such evidence has been previously furnished to the purchasing agency. The signer shall further certify that the proposal is made without collusion with any other person, persons, company or parties submitting a proposal; that it is in all respects fair and in good faith without collusion or fraud; and that the signer is authorized to bind the principal offeror.

4.3 Transmittal Letter

The Transmittal Letter accompanying the RFP shall be in the form of a standard business letter and shall be signed by an individual authorized to legally bind the offeror. It shall include:

- A statement referencing all addenda and written questions, the answers and any clarifications to this RFP issued by the University and received by the offeror (If no addenda have been received, a statement to that effect should be included.).
- A statement that the offeror's proposal shall remain valid for six (6) months after the closing date of the receipt of the proposals.
- A statement that the offeror will accept financial responsibility for all travel expenses incurred for oral presentations (if required) and candidate interviews.
- A statement that summarizes any deviations or exceptions to the RFP requirements and includes a detailed justification for the deviation or exception.
- A statement that identifies the confidential information as described in Section 6.23.

4.4 Executive Summary and Proposal Overview

The Executive Summary and Proposal Overview shall condense and highlight the contents of the technical proposal in such a way as to provide the evaluation committee with a broad understanding of the entire proposal.

As part of the Executive Summary and Proposal Overview, Offeror shall submit with their response a summarized profile describing the demographic nature of their company or organization:

1. When was your organization established and/or incorporated?
2. Indicate whether your organization is classified as local, regional, national, or international.
3. Describe the size of your company in terms of number of employees, gross sales, etc.
4. Is your company certified as small business, minority-owned, women-owned, veteran-owned, disabled-owned, or similar classification?
5. Include other demographic information that you feel may be applicable to the Request for Proposal submission.
6. Offeror shall describe in detail their company's commitment to diversity, equity, and inclusion. Information shall be provided as to the number of diverse individuals that the vendor employees as well as a description of vendors efforts to do business with Diverse Business Enterprises as they conduct their own business. In additional, please indicate the diversity nature of your company as well as ownership race/ethnicity.

Check One Only	Diverse Business Description (If Diverse Business, determine the classification that is the best description)	Internal Code
	Minority Owned (only)	10
	Veteran Owned and Small Business	100
	Minority and Woman and Small Business	110
	Minority and Woman and Veteran-Owned Business	120
	Minority and Veteran and Small Business	130
	Woman and Veteran and Small Business	140
	Minority and Woman and Veteran-Owned Small Business	150
	Woman Owned (only)	20
	Small Business (only)	30
	Veteran Owned (only)	40
	Minority and Woman Owned	50
	Minority and Small Business	60
	Minority and Veteran-Owned	70
	Woman Owned and Small Business	80
	Woman and Veteran-Owned	90
	Diversity not indicated	999

Race/Ethnicity	Check One
Asian	
Black/African American	
Hispanic or Latino	
Native American	
Native Hawaiian/Pacific Islander	
White	
Other	

4.5 Criteria 1 - Offeror Qualifications

The purpose of the Offeror Qualifications section is to determine the ability of the offeror to respond to this RFP. Offerors must describe and offer evidence of their ability to meet each of the qualifications listed below.

Offerors must describe and offer evidence of their ability to meet each of the qualifications listed below.

1. Equipment Schedule Performance (explain all deviations & exceptions)
2. Drawing Footprint Compliance (explain all deviations & exceptions)
3. Equipment Specifications Compliance (explain all deviations & exceptions)
4. Delivery (confirm FOB jobsite)
5. Manufacturing Facility's capacity to meet scheduled delivery.

4.6 Criteria 2 – Services Defined

Please refer to the Scope of Services, Section 7.0 and provide the information required. Include a complete spare parts listing and recommended spare parts list that owner should keep in spare parts inventory.

Address and explain your compliance, deviations, and exceptions with regards to entire Scope of Work. This includes the Plans & Specifications.

4.7 Criteria 3 – Financial Proposal

The Financial Summary Form shall contain the complete financial offer made to the University using the format contained in Section 8.0. All financial information must be submitted in a sealed envelope under separate cover.

4.8 Criteria 4 – Evidence of Successful Performance and Implementation Schedule

Please provide and outline with descriptions as to the overall process that your company would use in the expected deliverable. This includes all events from award, submittal process, changes made during coordination, internal design/engineering, procurement of material from suppliers, actual build time(s), factory testing, shipping/packaging, delivery, and any field-installation values/advantages you feel your equipment adds, start-up, reaction time to investigate performance/functional issues, training, assistance during commissioning, training, as-built drawings, warranty, and turnover to owner.

4.9 Criteria 5 – Other Additional Information

Please provide any additional information that the offeror feels should be considered when evaluating their proposal.

The offeror may present any creative approaches that might be appropriate. The offeror may also provide supporting documentation that would be pertinent to this RFP.

Offeror shall describe in detail their company's commitment to diversity, equity and inclusion. Information shall be provided as to the number of diverse individuals that the vendor employees as well as a description of vendors efforts to do business with Diverse Business Enterprises as they conduct their own business.

5.0 EVALUATION CRITERIA PROCESS

A committee of University officials appointed by the Chief Procurement Officer will evaluate proposals and make a recommendation to the Chief Procurement Officer. The evaluation will be based upon the information provided in the proposal, additional information requested by the University for clarification, information obtained from references and independent sources and oral presentations (if requested).

The evaluation of responsive proposals shall then be completed by an evaluation team, which will determine the ranking of proposals. Proposals will be evaluated strictly in accordance with the requirements set forth in this solicitation, including any addenda that are issued. The University will award the contract to the responsible offeror whose proposal is determined to be the most advantageous to the University, taking into consideration the evaluation factors set forth in this RFP.

The evaluation of proposals will include consideration of responses to the list of criteria in Section 4.0. Offerors must specifically address all criteria in their response. Any deviations or exceptions to the specifications or requirements must be described and justified in a transmittal letter. Failure to list such exceptions or deviations in the transmittal letter may be considered sufficient reason to reject the proposal.

The relative importance of the criteria is defined below:

Primary Criteria

- Offeror Qualifications
- Services Defined
- Financial Proposal
- Evidence of Successful Performance and Implementation

Secondary Criteria

- Other Additional Services

The University will evaluate proposals as submitted and may not notify offerors of deficiencies in their responses.

Proposals must contain responses to each of the criteria, listed in Section 4 even if the offeror's response cannot satisfy those criteria. A proposal may be rejected if it is conditional or incomplete in the judgment of the University.

6.0 SPECIAL CONDITIONS

6.1 Scope

This Request for Proposals is to establish a Purchase Order for CUSTOM Air Handling Equipment that will serve new construction at the University.

6.2 Effective Date

The effective date of the contract shall be the date upon which the parties execute it and all appropriate approvals, including that of the Commonwealth of Kentucky Government Contracts Review Committee, have been received.

6.3 Competitive Negotiation

It is the intent of the RFP to enter into competitive negotiation as authorized by KRS 45A.085.

The University will review all proposals properly submitted. However, the University reserves the right to request necessary modifications, reject all proposals, reject any proposal that does not meet mandatory requirement(s) or cancel this RFP, according to the best interests of the University.

Offeror(s) selected to participate in negotiations may be given an opportunity to submit a Best and Final Offer to the purchasing agency. All information-received prior to the cut-off time will be considered part of the offeror's Best and Final Offer.

The University also reserves the right to waive minor technicalities or irregularities in proposals providing such action is in the best interest of the University. Such waiver shall in no way modify the RFP requirements or excuse the offeror from full compliance with the RFP specifications and other contract requirements if the offeror is awarded the contract.

6.4 Appearance Before Committee

Any, all or no offerors may be requested to appear before the evaluation committee to explain their proposal and/or to respond to questions from the committee concerning the proposal. Offerors are prohibited from electronically recording these meetings. The committee reserves the right to request additional information.

6.5 Additions, Deletions or Contract Changes

The University reserves the right to add, delete, or change related items or services to the contract established from this RFP. No modification or change of any provision in the resulting contract shall be made unless such modification is mutually agreed to in writing by the contractor and the Chief Procurement Officer and incorporated as a written modification to the contract. Memoranda of understanding and correspondence shall not be interpreted as a modification to the contract.

6.6 Contractor Cooperation in Related Efforts

The University reserves the right to undertake or award other contracts for additional or related work to other entities. The contractor shall fully cooperate with such other contractors and University employees and carefully fit its work to such additional work. The contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor or by University employees. This clause shall be included in the contracts of all contractors with whom this contractor will be required to cooperate. The University shall equitably enforce this clause to all contractors to prevent the imposition of unreasonable burdens on any contractor.

6.7 Entire Agreement

The RFP shall be incorporated into any resulting contract. The resulting contract, including the RFP and those portions of the offeror's response accepted by the University, shall be the entire agreement between the parties.

6.8 Governing Law

The contractor shall conform to and observe all laws, ordinances, rules and regulations of the United States of America, Commonwealth of Kentucky and all other local governments, public authorities, boards or offices relating to the property or the improvements upon same (or the use thereof) and will not permit the same to be used for any illegal or immoral purposes, business or occupation. The resulting contract shall be governed by Kentucky law and any claim relating to this contract shall only be brought in the Franklin Circuit Court in accordance with KRS 45A.245.

6.9 Kentucky's Personal Information Security and Breach Investigation Procedures and Practices Act

To the extent Company receives Personal Information as defined by and in accordance with Kentucky's Personal Information Security and Breach Investigation Procedures and Practices Act, KRS 61.931, 61.932 and 61.933 (the "Act"), Company shall secure and protect the Personal Information by, without limitation: (i) complying with all requirements applicable to non-affiliated third parties set forth in the Act; (ii) utilizing security and breach investigation procedures that are appropriate to the nature of the Personal Information disclosed, at least as stringent as University's and reasonably designed to protect the Personal Information from unauthorized access, use, modification, disclosure, manipulation, or destruction; (iii) notifying University of a security breach relating to Personal Information in the possession of Company or its agents or subcontractors within seventy-two (72) hours of discovery of an actual or suspected breach unless the exception set forth in KRS 61.932(2)(b)2 applies and Company abides by the requirements set forth in that exception; (iv) cooperating with University in complying with the response, mitigation, correction, investigation, and notification requirements of the Act, (v) paying all costs of notification, investigation and mitigation in the event of a security breach of Personal Information suffered by Company; and (vi) at University's discretion and direction, handling all administrative functions associated with notification, investigation and mitigation.

6.10 Termination for Convenience

The University of Kentucky, Purchasing Division, reserves the right to terminate the resulting contract without cause with a thirty (30) day written notice. Upon receipt by the contractor of a "notice of termination," the contractor shall discontinue all services with respect to the applicable contract. The cost of any agreed upon services provided by the contractor will be calculated at the agreed upon rate prior to a "notice of termination" and a fixed fee contract will be pro-rated (as appropriate).

6.11 Termination for Non-Performance

Default

The University may terminate the resulting contract for non-performance, as determined by the University, for such causes as:

- Failing to provide satisfactory quality of service, including, failure to maintain adequate personnel, whether arising from labor disputes, or otherwise any substantial change in ownership or proprietorship of the Contractor, which in the opinion of the University is not in its best interest, or failure to comply with the terms of this contract;
- Failing to keep or perform, within the time period set forth herein, or violation of, any of the covenants, conditions, provisions or agreements herein contained;
- Adjudicating as a voluntarily bankrupt, making a transfer in fraud of its creditors, filing a petition under any section from time to time, or under any similar law or statute of the United States or any state thereof, or if an order for relief shall be entered against the Contractor in any proceeding filed by or against contractor thereunder. In the event of any such involuntary bankruptcy proceeding being instituted against the Contractor, the fact of such an involuntary petition being filed shall not be considered an event of default until sixty (60) days after filing of said petition in order that Contractor might during that sixty (60) day period have the opportunity to seek dismissal of the involuntary petition or otherwise cure said potential default; or
- Making a general assignment for the benefit of its creditors, or taking the benefit of any insolvency act, or if a permanent receiver or trustee in bankruptcy shall be appointed for the Contractor.

Demand for Assurances

In the event the University has reason to believe Contractor will be unable to perform under the Contract, it may make a demand for reasonable assurances that Contractor will be able to timely perform all obligations under the Contract. If Contractor is unable to provide such adequate assurances, then such failure shall be an event of default and grounds for termination of the Contract.

Notification

The University will provide ten (10) calendar days written notice of default. Unless arrangements are made to correct the non-performance issues to the University's satisfaction within ten (10) calendar days, the University may terminate the contract by giving forty-five (45) days' notice, by registered or certified mail, of its intent to cancel this contract.

6.12 Funding Out

The University may terminate this contract if funds are not appropriated or are not otherwise available for the purpose of making payments without incurring any obligation for payment after the date of termination, regardless of the terms of the contract. The University shall provide the contractor thirty (30) calendar days' written notice of termination under this provision.

6.13 Prime Contractor Responsibility

Any contracts that may result from the RFP shall specify that the contractor(s) is/are solely responsible for fulfillment of the contract with the University.

6.14 Assignment and Subcontracting

The Contractor(s) may not assign or delegate its rights and obligations under any contract in whole or in part without the prior written consent of the University. Any attempted assignment or subcontracting shall be void.

6.15 Permits, Licenses, Taxes

The contractor shall procure all necessary permits and licenses and abide by all applicable laws, regulations and ordinances of all federal, state and local governments in which work under this contract is performed.

The contractor must furnish certification of authority to conduct business in the Commonwealth of Kentucky as a condition of contract award. Such registration is obtained from the Secretary of State, who will also provide the certification thereof. However, the contractor need not be registered as a prerequisite for responding to the RFP.

The contractor shall pay any sales, use, personal property and other tax arising out of this contract and the transaction contemplated hereby. Any other taxes levied upon this contract, the transaction or the equipment or services delivered pursuant hereto shall be the responsibility of the contractor.

The contractor will be required to accept liability for payment of all payroll taxes or deductions required by local and federal law including (but not limited to) old age pension, social security or annuities.

6.16 Attorneys' Fees

In the event that either party deems it necessary to take legal action to enforce any provision of the contract and in the event that the University prevails, the contractor agrees to pay all expenses of such action including attorneys' fees and costs at all stages of litigation.

6.17 Royalties, Patents, Copyrights and Trademarks

The Contractor shall pay all applicable royalties and license fees. If a particular process, products or device is specified in the contract documents and it is known to be subject to patent rights or copyrights, the existence of such rights shall be disclosed in the contract documents and the Contractor is responsible for payment of all associated royalties. To the fullest extent permitted by law the Contractor shall indemnify, hold the University harmless, and defend all suits, claims, losses, damages or liability resulting from any infringement of patent, copyright, and trademark rights resulting from the incorporation in the Work or device specified in the Contract Documents.

Unless provided otherwise in the contract, the Contractor shall not use the University's name nor any of its trademarks or copyrights, although it may state that it has a Contract with the University.

6.18 Indemnification

The contractor shall indemnify, hold and save harmless the University, its affiliates and subsidiaries and their officers, agents and employees from losses, claims, suits, actions, expenses, damages, costs (including court costs and attorneys' fees of the University's attorneys), all liability of any nature or kind arising out of or relating to the Contractor's response to this RFP or its performance or failure to perform under the contract awarded from this RFP. This clause shall survive termination for as long as necessary to protect the University.

6.19 Method of Award

It is the intent of the University to award a contract to the qualified offeror whose offer, conforming to the conditions and requirements of the RFP, is determined to be the most advantageous to the University, cost and other factors considered.

Notwithstanding the above, this RFP does not commit the University to award a contract from this solicitation. The University reserves the right to reject any or all offers and to waive formalities and minor irregularities in the proposal received.

6.20 Reciprocal Preference

In accordance with KRS 45A.494, a resident offeror of the Commonwealth of Kentucky shall be given a preference against a nonresident offeror. In evaluating proposals, the University will apply a reciprocal preference against an offeror submitting a proposal from a state that grants residency preference equal to the preference given by the state of the nonresident offeror. Residency and non-residency shall be defined in accordance with KRS 45A.494(2) and 45A.494(3), respectively. Any offeror claiming Kentucky residency status shall submit with its proposal a notarized affidavit affirming that it meets the criteria as set forth in the above reference statute.

6.21 Confidentiality

The University recognizes an offeror's possible interest in preserving selected information and data included in the proposal; however, the University must treat such information and data as required by the Kentucky Open Records Act, KRS 61.870, et seq.

Information areas which normally might be considered proprietary, and therefore confidential, shall be limited to individual personnel data, customer references, formulae and company financial audits which, if disclosed, would permit an unfair advantage to competitors. If a proposal contains information in these areas and the offeror declares them to be proprietary in nature and not available for public disclosure, the offeror shall declare in the Transmittal Letter the inclusion of proprietary information and shall noticeably label as confidential or proprietary each sheet containing such information. Proposals containing information declared by the offeror to be proprietary or confidential, either wholly or in part, outside the areas listed above may be deemed non-responsive and may be rejected.

The University's General Counsel shall review each offeror's information claimed to be confidential and, in consultation with the offeror (if needed), make a final determination as to whether or not the confidential or proprietary nature of the information or data complies with the Kentucky Open Records Act.

6.22 Conflict of Interest

This Request for Proposal and resulting Contract are subject to provisions of the Kentucky Revised Statutes regarding conflict of interest and the University of Kentucky's Ethical Principles and Code of Conduct (www.uky.edu/Legal/ethicscode.htm). When submitting and signing a proposal, an offeror is certifying that no actual, apparent or potential conflict of interest exists between the interests of the University and the interests of the offeror. A conflict of interest (whether contractual, financial, organizational or otherwise) exists when any individual, contractor or subcontractor has a direct or indirect interest because of a financial or pecuniary interest, gift or other activities or relationships with other persons (including business, familial or household relationships) and is thus unable to render or is impeded from rendering impartial assistance or advice, has impaired objectivity in performing the proposed work or has an unfair competitive advantage.

Questions concerning this section or interpretation of this section should be directed to the University purchasing officer identified in this RFP.

6.23 Personal Service Contract Policies

Pursuant to the Kentucky Model Procurement Code (Code), the Government Contract Review Committee (GCRC) of the Kentucky General Assembly may establish policies that govern personal service contracts. Under the Code, a personal service contract is an agreement whereby an individual, firm, partnership or corporation is to perform certain services requiring professional skill or professional judgment for a specified period of time at an agreed upon price.

A. Professional Service Rate Schedules:

The GCRC has established rate schedules for certain professional services and may impact any contract established under the Code. These rate schedules are located on the GCRC website at the following link: <https://apps.legislature.ky.gov/moreinfo/contracts/homepage.html>. Access/click the dropdown menu within the web page for the rates information.

B. Invoicing of Personal Service Contracts:

The Kentucky Model Procurement Code was recently amended to establish conditions for invoicing for fees for personal service contracts. It states, "No payment shall be made on any personal service contract unless the individual, firm, partnership, or corporation awarded the personal service contract submits its invoice on a form established by the committee." The Government Contract Review Committee has adopted a personal service contract invoice form that must be submitted as a condition of payment. A copy of the form is located on the GCRC website at: <https://apps.legislature.ky.gov/moreinfo/contracts/PSC%20INVOICE%20FORM.pdf>.

6.24 Copyright Ownership and Title to Designs and Copy

The contractor and University intend this RFP to result in a contract for services, and both consider the products and results of the services to be rendered by the contractor hereunder to be a work made for hire. The contractor acknowledges and agrees that the work and all rights therein, including (without limitation) copyright, belongs to and shall be the sole and exclusive property of the University. For any work that is not considered a work made for hire under applicable law, title and copyright ownership shall be assigned to the University.

Title to all dies, type, cuts, artwork, negatives, positives, color separations, progressive proofs, plates, copy and any other requirement not stated herein required for completion of the finished product for use in connection with any University job shall be the property of and owned by the University. Such items shall be returned to the appropriate department upon completion and/or delivery of work unless otherwise authorized by the University. In the event that time of return is not specified, the contractor shall return all such items to the appropriate University department within one week of delivery.

6.25 University Brand Standards

The contractor must adhere to all University of Kentucky Brand Standards. University Brand Standards are maintained by the University Public Relations Office (UKPR) and can be viewed at <http://www.uky.edu/prmarketing/brand-standards>. Non-adherence to the standards can have a penalty up to and including contract cancellation. Only the UKPR Director or designee can approve exceptions to the University standards.

Graphics standards for the UK HealthCare areas are governed by UK HealthCare Clinical Enterprise Graphic Standards, found at: <https://ukhealthcare.uky.edu/staff/brand-strategy>.

Contractor warrants that its products or services provided hereunder will be in compliance with all applicable Federal disabilities laws and regulations, including without limitation the accessibility requirements of Section 255 of the Federal Telecommunications Act of 1996 (47 U.S.C. § 255) and Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794d), and its implementing regulations set forth at Title 36, Code of Federal Regulations, Part 1194. For purposes of clarity, updated regulations under Section 508 standards now incorporate WCAG 2.0, and for purposes of this agreement WCAG 2.0 Level AA compliance is expressly included. Contractor agrees to promptly respond to, resolve and remediate any complaint regarding accessibility of products or services in a timely manner and provide an updated version to University at no cost. If deficiencies are identified, University reserves the right to request from Contractor, a timeline by which accessibility standards will be incorporated into the products or services provided by Contractor and shall provide such a timeline within a commercially reasonable duration of time. Failure to comply with these requirements shall constitute a material breach of this Agreement and shall be grounds for termination of this Agreement.

Where any customized web services are provided, Contractor represents that it has reviewed the University's Web Policy and all products or services will comply with its published standards.

Contractor will provide University with a current Voluntary Product Accessibility Template (VPAT) for any deliverable(s). If none is available, Vendor will provide sufficient information to reasonably assure the University that the products or services are fully compliant with current requirements.

6.26 Printing Statutes

The purchase of printing services for all state agencies is governed by Chapter 57 of the Kentucky Revised Statutes. Specifically, all printing must be awarded to the lowest responsive bidder and approved by the Governor of Kentucky. In compliance with these statutes, all printing must be provided by a contract established by the Purchasing Division.

6.27 Payment Terms

The University adheres to a strategic approach regarding payables management based on risk minimization, processing costs, and industry best practices. As such, suppliers and individuals doing business with the University will be paid based on the following protocol:

1. The University utilizes Payment Plus (e-payables) as its primary default form of payment. By enrolling in Payment Plus, suppliers can receive payments immediately (all invoices will be paid immediately upon confirmation of goods receipt and invoice). The process is electronic and the supplier receives real-time payment notices. Additional information regarding Payment Plus (and enrollment form) can be found at: <https://www.uky.edu/ufs/payment-plus-supplier-enrollment-form>.
2. Payments by check. Payment terms for check payments are Net-30.
3. Individuals receiving payments from the University that require ACH direct payments will only be processed under special circumstances as approved by the Controller's office. Payment terms for ACH are Net-40.

7.0 SCOPE OF SERVICES

7.1 Detailed Services Defined

A. Contract Documents:

1. Drawings as prepared by Affiliated Engineers, Inc.
2. Specifications as prepared by Affiliated Engineers, Inc.
3. Custom AHU identified within the following "Related Specification Sections":
Product Related Specification Sections:

Specifications

20 0513	Motors
20 0529	Mechanical Supporting Devices
23 0550	Vibration Isolation
23 0902	Control Dampers
23 2116	Pipe and Pipe Fittings
23 2118	Valves
23 2120	Piping Specialties
23 3314	Ductwork Specialties
23 3400	Fans
23 4114	Filters
23 7328	Factory Fabricated Custom Air Handling Units
23 8216	Coils
23 8413	Humidification Equipment
26 0519	Low-Voltage Electrical Power Conductors and Cables
26 0533	Raceway and Boxes for Electrical Systems
26 2726	Wiring Devices
26 2816	Enclosed Switches and Circuit Breakers
26 2913	Enclosed Controllers

Drawings

M203B Level 3 Mechanical Plan Area B
M203D Level 3 Mechanical Plan Area D
M804 Mech Details
M902 Mech Schedules

*When a conflict between scopes and specifications is identified the more restrictive will apply.

A. Shipping & Schedule Requirements:

1. Equipment shall be delivered FOB Jobsite on the dates stated below:

<u>CUSTOM AIR HANDLING UNITS</u>	<u>DELIVERY / REQUIRED ON JOB</u>	
Tag numbers	<u>(ROJ) DATES</u>	
	On-Site	
Air Handling Unit BT-51AW		07/21/2022
Air Handling Unit BT-51AE		07/21/2022

2. FOB jobsite location: 1000 S.Limestone St. Lexington, KY 40536.
3. Equipment may be stored at on offsite location prior to jobsite delivery. Offsite location storage must be a covered warehouse at a minimum, at best inside storage. Equipment is not to be stored outside, exposed to elements.
4. Manufacturer to provide the fabrication release date for this equipment to meet the delivery date established above.
5. Equipment shall be shipped with firmly attached labels that indicate name of manufacturer, equipment model number, and equipment serial number.
6. Equipment manufacturer shall include the cost to properly seal and protect the equipment during shipment/transit. Exposed physical utility connections (flanges, pipe ends, etc.) shall be isolated for transport from ambient influences with appropriate blinds, caps or weatherproofing materials.
7. Manufacturer shall coordinate with Turner Construction Company’s Project Manager and installing/receiving TRADE the shipping sequence and provide all **final** weights and dimensions of any shipping splits for rigging purposes prior to shipping such equipment. Equipment is intended to be modularized to the fullest extent possible. Provide 14-day advance notice to installing/receiving TRADE and Turner’s Project Manager.
8. Provide 48-hour delivery call ahead to Turner Construction Company’s Project Manager. Delivery hours are between the hours of **8 am and 4 pm.**

B. Submittal/Training Requirements:

1. Equipment Manufacturer shall submit a duplicate performance test report (when required by the project documents) to the Owner prior to shipping the equipment certifying that the units meet the specified performance.
2. Engineering submittals {minimum four (4) copies} shall be provided to Turner Construction Company’s Project Engineer. Vendor shall submit sample warranty certificate and installation checklist with shop drawings/engineering submittals.
3. Engineer/Architect reviewed submittals: Allow three (3) weeks (including mailing processing) for return.

4. O&M Manuals, commissioning, training and start-up schedules including all other remaining submittals shall be issued within four (4) weeks of delivery.
5. *O&M manuals are to include a complete listing of part numbers and a recommended spare parts list.*
6. Warranty certificate and/or commissioning report shall be issued within one (1) week of start-up/testing/field services.
7. Training and Owner’s Acceptance shall be within four (4) weeks of start-up/testing/field services. This date is subject to change.

C. Project Coordination:

1. Equipment Supplier shall provide a single point of contact to serve as the project manager for this purchase contract.
2. Project contacts:

Title	Name	Address	Telephone/ Cell phone	Email
Turner Project Manager	Benton Stegman		513-309-1315	astegman@tcco.com
Turner Area Manager	Dave Opalka		513-383-8004	dopalka@tcco.com

D. Schedule of Values:

1. Applications for payment shall be submitted to:

 University of Kentucky, CPMD
 Attn: Denise Cooper
 411 S. Limestone Ave.
 222 Peterson Service Bldg
 Lexington, KY 40506-0005
Denise.Cooper@uky.edu
2. If the successful supplier intends to bill for materials stored off-site, they must adhere to the guidelines as outlines in Article 30.

E. Changes in Work:

1. The successful supplier must adhere to Article 30 of the General Conditions in regards to changes in work. These guidelines will be strictly enforced. Make sure to review price change “acknowledgement”.

F. Sales Tax:

- 1. Sales and Use Tax shall not be included. A tax exemption certificate will be provided by the University of Kentucky.

G. Warranty:

- 1. Provide a Parts Warranty for equipment from delivery to jobsite date through PROJECT COMPLETION (aprox. 4/1/2022) with warranty ending per specifications.

8.0 FINANCIAL OFFER SUMMARY

Offerors are to provide a fixed price for each Air Handling Unit.

8.1 FINANCIAL OFFER SUMMARY

Offerors are to provide a fixed price for the services offered.

8.1 Equipment Pricing

BT-51AW and BT-51AE

Price \$ _____

8.2 Equipment Delivery (FOB Jobsite – after storage period)

Freight included in Price

YES _____ NO _____

Method of Shipment _____

Transportation will take approximately _____ Days

Shipment date after receipt of order _____

Shipment date after receipt of approval drawings _____

8.3 Drawings / Manuals

Approval Drawings to be submitted 2 # of weeks after order.

“AS Built” Drawings to be submitted 3 # of weeks after construction.

Proposal includes price for three (1) sets of Maintenance, Operating and Instruction Manuals and one (1) electronic copy. YES _____ NO _____

8.4 General Information - splits, weights, dimensions

<i>Tag Numbers</i>	<i>Number of Splits</i>	<i>Largest Section (Size & Weight)</i>	<i>Heaviest Section (Size & Weight)</i>	<i>Delivery Date</i>
Air Handling Unit BT-51AW				07/21/2022
Air Handling Unit BT_51 AE				07/21/2022

8.5 Start-up, Training, Spare Parts, & Additional Services

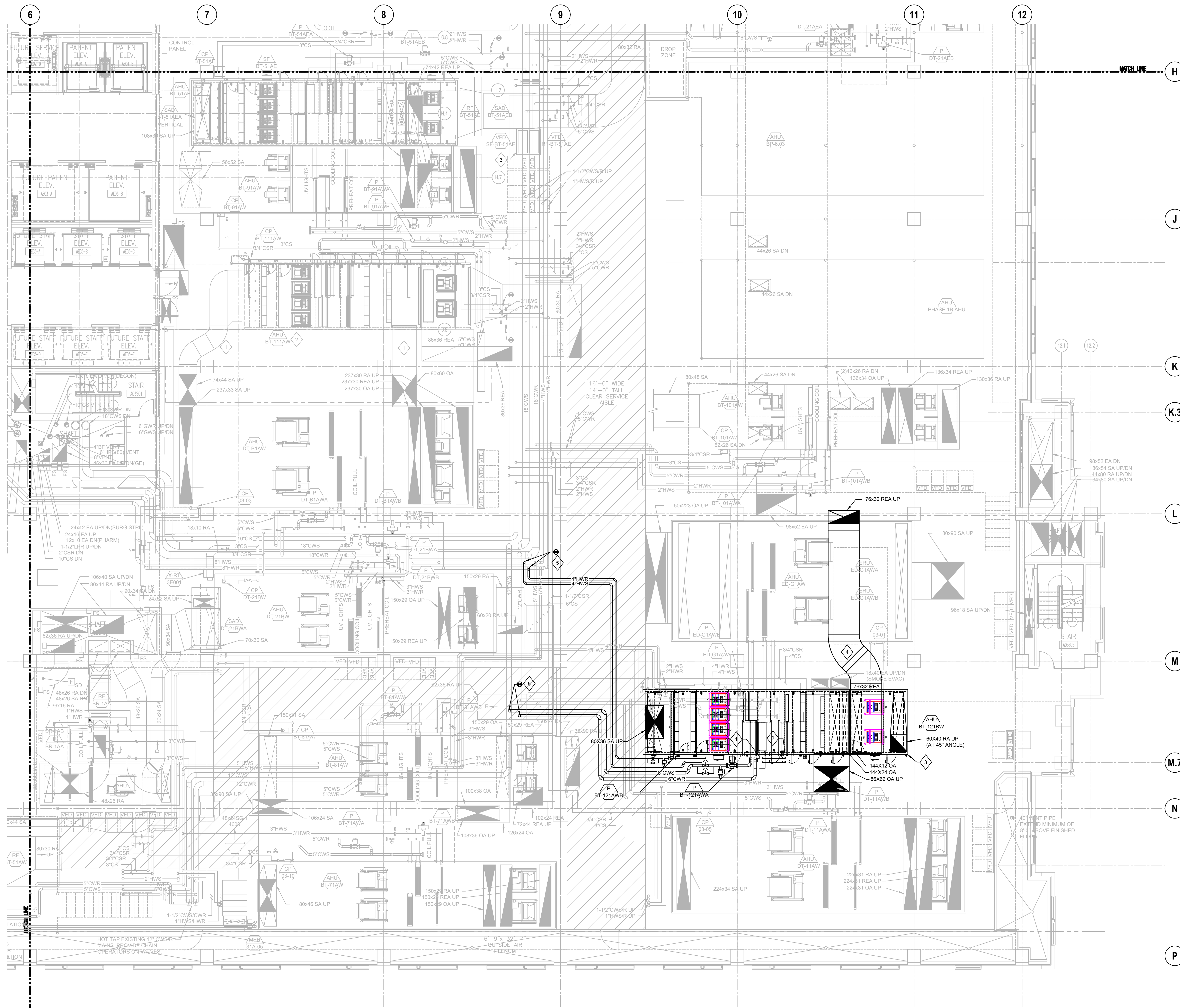
Start-up days included in proposal _____

Training days included in proposal _____

8.6 Optional Extended Maintenance / Support

**Maintenance/Support – First Year (After Warranty Period)	\$ _____
**Maintenance/Support - Second Year	\$ _____
**Maintenance/Support - Third Year	\$ _____
**Maintenance/Support - Fourth Year	\$ _____
**Maintenance/Support - Fifth Year	\$ _____

FOR REFERENCE ONLY



- GENERAL NOTES**
- FIELD VERIFY ALL DUCT AND PIPE ROUTINGS. COORDINATE WITH OTHER TRADE CONTRACTORS FOR RELOCATION OF ANY PIPING, CONDUIT, CABLE TRAY, OR SUPPORTS AS NEEDED.
 - HAVE NEW POWER AND CONTROLS CONDUIT AND WIRE IN PLACE BEFORE REMOVING EXISTING. COORDINATE WITH OWNER BEFORE DISCONNECTING ANY POWER OR CONTROLS.
 - PROVIDE CONCRETE HOUSEKEEPING PAD FOR AIR HANDLING UNITS. REFER TO ARCHITECTURAL SPECIFICATIONS FOR REQUIREMENTS.
 - SUPPORT DUCTWORK WITH NEW SUPPORTS FROM STRUCTURE OR STRUCTURAL PIPE RACK STEEL. REFER TO STRUCTURAL PLANS FOR DETAILS. CONSULT STRUCTURAL ENGINEER BEFORE USING ANY EXISTING SUPPORTS.

- KEYED NOTES**
- PROVIDE 3" CONNECTIONS TO (4) COOLING COILS. REFER TO M801 FOR COIL PIPING DETAILS. COORDINATE WITH AHU COIL SUBMITTALS FOR FINAL COIL CONNECTION SIZE.
 - PROVIDE 2-1/2" CONNECTIONS TO (4) HEATING COILS. REFER TO M801 FOR COIL PIPING DETAILS. COORDINATE WITH AHU COIL SUBMITTALS FOR FINAL COIL CONNECTION SIZE.
 - PROVIDE 3-1/2" HIGH CONCRETE HOUSEKEEPING PAD. PAD SHALL EXTEND 4" BEYOND EQUIPMENT EDGE ON ALL SIDES. COORDINATE EXACT PAD SIZE WITH FINAL EQUIPMENT SELECTION.
 - RELOCATE EXISTING CONDUITS.
 - HOT TAP EXISTING 8" HOT WATER MAINS.
 - HOT TAP EXISTING 12" CHILLED WATER MAINS.



PROJECT ARCHITECT
 332 E. 8th ST.
 Cincinnati, OH 45202-2217
 v 513.241.8700
 www.gbbn.com



Renovate/Upgrade
 UK Healthcare Facilities
 Pavilion A 12th Floor
 Project Number: 2402.9

OWNER
 University of Kentucky
 222 Peterson Service Building
 Lexington, Kentucky 40506

CONSTRUCTION MANAGER
 Turner Construction Company
 588 Leestown Road Suite 130-300
 Lexington, KY 40511
 859.421.4913

CONSULTANTS
MEP ENGINEERS
 AEI Affiliated Engineers, Inc.
 10 South LaSalle Street, Suite 2700
 Chicago, IL 60603
 312.977.2800

MEDICAL EQUIPMENT
 BSA Life Structures
 9365 Counselors Row #300
 Indianapolis, IN 46240
 317.819.7878

DRAWING ISSUE

**PHASE 2
 DESIGN DEVELOPMENT**

NO.	DATE	DESCRIPTION
A	12.10.21	DESIGN DEVELOPMENT SET

DRAWING TITLE

**LEVEL 03
 MECHANICAL PLAN
 - AREA B**

SEAL

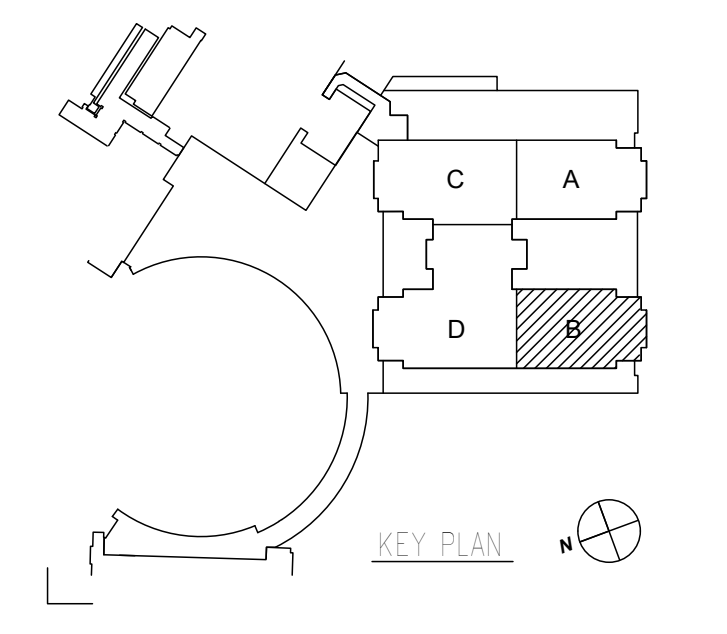
**PRELIMINARY
 NOT FOR
 CONSTRUCTION**

JOB NUMBER

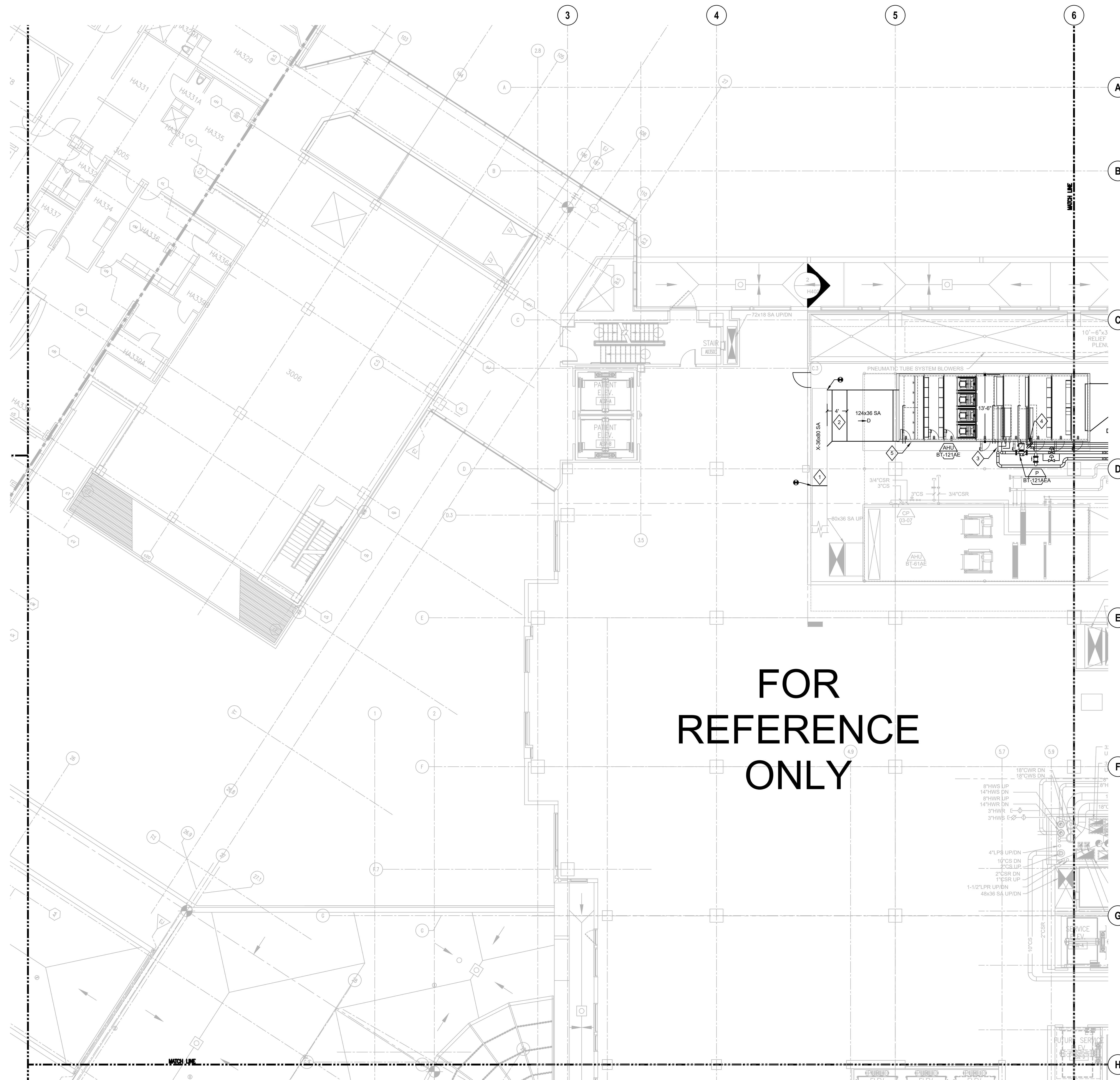
13703.01

M203B

1 M203B LEVEL 03 MECHANICAL PLAN - AREA B
 1/8"=1'-0"



Pavilion A 12th Floor | PAVILION A, 1000 S. LIMESTONE, LEXINGTON, KY 40536



GENERAL NOTES

1. FIELD VERIFY ALL DUCT AND PIPE ROUTINGS. COORDINATE WITH OTHER TRADE CONTRACTORS FOR RELOCATION OF ANY PIPING, CONDUIT, CABLE TRAY, OR SUPPORTS AS NEEDED.
2. HAVE NEW POWER AND CONTROLS CONDUIT AND WIRE IN PLACE BEFORE REMOVING EXISTING. COORDINATE WITH OWNER BEFORE DISCONNECTING ANY POWER OR CONTROLS.
3. PROVIDE CONCRETE HOUSEKEEPING PAD FOR AIR HANDLING UNITS. REFER TO ARCHITECTURAL SPECIFICATIONS FOR REQUIREMENTS.
4. SUPPORT DUCTWORK WITH NEW SUPPORTS FROM STRUCTURE OR STRUCTURAL PIPE RACK STEEL. REFER TO STRUCTURAL PLANS FOR DETAILS. CONSULT STRUCTURAL ENGINEER BEFORE USING ANY EXISTING SUPPORTS.

KEYED NOTES

1. RAISE EXISTING 80X36 SA DUCT AS HIGH AS POSSIBLE BY MODIFYING EXISTING OFFSET.
2. 124X36 TAKE-OFF TO BE AS HIGH AS POSSIBLE. RUN STRAIGHT FOR MINIMUM OF 4'-0" BEFORE OFFSETTING DOWN.
3. PROVIDE 3" CONNECTIONS TO (4) COOLING COILS. REFER TO M801 FOR COIL PIPING DETAILS. COORDINATE WITH AHU COIL SUBMITTALS FOR FINAL COIL CONNECTION SIZE.
4. PROVIDE 2-1/2" CONNECTIONS TO (4) HEATING COILS. REFER TO M801 FOR COIL PIPING DETAILS. COORDINATE WITH AHU COIL SUBMITTALS FOR FINAL COIL CONNECTION SIZE.
5. PROVIDE 3-1/2" HIGH CONCRETE HOUSEKEEPING PAD. PAD SHALL EXTEND 4" BEYOND EQUIPMENT EDGE ON ALL SIDES. COORDINATE EXACT PAD SIZE WITH FINAL EQUIPMENT SELECTION.



PROJECT ARCHITECT
 332 E. 8th ST.
 Cincinnati, OH 45202-2217
 v 513.241.8700
 www.gbbn.com



Renovate/Upgrade
 UK Healthcare Facilities
 Pavilion A 12th Floor
 Project Number: 2402.9

OWNER

University of Kentucky
 222 Peterson Service Building
 Lexington, Kentucky 40506

CONSTRUCTION MANAGER

Turner Construction Company
 588 Leestown Road Suite 130-300
 Lexington, KY 40511
 859.421.4913

CONSULTANTS

MEP ENGINEERS
 AEI Affiliated Engineers, Inc.
 10 South LaSalle Street, Suite 2700
 Chicago, IL 60603
 312.977.2800

MEDICAL EQUIPMENT

BSA Life Structures
 9365 Counselors Row #300
 Indianapolis, IN 46240
 317.819.7878

DRAWING ISSUE

**PHASE 2
 DESIGN DEVELOPMENT**

NO.	DATE	DESCRIPTION
A	12.10.21	DESIGN DEVELOPMENT SET

DRAWING TITLE

**LEVEL 03
 MECHANICAL PLAN
 - AREA D**

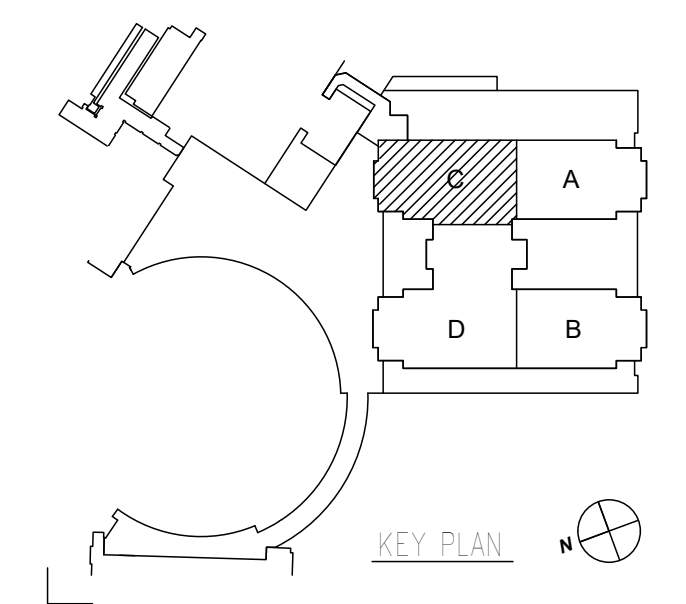
SEAL

**PRELIMINARY
 NOT FOR
 CONSTRUCTION**

JOB NUMBER

2402.16

M203D



1/203C THIRD LEVEL HVAC PLAN - AREA C 1/8"=1'-0"

Pavilion A 12th Floor | PAVILION A, 1000 S. LIMESTONE, LEXINGTON, KY 40536

12/10/21 10:00 AM 1/203C THIRD LEVEL HVAC PLAN - AREA C 1/8"=1'-0"

**PROJECT MANUAL
VOLUME 2**



**University of Kentucky
Renovate/Upgrade UK Healthcare Facilities
Pavilion A - 12th Floor**

**BP1 - AIR HANDLER RFP
UK Project Number 2402.16
December 22, 2021**

Prepared for:

**University of Kentucky
222 Peterson Service Building
Lexington, KY 40506**

PROJECT TEAM

ARCHITECT OF RECORD

GBBN ARCHITECTS, INC.
609 WEST MAIN STREET
LOUISVILLE, KY 40202
V502.583.0700
www.gbbn.com

MEP ENGINEERS

AFFILIATED ENGINEERS, INC.
10 SOUTH LASALLE ST, SUITE 2700
CHICAGO, IL 60603
v 312.977.2800
www.aeieng.com

MEDICAL EQUIPMENT

BSA LIFESTRUCTURES, INC.
9365 COUNSELORS ROW
INDIANAPOLIS, IN 46240
v 317.819.7878
www.bsalifestructures.com

STRUCTURAL ENGINEERS

THP LIMITED, INC.
332 EAST EIGHTH STREET
CINCINNATI, OH 45202
v 513.241.3222
www.thpltd.com

SECURITY

AFFILIATED ENGINEERS, INC.
10 SOUTH LASALLE ST, SUITE 2700
CHICAGO, IL 60603
v 312.977.2800
www.aeieng.com

OWNER

UNIVERSITY OF KENTUCKY
222 PETERSON SERVICE BUILDING
LEXINGTON, KY 40506
v 859.257.5911

PROJECT LOCATION

UK ALBERT B. CHANDLER HOSPITAL
PAVILION A
1000 SOUTH LIMESTONE
LEXINGTON, KY 40536
v 859.323.5000

SECTION 000110

TABLE OF CONTENTS

SECTIONS	PAGES
PROJECT FILES	
NOT USED	
COVER & TABLE OF CONTENTS	
000001.2 - TITLE PAGE - VOL 2	2
000110 - Table of Contents - Page Count	5
DIVISION 00 — PROCUREMENT AND CONTRACTING REQUIREMENTS	
NOT USED	
DIVISION 01 — GENERAL REQUIREMENTS	
NOT USED	
DIVISION 02 — EXISTING CONDITIONS	
NOT USED	
DIVISION 03 — CONCRETE	
NOT USED	
DIVISION 04 — MASONRY	
NOT USED	
DIVISION 05 — METALS	
NOT USED	
DIVISION 06 — WOOD, PLASTICS, AND COMPOSITES	
NOT USED	
DIVISION 07 — THERMAL AND MOISTURE PROTECTION	
NOT USED	
DIVISION 08 — OPENINGS	
NOT USED	
DIVISION 09 — FINISHES	
NOT USED	
DIVISION 10 — SPECIALTIES	
NOT USED	
DIVISION 11 — EQUIPMENT	
NOT USED	
DIVISION 12 — FURNISHINGS	
NOT USED	
DIVISION 13 — SPECIAL CONSTRUCTION	
NOT USED	
DIVISION 14 — CONVEYING EQUIPMENT	
NOT USED	

DIVISION 20 — MECHANICAL SUPPORT

200513 - Motors 0

DIVISION 21 — FIRE SUPPRESSION

NOT USED

DIVISION 22 — PLUMBING

NOT USED

DIVISION 23 — HEATING VENTILATING AND AIR CONDITIONING

230550 - Vibration Isolation 0

230902 - Control Dampers 0

232116 - Pipe and Pipe Fittings 0

232118 - Valves 0

233400 - Fans 0

234114 - Filters 0

237328 - Factory Fabricated Custom Air Handling Units 0

238216 - Coils 0

238413 - Humidification Equipment 0

DIVISION 25 — INTEGRATED AUTOMATION

NOT USED

DIVISION 26 — ELECTRICAL

260519 - Low-Voltage Electrical Power Conductors and Cables 0

260533 - Raceway and Boxes for Electrical Systems 0

262726 - Wiring Devices 0

262816 - Enclosed Switches and Circuit Breakers 0

262913 - Enclosed Controllers 0

DIVISION 27 — COMMUNICATIONS

NOT USED

DIVISION 28 — ELECTRONIC SAFETY AND SECURITY

NOT USED

DIVISION 31 — EARTHWORK

NOT USED

DIVISION 32 — EXTERIOR IMPROVEMENTS

NOT USED

DIVISION 33 — UTILITIES

NOT USED

DIVISION 34 — TRANSPORTATION

NOT USED

DIVISION 35 — WATERWAYS AND MARINE CONSTRUCTION

NOT USED

DIVISION 40 — PROCESS INTERCONNECTIONS

NOT USED

DIVISION 41 — MATERIAL PROCESSING AND HANDLING EQUIPMENT

NOT USED

DIVISION 42 — PROCESS HEATING, COOLING, AND DRYING EQUIPMENT
NOT USED

DIVISION 43 — PROCESS GAS AND LIQUID HANDLING, PURIFICATION AND STORAGE EQUIPMENT
NOT USED

DIVISION 44 — POLLUTION CONTROL EQUIPMENT
NOT USED

DIVISION 45 — INDUSTRY-SPECIFIC MANUFACTURING EQUIPMENT
NOT USED

DIVISION 46 — WATER AND WASTEWATER EQUIPMENT
NOT USED

DIVISION 48 — ELECTRICAL POWER GENERATION
NOT USED

This page intentionally left blank.

SECTION 20 0513 MOTORS

PART 1 - GENERAL

1.1 RELATED WORK

- A. Section 26 2913 - Enclosed Controllers

1.2 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.
- B. This section specifies a system or a component of a system being commissioned as defined in Section 01 91 00 Commissioning. Testing of these systems is required, in cooperation with the Owner and the Commissioning Authority. Refer to Section 01 91 00 Commissioning for detailed commissioning requirements.

1.3 SUBMITTALS

- A. Shop Drawings including, but not limited to, the following:
 - 1. Manufacturer
 - 2. HP, voltage, phase, hertz, rpm
 - 3. Motor type
 - 4. Enclosure type
 - 5. Frame type
 - 6. Insulation class
 - 7. NEMA design designation
 - 8. Service factor
 - 9. Nominal efficiency at full load
 - 10. Power factor at full load
 - 11. Full load amperes
 - 12. Bearings
 - 13. Mountings
 - 14. Dimensions
 - 15. Weight
 - 16. Shaft grounding brush for motors driven by Variable Frequency Drives (VFD)

1.4 PRODUCT CRITERIA

- A. Motors covered by this Specification shall conform to applicable requirements of NEMA, IEEE, ANSI, and NEC Standards and shall be UL Listed where applicable for service specified.
- B. Motors shall be designed for conditions in which they will be required to perform; i.e., general purpose, splash proof, explosion proof, standard duty, high torque or other special type as required by equipment manufacturers.
- C. Select motors so they do not exceed nameplate rating nor operate into service factor to meet specified duty.

- D. Motors located inside air handling units or exposed located in outdoor or wash down environments shall have totally enclosed fan cooled (TEFC) enclosures.
- E. Motors shall be furnished for starting in accordance with utility requirements and be compatible with starters specified hereinafter or under Electrical sections of Specifications.
 - 1. Refer to Section 26 2913 - Enclosed Controllers for reduced voltage starting requirements.
 - 2. Starters for NEMA rated 200 or 230 V motors, 25 HP and above shall be reduced voltage starting type.
 - 3. Starters for NEMA rated 460 V motors, 60 HP and above to be reduced voltage starting type.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall be new and guaranteed for service intended.

2.2 MANUFACTURERS

- A. Siemens, U.S. Motors, Lincoln, Marathon, Baldor, or Cutler-Hammer (Westinghouse).

2.3 MOTORS

B. Voltage Ratings

- 1. Refer to equipment schedules and specification sections for voltages required.
- 2. Unless otherwise indicated, motors 1/3 HP and smaller shall be rated 115 V for operation on 120 V, 1 Ph, 60 Hz service.
- 3. Unless otherwise indicated, motors 1/2 HP and larger shall be rated:
 - 1. 460 V for operation on 480 V, 3 Ph, 60 Hz service.
 - 2. 200 V for operation on 208 V, 3 Ph, 60 Hz service.
 - 3. 230 V for operation on 240 V, 3 Ph, 60 Hz service.

- C. Motors shall be 4 pole (approximately 1750 rpm) unless otherwise noted.

- D. Single-phase motors shall be furnished with built-in thermal overload protection.

- E. Use NEMA Design B motors, normal starting torque with regreasable ball bearings, and Class B insulation unless specified otherwise or unless manufacturer of equipment on which motor is being used has more stringent requirements.

- 1. Bearings shall be rated for minimum AFBMA 9, L-10 life of 26,280 hours (belted) and 200,000 hours (direct-coupled) at full-load.

- F. Motors shall be rated continuous duty and have 1.15 service factor unless otherwise noted.

G. Motors Driven by Variable Frequency Drives (VFD)

- 1. Motors shall comply with the latest NEMA MG-1, Section IV, Part 31.
- 2. Motors shall have service factor not less than 1.0 at rated load.

3. Insulation shall be Class F or H.
4. Furnish each motor with shaft grounding ring utilizing conductive microfiber similar to AEGIS SGR to protect motor bearings from electrical damage.
 - H. Vibration shall not exceed 0.15” per second, unfiltered peak unless otherwise noted.
 - I. Motors (180 frames and larger) shall have provisions for lifting eyes or lugs capable of safety factor of 5.
 - J. Full load nominal efficiency of motors 1 HP and larger, except special-purpose motors including 2-speed or multi-speed motors, and rewound motors, shall meet or exceed listed values when tested in accordance with IEEE Standard 112 Method B as defined by NEMA Standard MG 1-12.6C. Efficiency values listed are based on NEMA Premium Efficiency Electric Motors of NEMA MG 1-2011, Table 12-12.

HP	<u>Open Drip-Proof Motors</u>			<u>Totally Enclosed Fan-Cooled Motors</u>		
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
	(6 pole)	(4 pole)	(2 pole)	(6 pole)	(4 pole)	(2 pole)
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	88.5	89.5	85.5	89.5	89.5	86.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4
250	95.4	95.8	95.0	95.8	96.2	95.8

- K. Single-phase motors for hard starting applications including outdoor applications shall be capacitor start type. Motors for fans and pumps located indoors may be split phase or permanent split-capacitor. Motors shall be equipped with permanently lubricated and sealed ball bearings and shall be selected for quiet operation. Motors 1/8 HP and below may be shaded pole type.

- L. 3 Ph, 2-speed motors shall be one winding, consequent pole, variable torque type and 1 Ph, 2-speed motors shall be capacitor start capacitor run type.
- M. When submersible pumps are specified, each pump shall include in addition to controls specified, all necessary controls, relays, wiring, etc. that may be required for safety features incorporated in motor design. No submersible motor shall be run or activated until all requirements of motor manufacturer's recommendations have been complied with.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install materials in accordance with drawings, approved Shop Drawings and manufacturer's recommendations.

3.2 COMMISSIONING

- A. Refer to specification section 23 7328 Factory Fabricated Custom Air Handling Units for requirements.

END OF SECTION 200513

SECTION 23 0550 VIBRATION ISOLATION

PART 1 - GENERAL

1.1 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 DESIGN CRITERIA

- A. Isolate all motor driven mechanical equipment, unless otherwise noted, from building structure, and from systems that they serve, to prevent equipment vibrations from being transmitted to structure. Unless specifically indicated, follow the latest edition of ASHRAE Application Handbook - Sound and Vibration Control, or manufacturer's recommendations for isolator selection whichever is more stringent.
- B. Select and locate isolators to produce uniform loading and deflection. Use minimum of 4 isolators to support each piece of equipment.
- C. Select vibration isolation devices based on the lowest operating speed of equipment.
- D. Vibration Criteria:
 - 1. All rotating equipment shall operate at speeds less than 80% of their true critical speed. Unless otherwise required, equipment shall be balanced according to recommendations given in the following schedules.
 - 2. Vertical vibration of rotating equipment shall not be greater than levels indicated. Vibration shall be measured on equipment. If equipment has inertia base, allowable vibration level is reduced by ratio of equipment weight alone to equipment weight plus inertia base weight.

<u>Equipment Speed</u> rpm	<u>Maximum Allowable</u> <u>Vibration Displacement</u> Peak-to-Peak (mil)
100 to 200	10
200 to 300	6
300 to 600	4
600 to 1000	3
1000 or 2000	2
over 2000	1

- E. Following field installation, each fan and pump over 25 hp shall be balanced in accordance with the following maximum rms velocity levels:
 - 1. Fans: 0.15 inch/sec
 - 2. Pumps:

0.16 inch/sec	for 30 hp and smaller
0.18 inch/sec	for 40 through 60 hp
0.20 inch/sec	for 75 through 100 hp
0.22 inch/sec	for 125 hp and larger

Allowable field pump vibration values above are based on HI 9.6-2000, Figure 9.6.4.12.

- F. Final in-field balance shall be measured with each fan over 25 hp installed on springs specified for unit. Fans shall be loaded with design static pressure. Measurement shall be carried out in vertical, horizontal and axis planes at impeller shaft bearing location.

1.3 SUBMITTALS

- A. Submit Shop Drawings including, but not limited to, the following:
1. Manufacturer's name
 2. Isolator type and model number
 3. Materials of construction and finish
 4. Dimensional data
 5. Load ratings (lbs)
 6. Isolator free and operating heights
 7. Static deflections
 8. Isolation efficiency based on lowest operating speed
 9. All other appropriate data
- B. Provide seismic restraints for all vibration-isolated equipment. Restraints shall not be in contact with the equipment during its normal operation, but shall be capable of withstanding loads imposed by seismic acceleration of the equipment in any direction during seismic event.
- C. Refer to Section 20 0550 - Seismic Anchorage and Restraints for additional requirements.

1.4 SUPERVISION, INSPECTION AND CERTIFICATION

- A. Vibration isolation manufacturer or qualified representative shall provide supervision to assure correct installation and adjustment of isolators. Upon completion of installation and after system is put into operation, manufacturer or manufacturer's representative, shall make final inspection, adjustment, and submit report to Engineer in writing, certifying correctness of installation and compliance with Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials used shall retain their isolation characteristics for life of equipment served. Elastomeric materials shall comply with ASTM D2240 and shall be oil-resistant industrial grade neoprene.
- B. Isolators shall be treated to resist corrosion.
- C. Isolation devices subject to weather shall have either hot-dip or cold-dip galvanized, cadmium plated, or neoprene coated finish after fabrication and be furnished with limit stops to resist wind.
- D. Vibration isolator springs shall have minimum additional travel to solid equal to 50% of rated deflection.

- E. Ratio of lateral to vertical stiffness of vibration isolators shall not be less than 0.8 or greater than 2.0.
- F. Coordinate selection of devices with isolator and equipment manufacturer.

2.2 MANUFACTURERS

- A. Mason Industries, Amber/Booth Co., Aeroflex-VMC-Korfund. Vibration Eliminator, Vibro-Acoustics, or Kinetics equal to manufacturer's model listed, except flexible pipe connections.
- B. Mason, Metraflex, Proco, Twin City Hose, Engineered Flexible Products (EFP) or Flex-Weld/Keflex for flexible pipe connections.

2.3 TYPE 1 MOUNTS (NEOPRENE PAD)

- A. Mason Type Super W, neoprene waffle pads, 50 durometer. Select number and size of pads as required to accept equipment operating weight evenly.

2.4 TYPE 2 MOUNTS (NEOPRENE PAD)

- A. Mason Type ND or rails Type RND, double deflection neoprene mounts with cast-in metal inserts for bolting to equipment.
- B. Both surfaces shall be rib molded for skid resistance. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above mountings to compensate for overhang.

2.5 TYPE 3 MOUNTS (UNHOUSED SPRING WITH NEOPRENE)

- A. Mason Type SLF, combination spring and neoprene with rib molded base. Spring type isolators shall be free standing and laterally stable without any housing and complete with 1/4" neoprene acoustical friction pads between baseplate and support.
- B. Mountings shall have leveling bolts rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of compressed height of spring at rated load.

2.6 TYPE 4 MOUNTS (RESTRAINED SPRING WITH NEOPRENE)

- A. Mason Type SLR, combination spring and neoprene with rib molded base similar to Type 3 above, but shall have housing that includes vertical limit stops to prevent spring extension when weight is removed.
- B. Installed and operating heights shall be the same. Maintain minimum clearance of 1/2" around restraining bolts and between housing and spring so as not to interfere with spring action. Limit stops shall be out of contact during normal operations. Use height saving brackets.

2.7 TYPE S BASES (STEEL BASE)

- A. Mason Type WF, structural steel bases, rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be "T" or "L" shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. Perimeter members shall be beams with minimum depth equal to 1/10 of longest base span between isolators, but not less than 4". Beam depth need not exceed 14" provided that deflection and misalignment is kept within acceptable limits as determined by manufacturer. Employ height saving brackets in all mounting locations to provide base clearance of at least 1" above floor or housekeeping pad.

2.8 TYPE I BASES (INERTIA BASE)

- A. Mason Type K, or BMK rectangular or T shaped structural beam or channel concrete forms for floating foundations. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. Base depth need not exceed 12" unless specifically recommended by base manufacturer for mass, rigidity or component alignment. Base depth shall be a minimum of 1/10 of longest base span between isolators, but not less than 6". Forms shall include concrete reinforcement bars welded in place running both ways. Furnish forms with drilled steel members with sleeves welded below holes to receive equipment anchor bolts where anchor bolts fall in concrete locations. Employ height saving brackets in all mounting locations to maintain base clearance of at least 1" above floor or housekeeping pad.

2.9 TYPE 5 HANGERS (SPRING HANGER WITH NEOPRENE)

- A. Mason Type 30N, vibration hangers with steel spring and neoprene element in series. Neoprene element shall be molded with rod isolation bushing that passes through hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit hanger rod to swing through 30° arc before contacting hole and short circuiting spring.
- B. Mason Type DNHS may be used where load rating and specified deflection cannot be accommodated by Type 30N.

2.10 TYPE 6 HANGERS (PRECOMPRESSED SPRING HANGER WITH NEOPRENE)

- A. Mason Type PC30N, vibration hangers similar to Type 5, but precompressed to rated deflection so as to keep piping or equipment at fixed elevation during installation. Design hangers with release mechanism to free spring after installation complete and hanger is subjected to its full load.

2.11 TYPE 7 HANGERS (SPRING HANGER WITH DEFLECTION INDICATOR)

- A. Mason Type HES, steel spring in steel housing including deflection indicator scale. Hangers shall be preset at factory for required load. Select hangers so that actual loads do not exceed rated capacities (lbs).
- B. Submittals shall include isolator rated deflection, required deflection and supporting calculation. Calculations shall be made by registered mechanical or civil engineer demonstrating structural adequacy of hanger and that hanger connections to building and pipe are adequate for live and dead loads encountered.

2.12 TYPE 8 HANGERS (SPRING HANGER WITH NEOPRENE)

- A. Mason Type 30, W30, or PC30 steel spring located in neoprene cup manufactured with grommet to prevent short-circuiting of hanger rod. Neoprene cup to contain steel washer designed to properly distribute load on neoprene and prevent its extrusion. Spring diameters and hanger box lower hole size to be large enough to permit hanger rod to swing through 30° arc before contacting hole and short-circuiting spring. Provide hangers with rod attachments or eyebolts on spring end.

2.13 TYPE AG PIPE ANCHORS/GUIDES

- A. Mason Type ADA all-directional acoustical pipe anchors and Type VSG guides for vertical piping consisting of telescopic arrangement of 2 sizes of steel tubing separated by minimum 1/2" thickness of heavy duty neoprene and neoprene isolation material. Vertical restraints shall prevent vertical travel in either direction. Allowable loads on isolation materials shall not exceed 500 psi and design shall be balanced for equal resistance in any direction.
- B. Submittals shall include supporting calculations by registered mechanical or civil engineer indicating anchor/guide loads and isolator selection.

2.14 TYPE T THRUST RESTRAINTS

- A. Mason Type WB, horizontal thrust restraint consisting of spring element in series with neoprene pad as described for Type 3 mounts with the same deflection as specified for mountings or hangers. Spring element shall be contained within steel frame and designed so it can be preset for thrust at factory and adjusted in field for maximum of 1/4" movement at start and stop. Furnish thrust restraints complete with rods and angle brackets for attachment to both equipment and ductwork or equipment and structure. Attach horizontal restraints at centerline of thrust and symmetrically on either side of unit.

2.15 FLEXIBLE PIPING CONNECTORS

- A. Flexible connectors shall be suitable for pressure, temperature and fluid involved, but not less than 215 psig working pressure at 250°F for 14" and smaller and 150 psi working pressure at 250°F for 16" and larger.
- B. Flexible connectors shall be straight pipe configuration and shall not be used to replace pipe fittings such as elbows.
- C. Where metal braided covered flexible connector is utilized, minimum live length of flexible connector shall be as follows.

Nominal Pipe Diameter in	Minimum Live Length in
2-1/2" and smaller	12"
3" and 4"	18"
5" and larger	24"

- D. Water System:
1. Connection to Rotating Equipment:
 - a. Connectors shall consist of Kevlar or Nylon tire cord fabric reinforced with EPDM cover and liner. Solid steel rings or steel wire shall be used within raised face rubber flanged ends to prevent pullout. Furnish connectors with control rods only where recommended by connector manufacturer.
 - b. 2" and Smaller: Threaded connections, single sphere design similar to Mason SAFEFLEX SFU.
 - c. 2-1/2" and Larger: Floating steel flange connections, two sphere design with ductile iron or plated carbon steel reinforcing rings, similar to Mason SAFEFLEX SFDEJ. Single sphere design similar to Mason SAFEFLEX SFEJ, may be used for 14" and larger.
 2. Connection to Non-rotating Equipment Mounted on Vibration Isolators:
 - a. Seamless corrugated bronze or stainless steel flexible connector with braided cover for 2" and smaller with threaded or flanged connections; seamless corrugated stainless steel flexible connector with braided cover for 2-1/2" and larger with flanged connections.
- E. Steam and Condensate Including Pumped Condensate System:
1. Seamless corrugated stainless steel flexible connector with braided cover for 2" and smaller with threaded or flanged connections; seamless corrugated stainless steel flexible connector with braided cover for 2-1/2" and larger with flanged connections.
- F. Compressed Air Systems:

1. Seamless corrugated bronze flexible connector with bronze wire braided cover for copper piping and seamless corrugated stainless steel flexible connector with braided cover for steel piping. Connector ends shall be threaded, soldered, or flanged to match piping system valve ends.

G. Do not provide flexible piping connectors for compressed air piping.

H. Do not provide flexible piping connectors for gas piping.

2.16 PERFORMANCE

- A. Select vibration isolation devices to achieve either minimum 95% isolation efficiency or minimum static deflection and mounting requirements listed below, whichever is greater. Minimum static deflections listed below are not nominal but certifiable minimums with actual installed load. Unless otherwise indicated, apply requirements listed for floor mount for roof-mounted equipment.

Type of Equipment	Ground Supported Slab				Floor Span					
	Up to 20 ft		20 ft to 30 ft		30 ft to 40 ft		40 ft to 50 ft			
	Type	Min Defl. (in)	Type	Min Defl. (in)	Type	Min Defl. (in)	Type	Min Defl. (in)	Type	Min Defl. (in)

Pumps:

Inline Support inline pumps by connected pipes if suspended or by pipe stands or support frame from floor as shown. No vibration isolation mounts are required. Provided spring hangers for connected piping as specified in this Section.

Air Compressors:

Tank Mounted Horizontal										
Thru 10 hp	3	0.75	3	0.75	3	1.5	3	1.5	3	2.5
15 hp and over	3-I	0.75	3-I	0.75	3-I	1.5	3-I	1.5	3-I	2.5
Tank Mounted Vertical and Base Mounted										
All sizes	3-I	0.75	3-I	0.75	3-I	1.5	3-I	1.5	3-I	2.5

Vacuum Pumps:

Tank Mounted Horizontal										
Thru 10 hp	3	0.75	3	0.75	3	1.5	3	1.5	3	2.5
15 hp and over	3-I	0.75	3-I	0.75	3-I	1.5	3-I	1.5	3-I	2.5
Tank Mounted Vertical and Base Mounted										
All Sizes	3-I	0.75	3-I	0.75	3-I	1.5	3-I	1.5	3-I	2.5

Utility Set Fans:

Suspended Use Type 5 hangers with deflection from blower minimum deflection guide, but not to exceed 2.5".

Floor Mounted Use Type 2 for 0.75" deflection, Type 3 for 1.5" deflection and Type 3-S for over 1.5" deflection with deflection from blower minimum deflection guide, but not to exceed 2.5".

Roof Mounted Use Type 4 mount with deflection from blower minimum deflection guide up to 0.75" deflection. Over 0.75" deflection, use Type 4-S mount.

Centrifugal Blowers:

Suspended	Use Type 5-T hangers with deflection from blower minimum deflection guide.
Floor Mounted	
Up to 22" diameter all sizes	Use Type 2 mount with 0.25" deflection for slab on grade, Type 3 mount with 0.75" deflection for floor span up to 30', and Type 3 mount with 1.5" deflection for floor span over 30'.
24" diameter and up	
Thru 40 hp	Use Type 3-S mount with deflection from blower minimum deflection guide. Provide Type T thrust restraint for fans operating at 2" or more static pressure.
50 hp and over	Use Type 3-I mount with deflection from blower minimum deflection guide.

Axial Fans, Plenum Fans,
Centrifugal Inline Fans, Cabinet
Fans:

Suspended	Use Type 5 hangers with deflection from blower minimum deflection guide. Use Type 5-T for over 4" static pressure.
Floor Mounted	
Up to 22" diameter all sizes	Use Type 2 mount with 0.25" deflection for slab on grade, Type 3 mount with 0.75" deflection for floor span up to 30 ft, and Type 3-I mount with 1.5" deflection for floor span over 30 ft.
24" diameter and up	
Thru 2" WG SP	Use Type 3-S for slab on grade and floor span up to 20 ft, and Type 3-I mount for floor span over 20 ft with deflection from blower minimum deflection guide.
Over 2" WG SP	Use Type 3-I mount with deflection from blower minimum deflection guide.

Cooling Tower:

Use Type 1 mount for slab on grade and Type 4 mounts for floor/roof with deflection from blower minimum deflection guide.

Fan Coil Units, Heat Pump Units
and Fan Powered Boxes

Type 5 with minimum deflection of 0.5" for 600 cfm or less and 0.75" for over 600 cfm.

Piping Connected to Rotating or
Recipro-Equipment:

Use flexible piping connections, and Type 6 hangers for distance of 100 pipe diameters or 50 ft away from equipment, whichever is greater. Hangers shall have minimum deflection of 0.75" for pipe sizes 3" and smaller, 1.5" for pipe sizes 4" through 6" and 2.5" for pipe sizes 8" and larger. For piping less than 2" in diameter, neoprene or felt pad inserted between pipe or pipe covering and clamp or hanger may be used in lieu of Type 6 hangers.

Where piping is floor-supported, above requirements shall apply, but use Type 3 mounts instead of hangers.

Flexible piping connection shall not be used for unit heaters and in-line pumps that are supported by connected pipes. Type 6 hangers with 1" minimum deflection shall be applied within one foot of both sides of in-line pump and for distance of 100 pipe diameters or 50 ft away from first hanger at in-line pump, whichever is greater.

Piping 2.5" and Larger Supported
from Underside of 5th Floor:

Use Type 5 hangers with 0.75" minimum deflection.

Vertical Pipe Risers:

Use Type 6 hangers, Type AG anchors and guides. Refer to Section 20 0529 - Mechanical Supporting Devices for additional riser support requirements.

Ductwork in Mechanical
Equipment Rooms:

Use Type 8 hangers with 0.75" minimum deflection for ducts with cross sectional area greater than 2.0 sq ft and where air velocity is greater than 2000 fpm for distance 50 ft from fan.

Ductwork Suspended Underneath
5th Floor:

Use Type 8 hangers with 0.75" minimum static deflection for ductwork under the following circumstances:
Air velocities greater than 2000 fpm and duct cross sectional area greater than or equal to 2.0 sq ft.

BLOWER MINIMUM DEFLECTION GUIDE

When blowers are 60 hp or larger, select deflection requirements for next larger span, but not less than 2-1/2".

<u>Fan Speed (rpm)</u>	<u>Required Deflection (Inches)</u>				
	<u>On Grade</u>	<u>Up to 20 ft Floor Span</u>	<u>20 ft to 30 ft Floor Span</u>	<u>30 ft to 40 ft Floor Span</u>	<u>40 ft to 50 ft Floor Span</u>
Up to 300	2.5	3.5	3.5	3.5	3.5
301-500	1.5	1.5	2.5	2.5	3.5
501 and over	0.75	1.5	1.5	2.5	3.5

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and adjust vibration isolation devices as specified, as shown on drawings and according to manufacturer's recommendations.
 - 1. Adjust isolators after piping system is at operating weight.
 - 2. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
 - 3. Adjust active height of spring isolators.
 - 4. Adjust restraints to permit free movement of equipment within normal mode of operation.
 - 5. Adjust air-spring leveling mechanism.
- B. In no case shall installation short circuit isolation devices.

END OF SECTION 230550

SECTION 23 0902 CONTROL DAMPERS

PART 1 - GENERAL

1.1 RELATED WORK

- A. Section 23 3314 - Ductwork Specialties

1.2 REFERENCE

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 GENERAL

- A. Devices containing mercury are not allowed.

1.4 SUBMITTALS

- A. Product data sheets shall include construction materials and assembly methods, maximum design parameters (temperature, pressure, velocity, etc.), and performance data for full range of actuator stroke. Product data sheets shall include charts, graphics or similar items used in making selections, including damper to duct area ratio and free area ratio. Damper product data sheets shall indicate certified leakage rates for given pressure differentials.
- B. Damper Shop Drawing submittals will not be processed unless supporting data and sizing calculations are included.
- C. Submit damper schedules with Shop Drawings, indicating unique tag numbers for each device, equipment or system served, device model numbers, duct sizes, damper sizes, flow rates, pressure differentials, calculation of actual damper pressure drops, approach velocities, leakage rates, torque requirements, actuator model number, actuator torque capacities and pilot positioner locations.
- D. Select dampers to meet their intended service with respect to maximum approach velocities and maximum pressure differential. Damper materials shall be aluminum.

1.5 DAMPER SELECTION AND SIZING

- A. Submit engineering calculations for sizing modulating control dampers including outside, return, and relief air dampers of air handling units unless dampers are scheduled.
- B. Calculations for sizing dampers shall be based on actual characteristics of ductwork system being installed. Opposed blade dampers shall be sized for minimum of 10% of duct system pressure drop. Parallel blade dampers shall be sized for minimum of 30% of duct system pressure drop. Duct section is defined as ductwork containing flow control damper starting with inlet or branch tee and ending with outlet or branch tee. Calculate actual duct pressure drops for each duct section containing modulating damper using latest version of ASHRAE Handbook of Fundamentals. If control systems fixes pressure drop, use those pressure setpoints. Use balance damper to provide additional pressure drop as required for obtaining linear damper response.
- C. Control Contractor is responsible for obtaining adequate system information necessary for sizing.

- D. Two position dampers to be sized as close as possible to duct size, but in no case is damper size to be less than duct area.
- E. Submit leakage and flow characteristic data for control dampers along with shop drawings. Leakage ratings shall be based on AMCA Standard 500 and dampers shall bear AMCA Air Leakage Seals.

PART 2 - PRODUCTS

2.1 CONTROL DAMPERS

A. General:

- 1. If control damper sizes are not shown or scheduled, refer to Part 1 of this Section for sizing criteria.
- 2. Unless otherwise indicated, modulating control dampers shall be opposed blade type and 2-position (open/close) dampers shall be parallel blade type.
- 3. Blade linkage hardware shall have corrosion-resistant finish and be readily accessible for maintenance.
- 4. Actuators are to be electric type unless otherwise noted. Provide damper position switches when damper position is required by control sequences.
- 5. AMCA Leakage Classification of Control Dampers

Class	Static Pressure kPa (Inches Water Column)			
	1	4	8	12
	Leakage Rate L/s/m ² (cfm/ft ²)			
IA	3	N/A	N/A	N/A
I	4	8	11	14
II	10	20	28	35
III	40	80	112	140

B. Standard Modulating and Two-Position Dampers:

- 1. Manufacturers and acceptable model numbers:
 - a. Johnson Controls D-1200/D-1300 (Double Piece)
 - b. Honeywell D642/D643
 - c. Ruskin CD50/CD60
- 2. Damper frames shall be minimum of 14 ga extruded aluminum. Blades shall be minimum of 14 ga aluminum. Blades shall have maximum blade width of 8" with steel trunnions mounted in bronze sleeve, nylon or ball bearings.
- 3. Furnish dampers with blade seals and stainless steel side seals. Dampers and seals shall be suitable for maximum system temperature, pressure differential and approach velocity, but not less than temperature range of -40° to 200°F, pressure differential of 6" WC, and approach velocity of 4000 fpm based on 4 ft damper section width.
- 4. Leakage rate shall meet AMCA Leakage Class IA or I.
- 5. Testing and ratings shall be per AMCA Standard 500-D.

C. Smoke Dampers

- 1. Manufacturers: Air Balance, Johnson Controls, Ruskin or Vent Products.
- 2. Dampers shall be leakage rated at no higher than Leakage Class I (4 cfm/ft² at 1" WG and 8 cfm/ft² at 4" WG) under UL 555S at temperature category 250°F. Furnish dampers with factory-mounted, caulked

sleeve and actuator assemblies. Damper shall have 16 gauge or heavier frame with air foil-shaped blades, rated to minimum 4" WG in closed position and to 2000 fpm in open position.

3. Actuator assemblies shall be installed outside airstream, linked to damper for fail (normally) closed operation. Actuator shall be capable of closing damper at pressures encountered in system.
4. Size smoke dampers as close as possible to duct size, but in no case is damper size to be less than duct size.
5. Dampers shall fully open in 15 seconds or less and fully close in not more than 15 seconds and not less than 7 seconds when activated.
6. Electric actuators shall be non-stall type.

2.2 DAMPER ACTUATORS

A. Analog Electronic:

1. Manufacturers: Belimo, Honeywell, Johnson Controls, Siemens Building Technologies or TAC
2. Actuators shall be electric motor/gear drives that respond proportionally to analog voltage or current input, or digital floating control signals.
 - a. Floating control actuators shall only be used for terminal hot water or chilled water control.
 - b. Analog control actuators shall be used for all other modulating applications.
3. Stroke time for major equipment shall be 90 seconds or less for 90° rotation. Stroke time for terminal equipment shall be compatible with associated local controller, but no more than 6 minutes.
4. Provide spring return feature for fail open or closed positions, as required by control sequence, for critical applications such as outside, return, or exhaust dampers, heating and cooling coils on major air handling units, humidifiers, heat exchangers, flow control for major equipment items such as chillers, cooling towers, boilers, etc. Fail-last-position actuators do not have spring return feature.
5. Provide position feedback potentiometers connected to controller for closed loop control on major equipment analog control loops.
6. Actuators for terminal heating/cooling equipment do not require spring return feature.

B. Discrete Two-Position Electric:

1. Manufacturers: Belimo, Honeywell, Johnson Controls, Siemens Building Technologies or TAC
2. Actuators shall be electric motor/gear drives for two-position control. Stroke time shall be 90 seconds or less for 90° rotation.
3. Provide spring return feature for fail open or closed positions as required by control sequence. Fail-last-position actuators do not have spring return feature.

PART 3 - EXECUTION

3.1 CONTROL DAMPERS

- A. Install dampers in locations indicated on drawings, as detailed and according to manufacturer's instructions.
- B. Provide adequate operating clearance and access to operators.

3.2 SMOKE DAMPERS

- A. Install dampers in locations indicated on drawings, as detailed and according to manufacturer's instructions.
- B. Provide adequate operating clearance and access to operators.

3.3 ACTUATORS

- A. Provide actuator for each automatic damper with sufficient capacity to operate damper under all conditions. Select actuators to provide tight shut-off against maximum system temperatures and pressure encountered. Each actuator shall be full-modulating or two-position type as required or specified, and shall be provided with spring-return for fail open or fail closed position for fire, freeze, moisture, occupant safety, equipment protection, heating or cooling system protection on power interruption as indicated and/or as required. Smoke dampers shall fail-closed.
- B. Provide pilot positioners for all sequenced devices, and devices which require adjustable operating speeds.
- C. Provide pilot positioners for pneumatic modulating outside and return air dampers and fan volume control devices such as fan inlet dampers where used.
- D. Provide pilot positioners for pneumatic modulating damper actuators where torque required by controlled devices exceeds 50% of torque capacity of operator.
- E. Damper operating speeds shall be selected or adjusted so that actuators will remain in step with controllers without hunting, regardless of load variations. Actuators acting in sequence with other actuators shall have adjustment of control sequence as required by operating characteristics of system.
- F. Provide speed control valves for On/Off actuators for adjustment of actuator speed to prevent excessive stress on large dampers.
- G. Provide proper linkage and brackets for mounting and attaching actuators to devices. Design mounting and/or support to provide no more than 5% hysteresis in either direction (actual movement of damper shaft versus ideal movement) due to deflection of actuator mounting.
- H. Provide single actuator on damper section not exceeding torque capacity of actuator.
- I. Multiple damper sections where used shall be connected together via jackshaft or other coupling device, not by internal pinned connections at blade shafts of individual damper sections. Where multiple damper sections are connected together via jackshaft or other coupling device, damper actuator shall be mounted directly to jackshaft or other coupling device for operating damper sections. For instances where damper actuator cannot be mounted to jackshaft or other coupling device, damper actuator shall be provided for each damper section.
 - 1. Mounting multiple actuators to common damper jackshaft to meet torque requirements is not allowed.
- J. Calibrate position feedback potentiometers, where specified, with range and gain factors as required for proper operation per manufacturer's recommendations.
- K. Integral actuator end switches or feedback potentiometers shall not be used. Provide separate end switches/feedback potentiometers that provide actual damper position.
 - 1. Integral actuator end switches or feedback potentiometers can be used if damper shaft is keyed or directly affixed to the actuator such that the shaft cannot slip and provide false position. U-clamp type actuator mounting always requires separate end switches/feedback potentiometers.

END OF SECTION 230902

SECTION 23-2116 PIPE AND PIPE FITTINGS

PART 1 GENERAL

1.1 RELATED WORK

- A. Section 20-0529 – Piping and Equipment Supporting Devices.
- B. Section 23-2118 - Valves.
- C. Section 23-2120 - Piping Specialties.

1.2 REFERENCE

- A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

- A. This Section includes pipe and pipe fitting specifications and installation requirements for heating and cooling systems.
- B. Specification of an item in this or any other sections shall not relieve Contractor from providing all items, articles, materials, operations, methods, labor, equipment and incidentals necessary for a complete and functional system.
- C. Use only new material, free of defects, rust and scale, and guarantee for services intended.
- D. Use material meeting the latest revision of ASTM specifications as listed in this specification.
- E. Follow local codes if they require other types of pipe or joints.
- F. Use only long radius elbows having centerline radius of 1.5 pipe diameters unless otherwise indicated.
- G. Manufacturer, pressure class, size and heat code of each fitting and flange shall be permanently identified on its body in accordance with MSS SP-25.
- H. Where size for a pipe segment is not indicated, the pipe segment size shall be equal to the largest pipe segment to which it is connected. Transition to smaller size shall occur on the side of fitting where smaller size is indicated.
- I. Unless otherwise indicated, fittings and accessories connected to pipe shall be of the same material as the pipe.
- J. Unless otherwise indicated, construct piping for highest pressures and temperatures in respective system in accordance with the latest revision of the applicable Sections of ASME Code for pressure piping, ASME B31 including the following:
 - 1. B31.9 Building Services Piping
 - 2. B31.1 Power Piping
 - 3. B31.5 Refrigeration Piping

- K. Non-metallic piping will be acceptable only for services indicated and with written approval from Owner. It will not be acceptable in occupied spaces and ventilation plenum spaces.

1.4 SUBMITTALS

- A. Shop drawings for each piping system for all pipe sizes including, but not limited to, the following:
 - 1. Name of system
 - 2. Pipe; ASTM number, grade if known, type, wall thickness, material
 - 3. Fittings; ASME number, grade if known, class, type, wall thickness, material
 - 4. Joint type
 - 5. Flanges; ASTM number, grade, class, type, material
 - 6. Bolts and nuts; material
 - 7. Thread joint sealants; material
 - 8. Flange gaskets; material, rating
 - 9. Unions; ASTM number, type, material, rating
 - 10. Type of welding
 - 11. Welding Quality Control Program
 - 12. Test pressure and media
 - 13. Pipe flushing procedures
 - 14. Pipe cleaning method
 - 15. All other appropriate data
- B. Submit pipe certification as specified under Pipe Certification in this Section.
- C. Submit required documents as specified under Pipe Welding in this Section.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Furnish pipe with plastic end-caps/plugs on each end of pipe. Maintain end-caps/plugs through shipping, storage and handling to prevent pipe-end damage and eliminate dirt and construction debris from accumulating inside of pipe.
- B. Where possible, store materials inside and protect from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Before shipping, all carbon steel piping shall be free of rust and scale, and furnished with plastic end caps/plugs on each end of pipe.

1.6 PIPE WELDING

- A. Procedure and Welding Qualification Records:

1. Submit Welding Procedure Specifications (WPSs) and their supporting Procedure Qualification Records (PQRs) to be used on the work to Engineer for review and approval prior to performing any welding. These documents shall meet requirements of ASME B31.1 and B31.9, as applicable.
 2. Unless otherwise indicated, welding shall be done using only the following processes:
 - a. Shielded Metal Arc Welding (SMAW), also known as "stick" welding
 - b. Gas Tungsten Arc Welding (GTAW), also known as TIG and Heliarc welding
 - c. Gas Metal Arc Welding (GMAW), also known as MIG welding
 - d. Flux-Cored Arc Welding (FCAW), a variation of GMAW
 - e. Submerged Arc Welding (SAW)
 3. Unless otherwise stated, fabrication, installation, inspection, examination and testing shall be in accordance with ASME B31.1 or B31.9, as applicable.
 4. Backing rings (chill rings) or consumable inserts are not allowed, unless specifically requested by Owner or Engineer.
- B. Quality Control Program:
1. Submit written quality control program for review and approval prior to implementing any welding on this project. Quality control program shall include the following as minimum:
 - a. Explanation of how Contractor will assure proper fit up for each weld.
 - b. Explanation of how Contractor will document welds performed by individual welding operators for systems under ASME B31.1.
 - c. Explanation of how Contractor will assure that proper welding procedure is being followed.
 - d. Credentials of personnel responsible for required weld examinations.
- C. Weld Inspection and Examination:
1. Provide examination services for all welding for this project. Examination shall be in accordance with requirements of ASME B31.1, Table 136.4 or B31.9, as applicable. Personnel performing examinations shall comply with requirements stipulated in 136.1 (A) through (E) or shall be AWS QC1 certified.
 2. Periodically, as welding progresses, submit report, signed by weld examiner, indicating status of project welding quality.
 3. Arrange with Owner's Inspector for observation of fit up and welding methods prior to implementing any welds, including shop welds, on this project.
 4. In addition, Owner's Inspector will perform any additional observations deemed necessary before, during, or after fabrication to assure, to Owner's satisfaction, that proper welding is provided. Owner reserves the right to perform independent examination of welds. If Owner has any concern as a result of such examination Owner reserves the right to stop in progress welding work, without any cost to Owner, until resolution satisfactory to Owner is reached.
- D. Welder Qualifications:
1. Each welder and welding operator must qualify by passing required procedure test before performing any project welds. Submit copy of Manufacturer's Record of Welder or Welding Operator Qualification Tests as required by Section IX of ASME Boiler and Pressure Vessel Code for all welding procedures to be performed by welding operator.
 2. Welder qualifications must be current. If qualification test is more than 6 months old, provide record of welding continuity for each welder.

3. Record of welding continuity is intended to show that welder has performed welding at least every 6 months since the date that welder qualification test was passed for the submitted welding procedure specification.
 4. Record of welding continuity shall include, at minimum, the following:
 - a. Welder's employer name and address
 - b. Date Welder Qualification Test was passed
 - c. Dates indicating welding continuity
 5. Welders shall be qualified as required by ASME B31.1 or B31.9, as applicable. In addition, there shall be an independent witness of welder tests. That witness shall be representative of independent testing laboratory, Authorized (Code) Inspector, Owner's or Engineer's Inspector or consultant approved by National Certified Pipe Welding Bureau.
 6. Welder qualifications must cover all pipe sizes and wall thickness used on this project. Test segments or coupons shall be appropriately selected for qualification. Test position shall be arranged in "6G position."
- E. Weld Record:
1. For welding within the scope of ASME B31.1 Power Piping, submit to Engineer for approval an administrative procedure for recording, locating, monitoring and maintaining quality of welds to be performed on the project. This quality control document record shall include but not be limited to:
 - a. Drawings and schedules identifying location of each weld by individual number, identification of welder who performed each weld by individual welder's name, stamp number, date, and WPS used.

1.7 PIPE CERTIFICATION

- A. Certification is required for all pipe within scope of ASME B31.1. Submit certification papers, as outlined below, within 30 days of delivery of pipe to project site.
- B. Type E or S Pipe:
 1. Furnish manufacturer's mill certificates (material test report) including dimensions, heat numbers, chemical analysis and tensile test results for pipe shipped to project site.

1.8 CATHODIC PROTECTION

- A. Cathodic protection shall be designed and provided by system pre-insulated pipe manufacturer for pipe systems as specified in Part 2. Cathodic protection shall conform to recognized practices and shall be designed by qualified personnel. Measurements of corrosivity of soil environment expressed in terms of soil's electrical resistivity (ohm/cm) shall be taken and checked out by pre-insulated pipe manufacturer. Resistivities shall be given along proposed routing of piping systems. Anodes and test stations shall be provided by, this Contractor as recommended by pre-insulated pipe manufacturer.
- B. After installation, field survey, shall be made by, pre-fabricated pipe manufacturer and measurement of current and conduit-to-soil potentials at each test station shall be taken.

PART 2 PRODUCTS

2.1 LOW PRESSURE STEAM (15 psig and lower)

- A. 2" and Smaller:
 - 1. Pipe: ASTM A312, 304, Schedule 40S, seamless stainless steel.
 - 2. Fittings: ASTM 182, Gr. F304, ASME B16.11, 3000 lb socket-weld.
 - 3. Unions: 3000 lb socket-weld, stainless steel ground joint. Refer to Unions and Flanges in this Section.
- B. 2-1/2 inches and Larger:
 - 1. Pipe: ASTM A312, 304, Schedule 40S, seamless stainless steel.
 - 2. Fittings: ASTM A403, Gr. WP, Class S or Class W, ASME 16.9.
 - 3. Flanges: ASTM A182, Gr. F304, ASME B16.5, 150 lb std. with 1/16" raised face, serrated face finish and welding neck.
 - 4. Bolts: Stud bolts, ASTM A193, Gr. B7
 - 5. Nuts: ASTM A194, Gr. 2H

2.2 LOW PRESSURE STEAM CONDENSATE (Steam Pressure 15 psig and Lower)

- A. 2" and Smaller:
 - 1. Pipe: ASTM A312, 304, Schedule 40S, seamless stainless steel.
 - 2. Fittings: ASTM 182, Gr. F304, ASME B16.11, 3000 lb socket-weld.
 - 3. Unions: 3000 lb socket-weld, stainless steel ground joint. Refer to Unions and Flanges in this Section.
- B. 2-1/2" and Larger:
 - 1. Pipe: ASTM A312, 304, Schedule 40S, seamless stainless steel.
 - 2. Fittings: ASTM A403, Gr. WP, Class S or Class W, ASME 16.9.
 - 3. Flanges: ASTM A182, Gr. F304, ASME B16.5, 150 lb std. with 1/16" raised face, serrated face finish and welding neck.
 - 4. Bolts: Stud bolts, ASTM A193, Gr. B7
 - 5. Nuts: ASTM A194, Gr. 2H

2.3 HEATING HOT WATER

- A. 2" and Smaller:
 - 1. Pipe: ASTM B88 seamless, Type L, hard temper copper tube.
 - 2. Fittings: ASME B16.22, wrought copper solder joint.
 - 3. Joint: ASTM B32, lead free solder, Bridgit, Silvabrite, Silverflow or Canfield.
 - 4. Unions: ASME B16.18 cast copper alloy or ASME B16.22 wrought copper solder joint, Class 125. No unions to be used for line sizes 3/4" and smaller. Unions shall be used for line sizes over 1".
 - 5. Flanges: ASME B16.24, Class 150, cast copper alloy.
 - 6. Use solder joints for valves and piping specialties in copper piping.
- B. 2-1/2" and Larger:

1. Pipe: ASTM A53, Grade B, Type E or S, standard weight, carbon steel.
2. Fittings: ASTM A234 Grade WPB/ASME B16.9, standard weight, seamless, carbon steel weld.
3. Flanges: Class 150. Refer to Unions and Flanges in this Section.

2.4 CHILLED WATER

- A. 2" and Smaller:
1. Pipe: ASTM B88 seamless, Type L, hard temper copper tube.
 2. Fittings: ASME B16.22, wrought copper solder joint.
 3. Joint: ASTM B32, lead free solder, Bridgit, Silvabrite, Silverflow or Canfield.
 4. Unions: ASME B16.18 cast copper alloy or ASME B16.22 wrought copper solder joint, Class 125. No unions to be used for lines sizes 3/4" and smaller. Unions shall be used for line sizes over 1".
 5. Flanges: ASME B16.24, Class 250, cast copper alloy.
 6. Use solder joints for valves and piping specialties in copper piping.
- B. Contractor may use carbon steel as specified below in lieu of copper pipe for 2" and smaller.
1. Pipe: ASTM A53, Type F, standard weight, carbon steel.
 2. Fittings: ASME B16.4, Class 125, cast iron, threaded or ASME B16.3, Class 150, malleable iron, threaded.
 3. Unions: ASME B16.39, malleable iron, Class 250. Refer to Unions and Flanges in this Section.
- C. 2-1/2" and larger:
1. Pipe: ASTM A53, Grade B, Type E or S, standard weight, carbon steel.
 2. Fittings: ASTM A234 Grade WPB/ASME B16.9, standard weight, seamless, carbon steel weld.
 3. Flanges: Class 250. Refer to Unions and Flanges in this Section.

2.5 VENTS AND RELIEF VALVES

- A. Use pipe and pipe fittings as indicated for the system to which relief valve or vent is connected.
- B. Use ASTM A53, Type F, carbon steel with ASTM A234 Grade WPB/ASME B16.9, standard weight, seamless carbon steel weld fittings for refrigerant vent piping.

2.6 DIELECTRIC UNIONS, FLANGES AND FITTINGS

- A. Copper to Steel Pipe:
1. 1" and Smaller: ASTM A197/ASME B16.3, 300 lb, WOG malleable insulating unions with vulcanized fiber insulating sleeve and neoprene gasket, equal to Stockham figure 693-1/2, or Epcos model FX or FB dielectric unions with dielectric gasket, 250 psi at 210°F.
 2. 1-1/2" and Larger: Epcos model GX dielectric flange for 1-1/2" and 2" and model GWX for 2-1/2" and larger with dielectric gasket, 175 psi at 210°F.

2.7 UNIONS AND FLANGES

- A. Unions:
1. 2" and Smaller: Malleable iron, ASME B16.39 with ground joint, bronze or brass to iron. Provide black malleable iron for carbon steel piping and galvanized malleable iron for galvanized steel piping. Unless otherwise specified, pressure class and joint type of union shall be equal to that specified for fittings of respective piping service. Minimum pressure class of unions shall be Class 250.
 2. 2" and Smaller: Forged steel, ASTM A105 Grade 2, ASME B16.11, 3000 lb. WOG with steel to steel seats. Joint type shall match that specified for fittings of respective piping service.
- B. Flanges:
1. 2-1/2" and Larger: ASTM A105, ASME B16.5, hot forged steel, welding neck pattern. Slip-on pattern are not allowed. Bore dimension of welding neck flange shall match inside diameter of connected pipe.
 2. Use raised face flanges for mating with other raised face flanges with self-centering flat ring gaskets. Use flat face flanges for mating with other flat face flanges with full face gaskets.
 3. Flange pressure class indicated in respective piping service is minimum required. Mating flange pressure class shall match pressure class of connected device, such as valves and piping specialties.
- C. Flange Gaskets:
1. Gasket material shall be asbestos free and suitable for pressures, temperatures and fluid of respective piping system. Non-metallic gaskets shall be in accordance with ASME B16.21 and ASTM F104. Unless otherwise indicated or recommended by manufacturer, gaskets shall be similar to Garlock IFG 5500 with 1/16" thick gasket.
 2. Service Temperature (250°F thru 800°F) - Flexitallic, Garlock, Lamos equal to Flexitallic Style CG, flexible graphite filler, 304 SS winding, carbon steel centering ring, 0.175" thickness.
- D. Bolting:
1. Bolts, bolt studs, nuts and washers shall have zinc plated finish.
 2. Thread shall be in accordance with ASME B1.1, Class 2A tolerance for external threads and Class 2B tolerance for internal threads. Threads shall be coarse-thread series except that alloy steel bolting 1-1/8" and larger in diameter shall be 8 pitch thread series.
 3. Threaded rods are not allowed as fastening elements.
 4. For Class 150 and Class 300 flanges at 400°F or lower temperature, use carbon steel bolts or stud bolts conforming to ASTM A307, Grade B with nuts conforming to ASTM A307.

2.8 THREADED JOINT SEALANTS

- A. Paste type for brush application or cord type. Products shall be non-toxic, chemically inert, non-hardening, rated for -50 to 400°F and up to 10000 psi (liquids) and 2600 psi (gases), certified by UL, CSA, and NSF.
- B. Teflon tapes are not allowed.

2.9 CLEAN STEAM AND CONDENSATE (HUMIDIFICATION)

- A. Use pipe and pipe fittings as indicated for associated steam and steam condensate specified in this Section.

PART 3 EXECUTION

3.1 GENERAL

- A. Remove foreign materials before erection. Ream ends of piping to remove burrs.
- B. Install piping parallel to building walls and ceilings and at such heights so as not to obstruct any portion of window, doorway, stairway, or passageway. Install piping to allow adequate service space for equipment. Piping installed in shell spaces shall be routed tight to structure above in order to allow space for installation of fit-up related systems and equipment. Refer to drawings and/or manufacturer's recommendations. Install vertical piping plumb. Where interferences develop in field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings or other architectural details before installing piping.
- C. Provide anchors, expansion joints, swing joints and expansion loops so that piping may expand and contract without damage to itself, equipment or building.
- D. Mitered elbows, welded branch connections, notched tees and "orange peel" reducers are not allowed. Unless specifically indicated, reducing flanges and reducing bushings are not allowed. Reducing bushings may be used for air vents and instrumentation connections.
- E. Unless otherwise indicated, use fittings as specified in Part 2 of this Section for elbows, tees, reducers, etc.
- F. "Weldolets" with outlet size 2-1/2" and larger and "Threadolets" or "Sokolets" with outlet size 2" and smaller may be used for branch takeoff up to one half (1/2) diameter of main. Use "Threadolets" where threaded fittings are specified and use "Sokolets" where socket weld fittings are specified. Materials of "Weldolets", "Threadolets" and "Sokolets" shall match material of piping.
- G. Install drains throughout systems to permit complete drainage of entire system.
- H. Do not install piping over electrical panelboards, switchgear, switchboards or motor control centers.
- I. Install valves, control valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide reducing fittings for valves smaller than pipe size.
- J. Make connections to all equipment installed by others where that equipment requires piping services indicated in this Section.
- K. For piping within the scope of ASME B31.1 Power Piping, transfer piping material specification and "Heat Number" to each segment of pipe prior to cutting.

3.2 THREADED PIPE JOINTS

- A. Threads of pipe and fittings shall conform to ASME B1.20.1.
- B. Ream pipe ends after cutting and clean before erection. Apply thread sealants to cleaned male threads. Assemble joint to appropriate depth and remove any excess pipe joint compound from tightened joint.

3.3 FLANGED JOINTS

- A. Clean flange surfaces and align them parallel. Bolt holes of gaskets shall be cut slightly larger than bolt diameter. Gasket ID shall be slightly larger than flange ID.
- B. Position gasket concentrically so compression is equally distributed over entire gasket surface.
- C. Lubricate bolts and run nuts down by hand.
- D. By using torque wrench, tighten nuts in the proper sequence so gasket is compressed evenly, and to the appropriate torque specified by bolt manufacturer.

- E. Re-torque bolts 12 to 24 hours after start up.

3.4 WELDED PIPE JOINTS

- A. Inspect pipe and pipe fittings for roundness before they are fit-up or set in place.
- B. Properly clean and prepare pipe base material before fit-up. Verify joint land and bevel.
- C. Preheat pipe base material as required by welding procedure specification. Temperature of pipe material must be minimum of 60°F before welding.
- D. Properly align and adjust joint as required by welding procedure and thickness of material. Verify tolerances after tacking sequence.
- E. Use weld material diameter as procedurally required for type and thickness of work being done.
- F. Use sufficient argon pre-purge and argon post-purge for GTAW processes. Post purge should be until weld is no longer glowing plus 5 seconds. Maintain purge for at least 2 layers of weld material.
- G. Properly store welding materials.
- H. Clean tacks before welding out. Remove slag after each pass by grinding to avoid slag inclusion.
- I. Weld reinforcement shall not exceed limits established in Chapter V of ASME B31.1.
- J. Brush each weld free of rust and paint with rust resistant product that matches piping surface color.
- K. For piping within scope of ASME B31.1, each weld shall be permanently marked by welder performing weld. Each welder shall sign and date field welding log record for all welds performed by welder as indicated in Part 1.
- L. Conduct radiographic test for sections or joints that cannot be tested by hydrostatic test methods (such as joints cut into existing piping systems) by qualified radiographic testing firm.

3.5 COPPER PIPE JOINTS

- A. Cutting of tubing shall not make tubing out of round. Ream cut tube ends to full inside diameter.
- B. Remove slivers and burrs remaining from tube cut by reaming and filing both pipe surfaces. Clean fitting and tube with emery or sand cloth. Remove residue from cleaning operation, apply flux and assemble joint. Use solder or brazing to secure joint as specified for specific piping service.

3.6 STEAM AND STEAM CONDENSATE

- A. Pitch steam mains down at 1" per 40 ft in direction of flow. Pitch runouts to terminal equipment and control valves at 1/2" per 1 ft for proper condensate drainage. Install drip traps at each rise and at horizontal termination of each steam main.
- B. Pitch steam condensate lines down at 1" per 20 ft in direction of flow.
- C. Unless otherwise indicated, use eccentric fittings for changes in horizontal pipe sizes with fittings installed for proper condensate drainage (bottom of pipe straight). Concentric fittings may be used for changes in vertical pipe sizes.
- D. For steam branch connections and runouts, use top or top 45° connection to main.
- E. For condensate branch connections to condensate mains, use top or top 45° connection to main.

- F. For condensate connections from steam mains, use bottom connection to main.
- G. Install minimum of 3 elbows in each pipe run out to terminal equipment to provide flexibility for expansion and contraction of piping system.

3.7 CHILLED WATER SYSTEM

- A. All chilled water system piping and associated components shall be designed, tested, and installed to support 250 psig system pressure.

3.8 WATER SYSTEMS

- A. Pitch horizontal mains up at 1" per 40 ft in direction of flow. Install manual air vents at all high points where air may collect. If vent is not in accessible location, extend air vent piping to nearest code acceptable drain location with vent valve located at nearest accessible location to pipe.
- B. Main branches and runouts to terminal equipment may be made at top, side or bottom of main provided that there are drain valves suitably located for complete system drainage and manual air vents are located as described above.
- C. Unless otherwise indicated, for upfeed risers, use top or top 45° connection to main and for downfeed risers use side or bottom 45° connection to main. If side or bottom 45° connection is not practical and bottom connection to main must be used, provide line size Y strainer with shut-off valve at each side at branch connection.
- D. Use minimum of 3 elbows in each pipeline to terminal equipment to provide flexibility for expansion and contraction of piping systems.
- E. Use eccentric fittings for changes in pipe sizes and for valves smaller than pipe sizes, in horizontal lines, with fittings installed for proper air venting (top of pipe straight). Concentric fittings may be used for changes in pipe sizes and for valves smaller than pipe sizes in vertical lines.
- F. Where mechanically formed tee fittings are allowed, form mechanically extracted collars in continuous operation, consisting of drilling pilot hole and drawing out tube surface to form collar having height of not less than 3 times thickness of tube wall. Collaring device to be adjustable.
- G. Notch and dimple branch tubes. Braze joints. Apply heat properly so that pipe and tee do not distort. Remove distorted connections.

3.9 VENTS AND RELIEF VALVES

- A. Install vent and relief valve discharge lines as indicated on drawings, as detailed, and as specified for each specific valve or piping specialty item.

3.10 DIELECTRIC UNIONS AND FITTINGS

- A. Install dielectric unions, flanges or fittings in main and branch piping of water systems at each point where copper to steel pipe connection occurs. Dielectric unions or fittings shall not be used at terminal device connections.
- B. Concealed dielectric unions and fittings are not allowed.

3.11 UNIONS AND FLANGES

- A. Unions are not required on copper piping with soldered joints for 1/2" and 3/4" line sizes. Unions are required for line sizes 1" and larger.

- B. Install union or flange at each automatic control valve and at each piping specialty or piece of equipment that requires tube pull or removal for maintenance, repair or replacement. If required, provide additional unions or flanges in order to facilitate removal of piping sections that interfere with tube pulls or equipment removal. Where valve is located at piece of equipment, provide flange or union connection on equipment side of valve.
- C. Concealed unions or flanges are not allowed.

3.12 PIPING SYSTEM PRESSURE TESTS

- A. Owner and/or Owner's representative may elect to witness pressure test. Notify Owner and/or Owner's representative at least 3 days in advance.
- B. Conduct pressure test prior to flushing and cleaning of piping systems.
- C. Conduct hydrostatic (HYDRO) test in accordance with ASME B31.1 137.4. Test pressure shall be in accordance with ASME B31.1, but shall not be lower than the minimum test pressure listed below.
- D. If leaks are found, repair with new materials and repeat test until leaks are eliminated. Caulking will not be acceptable.
- E. Pressure tests may be made of isolated portions of piping systems to facilitate general progress of installation. Any revisions made in piping systems require retesting of affected portions of piping systems.
- F. No systems shall be insulated until it has been successfully tested. If required for additional pressure load under test, provide temporary restraints at expansion joints or isolate them during test. Unless otherwise noted, minimum test time shall be 4 hrs plus such additional time as may be necessary to conduct examination for leakage.
- G. No pressure drop shall occur during test period. Any pressure drop during test period indicates leakage.
- H. Provide pumps, gauges, instruments, test equipment, temporary piping and personnel required for tests and provide removal of test equipment and draining of pipes after tests have been made.
- I. For hydrostatic tests, remove air from piping being tested by means of air vents. Measure and record test pressure at high point in system. Where test pressure at high point in system causes excessive pressure at low point in system due to static head, portions of piping system may be isolated and tested separately to avoid undue pressure. However, every portion of piping system must be tested at the specified minimum test pressure.
- J. Conduct pressure tests with parameters indicated below:

<u>System</u>	<u>Minimum Test Pressure</u>	<u>Remarks</u>
Low pressure steam and condensate	75 psig	HYDRO
Steam condensate pump discharge	150 psig	HYDRO
Heating hot water	150 psig	HYDRO
Chilled water	300 psig	HYDRO

- K. Contractor shall provide all pumps, gauges, instruments; test equipment, flow meters, temporary piping and personnel required for tests and provide removal of test equipment and draining of pipes after tests have been made.
- L. If piping system is drained after testing and left empty or untreated for more than 3 days, add Nalco 2572 at recommended dosages for dry system lay-up.

3.13 FLUSHING AND CLEANING PIPING SYSTEMS

- A. Flush new water, steam and condensate systems thoroughly for 15 minutes or longer, as required to ensure removal of dirt and foreign matter from piping system. Flush with clean domestic water.

3.14 PIPE PAINTING

- A. Exposed exterior carbon steel, black iron or other ferrous pipe and fittings shall be prepared and painted by qualified painters using corrosion inhibitive paints. Pipe shall be prepared in accordance with paint manufacturer's instructions and primed (2 coats) and finish painted (2 coats). Paint type shall be approved by Architect/Engineer.
- B. Protect piping from weather and paint promptly to prevent corrosion.

END OF SECTION 232116

This page intentionally left blank.

SECTION 23 2118 VALVES**PART 1 - GENERAL****1.1 REFERENCE**

- A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 SUBMITTALS

- A. Shop Drawings for each system for all sizes including, but not limited to, the following:
1. Name of system
 2. Manufacturer's name
 3. Type
 4. Model number
 5. Materials of construction
 6. Temperature/pressure ratings
 7. Manufacturer's data sheets clearly cross-referenced
 8. All other appropriate data

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Acceptable manufacturers and Figure Number listed under each item.

2.2 WATER SYSTEM VALVES**A. General:**

1. Valves 2" and smaller in steel piping shall have threaded ends.
2. Valves 2" and smaller in copper piping shall have solder ends.
3. All chilled water piping valves shall be rated to 250 psig WOG working pressure at 100°F.

B. Ball Valves:

1. 2" and Smaller: ASTM B584 bronze body, chrome plated brass/bronze or stainless steel ball, full port, Teflon seat rings, blowout-proof stem, 2-piece construction, 600 psi WOG, 150 psi SWP, Nibco Fig. T(S)-580-70, Apollo No. 70, Watts, Milwaukee BA-150, Hammond, FNW or Anvil

2.3 STAINLESS STEEL VALVES (HUMIDIFICATION STEAM AND CONDENSATE)**A. Gate Valves:**

1. 2 and Smaller: stainless steel body, flanged, stainless steel solid wedge, stellite seats, rising stem, union bonnet, malleable iron handwheel, impregnated teflon packing, Class 150 (150 psi WP steam), Williams, Powell or Velan equal to Williams Fig. S15F6-316
2. 2-1/2" and Larger: stainless steel body, flanged, stainless steel solid wedge, stellite seats, impregnated teflon packing, Class 150 (150 psi WP steam), Williams, Powell or Velan equal to Williams Fig. S15F6-316

B. Globe Valves:

1. 2" and Smaller: stainless steel body, flanged, stainless steel disc, stellite seats, impregnated teflon packing, union or screw-over bonnet, malleable iron handwheel, Class 150 (150 psi WP steam), Williams, Velan or Powell equal to Williams Fig. S152F6-316
2. 2-1/2" and Larger: stainless steel body, flanged, stainless steel disc, stellite seats, Class 150 (150 psi WP steam), Williams, Powell or Velan equal to Williams Fig. S152F6-316

C. Swing Check Valves:

1. 2" and Smaller: stainless steel body, flanged, stainless steel disc, Class 150 (150 psi WP steam), Williams, Powell or Velan equal to Williams Fig. S151F6-316
2. 2-1/2" and Larger: stainless steel body, flanged, stainless steel disc, Class 150 (150 psi WP steam), Williams, Powell or Velan equal to Williams Fig. S151F6-316

D. Drain Valves:

1. Gate valve as specified above with hose thread adapter. Provide 3/4" minimum drain valve size except strainer blowdown valves to be blowdown connection size.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install valves as shown on plans, details and according to manufacturer's installation recommendations.

3.2 DRAIN VALVES

- A. Provide ball valves at low points of all coils.
- B. Unless otherwise indicated, provide 1/2" drain valve for all coils.

3.3 COIL VENTS

- A. Provide ball valves at high points of all coils.
- B. Unless otherwise indicated, provide 1/2" ball valve for all coils.

END OF SECTION 232118

SECTION 23-3400 FANS

PART 1 GENERAL

1.1 RELATED WORK

- A. Section 20-0513 - Motors
- B. Section 23-0550 - Vibration Isolation
- C. Section 26-2816 - Enclosed Switches and Circuit Breakers

1.2 REFERENCE

- A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.
- B. This section specifies a system or a component of a system being commissioned as defined in Section 01 91 00 Commissioning. Testing of these systems is required, in cooperation with the Owner and the Commissioning Authority. Refer to Section 01 91 00 Commissioning for detailed commissioning requirements.

1.3 SUBMITTALS

- A. Shop drawings including, but not limited to, the following:
 - 1. Manufacturer's name and model number
 - 2. Identification as referenced in the documents
 - 3. Capacities/ratings
 - 4. Fan curves
 - 5. Materials of construction
 - 6. Sound power levels
 - 7. Fan type, size, class, drive arrangement, discharge/rotation, bearings, drives
 - 8. Wheel type, diameter, rpm, tip speed
 - 9. Required fan horsepower including drive losses
 - 10. Motor data (refer to Section 20 0513 - Motors)
 - 11. Vibration isolators furnished with fans
 - 12. Dimensions and weights
 - 13. Special coatings where applicable
 - 14. Color selection charts where applicable
 - 15. Manufacturer's installation instructions
 - 16. All other appropriate data
- B. Fan curves shall include series of curves indicating relationship of flow rate (cfm) to static or total pressure for various fan speeds, brake horsepower curves, and selection range (surge curves, maximum rpm, etc).
- C. Indicate performance data, based on both design air quantity and 110% of design air quantity.

- D. For variable air volume application, indicate operating points at 100, 80, 60 and 40% of design capacity on fan curves including data to indicate effect of capacity control devices such as inlet vanes on flow, pressure and horsepower.

1.4 DESIGN CRITERIA

- A. Fan ratings shall be tested and certified in accordance with AMCA Standards 211 and 311 and fans shall bear AMCA Seal.
- B. Fans shall be furnished complete with motors, wheels, drive assemblies, bearings and accessories as hereinafter specified. Motors for V-belt drives shall be furnished with adjustable rails or bases.
- C. Each fan wheel shall be statically and dynamically balanced to grade G6.3 per ANSI S2.19. Complete fan assembly shall be factory balanced statically and dynamically in accordance with Standard AMCA 204-96 for Balance Quality and Vibration Levels for Fans and meet or exceed guidelines in Application Category BV-3.
- D. For fans furnished with 5 HP or larger HP motors, each fan assembly shall have factory run test including vibration signatures taken on each bearing in horizontal, vertical and axial direction. Filter-in reading as measured at fan, scheduled rpm shall not exceed the following values when fan is rigidly mounted.
1. Belt Drive (except Vane Axial) 0.15 in/sec peak velocity
 2. Belt Drive Vane Axial 0.08 in/sec peak velocity
 3. Direct Drive 0.08 in/sec peak velocity
 4. Written records of run test and vibration test shall be available upon request.
- E. Furnish fans specified with V-belt drives with either variable-pitch or fixed-pitch sheaves for drives 3 HP and smaller and fixed-pitch sheaves for drives 5 HP and larger. Select variable pitch sheaves to drive fan at such speed as to produce specified capacity at approximate midpoint of sheave adjustment.
- F. When fixed-pitch sheaves are furnished, system air balancing shall be accomplished by either trial of different fixed-pitch sheaves or use of temporary adjustable-pitch sheaves. This Contractor shall provide necessary trial and final sheaves and drive belts as required by TAB Contractor.
- G. Select each fan to operate at single stable operating point as predicted by fan curve. Fans having 2 potential operating points on fan curves are not acceptable.
- H. Unless otherwise indicated, V-belt drives shall be selected for 150% of motor nameplate horsepower.
- I. Provide OSHA compliant belt and shaft guards for belt driven fans. Provide speed test openings at shaft locations. Paint guards bright yellow. Belt driven fans on smoke exhaust systems shall be provided with 1.5 time required number of belts (2 minimum).
- J. Sound power levels shall be based on tests performed in accordance with AMCA Standards 300 and 301.
- K. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. Motor furnished with fan shall not operate into motor service factor in any of these cases.
- L. Consider drive efficiency in motor selection according to manufacturer's published recommendation, or according to AMCA Publication 203, Appendix L.
- M. Where inlet and outlet ductwork at any fan is changed from that shown on drawings, submit scaled layout of change and system effect factor calculations indicating increased static pressure requirements as described in

AMCA Publication 201. This Contractor shall be responsible for costs associated with any motor, drive, and/or wiring changes required as a result of duct configuration changes at fan.

- N. Unless otherwise scheduled, AMCA Type A spark resistant construction shall be used for fans handling flammable or grease laden, vapors.

PART 2 PRODUCTS

2.1 PLENUM FANS

- A. Manufacturers: Greenheck, Barry, Chicago Blower, Twin City, or Cook.
- B. General: Fans shall be airfoil centrifugal type designed for industrial duty and suitable for continuous operation. Fans shall be single width, single inlet, arrangement 3, plenum fans with capacities and operating characteristics as indicated on schedules.
- C. Hubs: Hubs shall be cast or welded fabricated hubs with straight bores and keyways. Hubs shall be screwed to the shaft with a minimum of 2 set screws for positive attachment. Hubs using taper lock bushings are not acceptable.
- D. Wheels: Airfoil type, double skinned and welded to center and wheel sideplates. Fan impeller diameters shall conform to AMCA Standard 99-2401-82. Fan blades shall be designed to provide smooth airflow over all surfaces of blade. Fan shafts shall be solid AISI 1040 or 1045 steel. Straight shafts shall be turned, ground and polished to a minimum 16 micro-inch finish. Shaft shall be sized to run at a minimum of 20% greater than the maximum AMCA class speed.
- E. Bearings: Air handling quality, heavy-duty, grease lubricated, pillow block, self-aligning ball or roller type. Bearings shall be selected for minimum life (ABMA L10) of not less than 80,000 hr operation at maximum cataloged operating speed.
- F. Screen Enclosure: Entire plug fan and drive assembly shall be encased with protective screen enclosure. Enclosure shall be constructed of aluminum or galvanized steel mesh or expanded metal and sized to have no measurable system effect on fan performance. Screen shall be reinforced as required to maintain stable structure during fan operation. Access shall be provided for periodic service. Door shall be of suitable size to allow service personnel into enclosure. Enclosure shall be designed and constructed to allow for complete disassembly.
- G. Inlet Screens: Heavy gauge, corrosion resistant, zinc plated steel wire for fans without inlet ductwork.
- H. Inlet Cones: Inlet cones shall be precision spun. Inlet cones shall be aerodynamically matched to wheel side plate to insure full loading of blades. Inlet cones shall be heavy gauge steel.
- I. Painting: All metal parts to be painted with prime coat after metal cleaning and surface preparation. In addition, apply second coat of paint to all exterior surfaces.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install units as shown on drawings, and according to manufacturer's installation instructions. On units provided with drain connection, install drain valve and cap discharge of drain.

- B. Perform field mechanical balancing, if necessary, to meet vibration tolerance specified in Section 23 0550 - Vibration Isolation.

3.2 COMMISSIONING

- A. Refer to specification section 23 7328 Factory Fabricated Custom Air Handling Units for requirements.

END OF SECTION 233400

Fan Data Sheet

General

Project _____
Identification _____
Service _____
Location _____
Type _____
Manufacturer _____
Model Number _____

Performance

Capacity _____
Efficiency (%) _____
Brake Horsepower at design flow rate (cfm) _____
Brake Horsepower at 110% of design flow rate (cfm) _____

Physical Characteristics

Size _____
Class _____
Drive Arrangement _____
Discharge Rotation _____
Drive _____
Bearing _____

Motor

Manufacturer _____
Horsepower _____
Voltage _____
Phase _____
Hertz _____
RPM _____
Type _____
Enclosure Type _____
Frame Type _____
Insulation Class _____
NEMA Design Designation _____
Service Factor _____
Nominal Efficiency _____
Nominal Power Factor _____
Full Load Amps _____
Variable Frequency Drive Driven (Yes or No) _____

Miscellaneous

Vibration Isolators _____
Special Coating (Yes or No) _____
Special Coating Type _____

THIS PAGE INTENTIONALLY BLANK

SECTION 23-4114 FILTERS

PART 1 GENERAL

1.1 RELATED WORK

- A. 23-7328 Factory Fabricated Custom Air Handling Units

1.2 REFERENCE

- A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 SUBMITTALS

- A. Shop drawings including, but not limited to, the following:
 1. Manufacturer's name and model number
 2. Identification as referenced in the documents
 3. Capacities/ratings; cfm, area, face velocity
 4. Efficiencies and initial/final pressure drop
 5. Materials of construction
 6. Dimensions
 7. Filter gauges data
 8. Manufacturer's installation instructions
 9. All other appropriate data

1.4 DESIGN CRITERIA

- A. Filters shall have UL, Class I or Class II listing.
- B. Holding frames or housings specified in this Section may be furnished by filter manufacturers listed below, or where applicable, as part of factory packaged air handling units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Camfil/Farr, Flanders Precisionaire, or Airguard unless otherwise noted under individual filter.

2.2 DISPOSABLE PANEL FILTERS (PRE-FILTERS)

- A. Cam-Farr 30/30 or approved equal by American Air Filter, Eco-Air or Airguard.
- B. Media shall be non-woven, cotton fabric material laminated to rigid backing to hold pleat formation, having minimum efficiency MERV 8 based on ASHRAE Test Standard 52.2 (average efficiency of 40% based on ASHRAE Test Standard 52.1) with a minimum arrestance of 90%. Filters shall be UL Class 2 labeled.
- C. Filter housing shall consist of air handling unit manufacturer's low velocity filter section, or holding frame, as scheduled. When holding frame is indicated, it may be furnished by, filter manufacturer or it may be contractor fabricated.

- D. Media support shall consist of welded wire grid with 90% or more open face area. Grid shall be bonded to filter media.
- E. Filter enclosing frame shall be constructed of rigid, heavy duty, high wet strength beverage board bonded to filter pack. Standard sizes shall be 12" x 24" x 2" and 24" x 24" x 2".
- F. Filters shall be capacity as scheduled. Clean filter pressure drop shall not exceed 0.28" WG based on 500 fpm face velocity.

2.3 DISPOSABLE RIGID CARTRIDGE TYPE AIR FILTERS (FINAL FILTERS)

- A. Similar to Farr E-Series RIGA-FLO or equal by American air Filter, Airguard or Eco-Air.
- B. High performance deep pleated, rigid, disposable type filters. Filters shall be constructed without use of steel components. Each filter shall consist of high efficiency media, enclosing frame, contour stabilizers on both air entering and exiting sides and support grilles. Filters shall be designed to withstand minimum differential pressure of 6" WG without structural damage to filter frame, seals or media. Filters shall be UL Class 2 labeled.
- C. Media shall be high density microfine glass fiber laminated to non-woven synthetic backing to form a lofted filter blanket.
- D. Media support shall be welded wire grid with effective open area of not less than 96%. Grid shall be bonded to filter media to eliminate media oscillation and pull away. Grid shall support media both vertically and horizontally. Contour stabilizers shall be permanently installed on both air entering and exiting sides of filter media pack to insure pleat configuration is maintained throughout life of filter.
- E. Enclosing frame shall be constructed of galvanized steel. It shall be constructed and assembled to provide rigid and durable enclosure for filter pack. Frame shall be bonded to filter pack. Standard sizes shall be 12" x 24" x 12" and 24" x 24" x 12".
- F. Filter thickness, size and capacity shall be as scheduled.
- G. Filters shall have minimum efficiency MERV 11 based on ASHRAE Test Standard 52.2 (average efficiency of 60-65% based on ASHRAE Test Standard 52.1) with a minimum arrestance of 90%. Initial resistance at 500 fpm face velocity shall not exceed scheduled pressure drop.
- H. Filters shall have minimum efficiency MERV 14 based on ASHRAE Test Standard 52.2 (average efficiency of 90-95% based on ASHRAE Test Standard 52.1) with a minimum arrestance of 90%. Initial resistance at 500 fpm face velocity shall not exceed scheduled pressure drop.

2.4 HIGH EFFICIENCY PARTICULATE AIR (HEPA) FILTERS (FUTURE)

- A. Filter size, capacity, and static pressure drop shall be as scheduled.
- B. Filters to be individually tested and certified shall be 99.97% minimum efficient with handling 0.3 micron particles in accordance with DOP test method. DOP efficiency along with filter serial number and name of manufacturer shall be marked on filter.
- C. Each filter element shall consist of glass fiber media, fire retardant epoxy or self-extinguishing neoprene rubber sealer and neoprene gasket all contained in suitable protected steel frame. Each filter element shall be constructed without use of spacers of any kind, including separators, tape, string or strips of medium by self-supporting pleating continuous sheet of formed, corrugated medium. Mount filters in side access housing or holding frames specified elsewhere in this section.
- D. Filters to be listed or classified under UL 586 test standard.

2.5 CARTRIDGE CHARCOAL FILTERS (FUTURE)

- A. Air filters shall be compact 12” deep adsorber type with combination sorbent/particulate removal media, impact-resistant plastic end caps, plastic vertical support channels, and a nominal 1” header for front or side-access applications.
- B. Filter cartridge sizes shall be 24”x24”x12” except as required to maximize filter surface area, 24”x12”x12” cartridges shall be acceptable.
- C. Filter media shall be specifically manufactured for the removal of molecular and particulate contaminants. Sorbent shall be broad spectrum grade of carbon incorporating Rapid Adsorption Dynamics (RAD) designed for the removal of a wide range of odors and VOCs.
- D. The media shall be formed into uniform pleats using hot-melt separators, assembled into multi media packs and bonded into a high-impact resistant plastic frame to prevent air bypass. Filter assemble shall include after filter as necessary to prevent carbon dust from traveling downstream.
- E. Resistance to airflow shall not exceed 0.48 inches w.g. at 500 feet per minute velocity.
- F. The media shall have a particulate removal efficiency of MERV of 13 when tested per ASHRAE Standard 52.2.

2.6 FILTER HOLDING FRAMES

- A. Frames shall be minimum 16 ga galvanized steel construction with provisions for assembly in a bank. Frames shall be suitable for filters scheduled and incorporate gaskets and spring clips to prevent air bypass.

2.7 LOW VELOCITY FILTER SECTIONS

- A. Provide for factory packaged, air handling units and cabinet fans as indicated.
- B. Housing shall consist of modular steel section with hinged access doors for filter replacement. Each housing shall be internally insulated by manufacturer or externally insulated in the field. Factory applied internal insulation shall have thermal resistance equivalent to that specified for duct in which housing is located, shall have internal vapor barrier, and shall have flame spread and smoke developed ratings as specified in Section 20 0700 - Mechanical Systems Insulation.

2.8 FILTER PRESSURE DROP GAUGES

- A. Dwyer Series 2000 Magnehelic pressure gauge.
- B. Unless otherwise indicated below, select scale range to be most appropriate to clean and dirty filter pressure drops.

<u>Filter Type</u>	<u>Scale Range (inch WG)</u>
Pre-Filters	0 - 1.0
Final Filters	0 - 2.0
HEPA filters	0 - 4.0
Charcoal filters	0 - 2.0

- C. Provide gauges for each filter bank, including gauges across each individual filter bank in built-up rack assemblies, suitable for flush mounting in a panel, including air filter gauge accessory package for use with 1/4" OD copper tubing.

- D. Provide 3/4" spacer at one 2' x 2' filter section between filter elements in built-up rack, adjacent to unit wall for placement of intermediate pressure probe.

2.9 REPLACEMENT FILTERS

- A. Enough media for 3 filter changes shall be provided for each air handler, excluding HEPA and carbon filters.

2.10 FILTER CLIPS

- A. Provide 2" long "D" style holding clips for pre-filters.
- B. Provide 3/4" long "D" style holding clips for final filters.
- C. Provide swing bolt style holding clips with hand turn knobs for HEPA filters.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install filters as shown on drawings and according to manufacturer's instructions.
- B. Provide supports as required and necessary clearance for changing filters.
- C. Provide structural supports, outside casing and blank-off materials for all field assembled filter banks, and filter banks where housings are not furnished by filter manufacturer.

3.2 FILTER PRESSURE DROP GAUGES

- A. Mount gauge near each filter bank and install static pressure sensors according to manufacturer's instructions.
- B. Mount gauge on control panel.

END OF SECTION 234114

SECTION 23-7328 FACTORY FABRICATED CUSTOM AIR HANDLING UNITS (FOR REFERENCE ONLY – OWNER PROVIDED)

PART 1 GENERAL

1.1 RELATED WORK

- A. Section 20-0513 - Motors
- B. Section 20-0529 – Pipe and Equipment Supporting Devices
- C. Section 23-0550 - Vibration Isolation
- D. Section 23-0902 - Control Dampers
- E. Section 23-2116 - Pipe and Pipe Fittings
- F. Section 23-2118 - Valves
- G. Section 23-2120 - Piping Specialties
- H. Section 23-3400 - Fans
- I. Section 23-4114 - Filters
- J. Section 23-8216 - Coils
- K. Section 23-8413 - Humidification Equipment
- L. Section 26-0519 - Low-Voltage Electrical Power Conductors and Cables
- M. Section 26-0533 - Raceway and Boxes for Electrical Systems
- N. Section 26-2726 - Wiring Devices
- O. Section 26-2816 - Enclosed Switches and Circuit Breakers
- P. Section 26-2913 - Enclosed Controllers

1.2 REFERENCE

- A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplemental Conditions, and sections under Division 01 General Requirements.
- B. This section specifies a system or a component of a system being commissioned as defined in Section 01 91 00 Commissioning. Testing of these systems is required, in cooperation with the Owner and the Commissioning Authority. Refer to Section 01 91 00 Commissioning for detailed commissioning requirements.

1.3 SUBMITTALS

- A. Shop drawings for all equipment including, but not limited to, the following:
 - 1. Appropriate identification
 - 2. Complete drawings showing plans and sections including details of construction
 - 3. Overall unit dimensions and individual components and sections dimensions
 - 4. Shipping and operating weight of unit and/or sections
 - 5. Structural design load
 - 6. Details of component support
 - 7. Capacities/ratings
 - 8. Materials of construction
 - 9. Thermal and acoustical performance of wall, roof and floor panels
 - 10. Pressure ratings and leakage ratings
 - 11. Thermal break construction details and performance calculations or test data
 - 12. Each component manufacturer's name, model number and data. (Refer to each component section for submittal requirements.)
 - 13. Air leakage rates and test data
 - 14. Wiring diagrams and terminal points for control panels provided with units
 - 15. Manufacturer's installation instructions
 - 16. Air handling unit manufacturer's local representative and phone number

1.4 DESIGN CRITERIA

- A. For housings and floors operating under positive pressure (fan discharge side), maximum allowable deflection shall not exceed 1/200th of any span in any direction at + 10" WG.
- B. For housings and floors operating under negative pressure (fan inlet side), maximum allowable deflections shall not exceed 1/200th of any span in any direction at - 10" WG.
- C. Air handling unit manufacturer shall provide equipment as specified and install equipment furnished by others to result in complete and operational unit. Unit manufacturer shall assume single source responsibility for all air handling unit components and accessories.
- D. Furnish units complete with fans, piping, valves, piping specialties, actuators, motors, coils, humidifiers, drain pans, filter sections, damper sections and interior lighting, meeting configuration and as shown on drawings, specified and as scheduled. All unit components shall meet this Section of specification and all requirements specified in each section and division listed under Related Work. Control dampers shall be provided by unit manufacturer. Control dampers actuators will be furnished by Control Contractor for factory mounting by unit manufacturer.
- E. Unit performance shall be in accordance with ARI, Standard 430.
- F. All materials shall meet NFPA 90A flame and smoke generation requirements.
- G. All materials shall comply with FM Global insurance requirements.

- H. Unless otherwise indicated, galvanized steel shall be G90 according to ASTM A924 (formerly ASTM A525), A653 and ASTM A-90 and aluminum sheet shall be 3003-H14 alloy, conforming ASTM B209.
- I. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure.
- J. Motor furnished with fan shall not operate into motor service factor in any cases.
- K. Where inlet and outlet ductwork at any fan is changed from that shown on drawings, submit scaled layout of the change and system effect factor calculations, indicating increased static pressure requirement as described in AMCA Publication 201. This Contractor shall be responsible for any motor drive and/or wiring changes required as result of duct configuration changes at fan.
- L. Air handling unit static pressure to take into consideration actual static pressure loss of components furnished within unit and any system effects due to unit arrangement and inlet and discharge connections.
- M. Wire brush all welds with solvent and wipe clean all bare metal before painting.
- N. Unit dimensions shall reflect space provided on plans including access allowances for equipment maintenance and overhead clearance requirements for stacked units located on raised structural platforms. All access aisle clearances shall be maintained as indicated on drawings to allow future AHU installation and replacement. Shipping splits shall allow installation of units within constraints of available access space.

1.5 FINAL CLEANING

- A. Outside and inside of each air handling unit shall be thoroughly cleaned. Use industrial grade cleaners to remove construction dust, sheet metal mil finish or grease. All proposed cleaning materials shall have contents identified and approved prior to use. Cover unit openings with sheet metal or other proper material until ductwork is connected to maintain unit cleanliness.

1.6 MANUFACTURER QUALIFICATIONS

- A. Air handling units shall be manufactured by qualified unit manufacturer that has been making custom units for at least 10 years, and shall carry manufacturer's nameplate. Unit manufacturer shall be held responsible for specified performance of units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Governair/Ventrol, Ingenia, TMI Climate Solutions, Air Flow Equipment, ClimateCraft or Trane Custom with operating characteristics as scheduled and physical dimensions as shown on drawings and/or detailed.

2.2 UNIT BASE

- A. Unit base shall be fabricated from structural steel or galvanized formed steel.
- B. Base shall be sized to provide sufficient height above floor to accommodate cooling coil drain trap height indicated on details. Additional steel base may be used as sub-base to provide the required trap height. Sub-base shall be provided by unit manufacturer.
- C. Weld steel solid at connection points to assure rigidity. Size perimeter steel to allow for rigging and handling.
- D. Locate and size base cross supports to support internal components.
- E. Provide lifting lugs to perimeter base steel. Incorporate means of attaching cable or chain into each lug.

- F. Base shall be split in maximum size pieces to allow for economical shipment to jobsite and placement within building. Provide bolting structural steel on both sides of split for field joining.
- G. Unit base shall be primed and finished with rust inhibiting epoxy paint. Galvanized dipped or powder coating may be used in lieu of epoxy paint. If base rail is not galvanized dipped, then the bottom of the base rails need to be painted to avoid rust issues.

2.3 UNIT FLOOR

- A. Unit floor shall be constructed to meet the maximum allowable deflection, and constructed of no lighter than:
 - 1. 3/16" aluminum plate or 1/8" aluminum plate with an increase in floor supports for framing. Floor plate shall have diamond-tread.
- B. Floor joints and seams shall be continuously welded water tight. Each section shall have turned up lip around section perimeter with welded corner to form drain pan type floor capable of retaining minimum 1-1/2" of water without leakage. Locate drain connection at lowest point of each pan type floor section. Connections shall extend through perimeter base channel and be welded water tight. Provide removable cap on each drain connection.
- C. Weld flooring material to structural members below. Drive screw attachment is not acceptable.
- D. Unit manufacturer shall field weld the unit floors as required to connect air handling unit shipping splits.
- E. Entire floor including base drain pans shall be insulated on underside to have same thermal and acoustical performance specified for unit housing. Insulation shall be supported by minimum 20 ga galvanized steel liner with joints sealed to provide continuous vapor barrier.
- F. Base Drain Pans:
 - 1. Provide recessed drain pans as integral part of unit floor in pre-heating coils, outside air sections and humidifier sections.
 - 2. Drain pans shall be constructed from minimum 16 ga 304 SS sheet, all seams continuously welded.
 - 3. Drain pan shall be double sloped; pitched down in direction of air flow and pitched sideways to drain connection.
 - 4. Locate drain connections at lowest point of pan, one on either end. Connections shall extend through perimeter base channel and be continuously welded to insure air-tight seal as well as eliminate requirement for backup wrench during field piping. Provide removable cap on each drain connection.
 - 5. Refer to Cooling Coil Section for cooling coil drain pan requirements.

2.4 UNIT HOUSING

- A. Unit housing shall be constructed of minimum 3" thick double wall panels meeting thermal, acoustical and structural requirements specified.
- B. Panels shall utilize modular panel type construction. Panels may be self-supporting with internal support structure or supported by structural frame work.
- C. Panel joints and seams shall be sealed with proper gasket and caulking to meet maximum allowable housing leakage rate specified.
- D. Panel system, including service corridor where used, shall incorporate thermal break design at panel frames, joining mullions, supporting base, or corners. Thermal break is defined as prevention of condensation on

outside surface of unit casing with 91°F dry bulb and 77°F wet bulb temperature in adjacent space and 50°F dry bulb temperature inside air handling unit.

- E. Unit manufacturer shall submit, as part of shop drawings, details of thermal break construction and calculations or test data indicating that thermal break design will prevent condensation on outside surface of unit casing with specified air temperatures at outside of unit and specified air temperature at inside of unit.
- F. Outer face of panels shall be constructed of no lighter than:
 - 1. 16 ga galvanized steel.
- G. Solid inner face of panels shall be constructed of no lighter than
 - 1. 22 ga 304 SS sheet
 - 2. All interior panel joints shall be sealed water and air-tight and suitable for low pressure washdown with a hose without wetting of the insulation.
 - 3. Unit casing shall be insulated with minimum 3 pcf density glass fiber, 2.5 pcf density polyisocyanurate, or 3 pcf density urethane foam insulation. Composite panel shall have heat transfer factor not greater than 0.06 Btu/hr/sq ft/°F. All products as applied shall meet NFPA 90A possessing flame spread rating of not over 25, fuel contributed rating of not over 50 and smoke developed rating of not over 50.
- H. Use solid inner surface for all sections.
- I. Provide center vertical partition to divide units into modules, as detailed on drawings. Partition panels shall be same construction as housing wall panels except both faces be constructed of no lighter than 16 ga solid galvanized steel.
- J. Provide blank-off panels with proper gaskets and sealants to prevent air bypass around equipment such as filters, coils, humidifiers and sound attenuators. Blank-off panels shall be constructed of galvanized steel no lighter than 16 ga unless otherwise noted. Blank-off panels at cooling coil sections shall be insulated with 3/4" thick insulation similar to AP Armaflex SA Duct Liner. Do not insulate blank-off panels between cooling coils located above drain pans.
- K. Panel manufacturer shall have published literature available stating sound absorption coefficient of panel system obtained using ASTM method of Test for Sound Absorption of Acoustical materials in
- L. Reverberation Rooms (ASTM Designation C423-66), and sound transmission loss obtained using procedures conforming to ASTM Designation E90-70, E413-70T and other pertinent standards.
 - 1. Sound Transmission Loss in accordance with ASTM E90 shall equal or exceed the following:

	Octave Band Center Frequency (Hz)					
	125	250	500	1000	2000	4000
Transmission Loss (dB) of 4" Panels	21	24	34	44	51	53

- 2. Sound performance tests must be documented by independent laboratory (ETL, Riverbank Laboratories, Kideras Labs, etc.).
- M. Manufacturer shall have published literature available describing load-carrying capabilities and thermal characteristics of the panel system.

2.5 ACCESS DOORS

- A. Each unit section shall have 24" x 72" access door, unless shown differently on drawings.

- B. Fan section access door shall be sized to allow removal of fan wheel and motor through door, but not smaller than 30" x 72". If access door needs to be wider than 36", removable access panel may be provided.
- C. Access doors and door frames shall have similar thermal break construction as specified under Unit Housing.
- D. Access doors shall be same construction as housing panels.
- E. Access doors located downstream of cooling coils shall be true thermal break design with no metal to metal contact.
- F. Access doors shall be guaranteed tight closing through use of seals around entire periphery. Provide neoprene gasket between door frame and housing for air tight seal.
- G. Each access door shall contain 1/4" thick wire glass or double glazed tempered glass window minimum size of 12" x 12" or 12" round. Window shall be double paned with vapor seal construction.
- H. Each access door shall be furnished with corrosion resistant metal hinges or continuous piano hinge and shall have at least 2 stainless steel or aluminum alloy handles operable from either side.
- I. Doors shall open against higher air pressure to affect seal.

2.6 ACCESS SECTIONS

- A. Access sections shall allow minimum of 30" between adjoining equipment. Provide access doors as indicated on the plans.

2.7 REMOVABLE ACCESS PANELS

- A. Removable access panels shall be provided as indicated on drawings and where equipment removal is not possible through access door. Removable panels shall be same construction as housing panels.

2.8 AIR MIXING SECTION

- A. Manufacturers: Blender Products, Inc
- B. Units shall be not less than 0.08" aluminum of all welded construction.
- C. Units shall be completely fixed devices capable of providing mixed air temperatures within 6°F of theoretical values.
- D. Provide air mixing devices as scheduled, with proper bulk needs and distances to dampers and coils per manufacturer's recommendations.

2.9 FILTER SECTIONS

- A. Filters shall be provided as specified and scheduled. Holding frames shall be installed by unit manufacturer to raise filters off floor and to prevent leakage as specified by unit manufacturer.
- B. Provide space in prefilter section, downstream of prefilters, for installation of future carbon filters.
- C. Each filter section shall have individual pressure gauges.

2.10 PREHEAT COIL SECTION

- A. Provide preheat coils, piping and internal piping as specified and indicated on drawings.

- B. Install coils, piping, and specialties not to block face area of coils. Terminate piping outside of unit casing for connection by Trade Contractor.
- C. Support piping to interior coils with minimum of 2 supports. Support material shall be hot dipped galvanized steel. Supporting devices in contact with copper piping shall be vinyl or epoxy coated.
- D. Coil pull access is not available on both sides of units, therefore coil flanges, mounting, and blank-off provisions shall be arranged for upstream or downstream face pull. Refer to drawings and coordinate with internal component arrangement. Coil sizes and quantities at each unit shall allow for coil pull through access space shown on plans.
- E. Each coil shall be supported by galvanized steel frame which is independent of unit casing. Support frame shall allow individual coil removal. Blank-off panels shall be galvanized steel sheets with insulation as specified.

2.11 COOLING COIL SECTIONS

- A. Provide cooling coils, piping and piping specialties specified, and indicated on drawings.
- B. Install coils, internal piping, and specialties not to minimize blockage of face area of coils. Terminate piping outside of unit casing for connection by Trade Contractor.
- C. Piping internal to the unit shall be painted with corrosive resistant paint.
- D. Support piping to interior coils with minimum of 2 supports. Support devices shall be hot dipped galvanized steel.
- E. Each coil shall be supported by 304 stainless steel frame which is independent of unit casing. Support frame shall allow individual coil removal without disturbing any other coil or piping to any other coil. Coils shall be removable through unit access doors or removable access panels. Blank-off panels shall be 304 stainless steel sheet with insulation as specified.
- F. Coil pull access is not available on both sides of units, therefore coil flanges, mounting, and blank-off provisions shall be arranged for upstream or downstream face pull. Refer to drawings and coordinate with internal component arrangement. Coil sizes and quantities at each unit shall allow for coil pull through access space shown on plans.
- G. Each coil support shall include minimum 16 ga 304 stainless steel all welded condensate drain pan extending min. 4", but no more than 12" downstream of coil face. Each drain pan shall have sufficient depth to hold condensate water but not less than 2". Drain pan shall be sloped in 2 directions (pitched down in direction of airflow and pitched sideways to drain connection) for self-drainage at minimum 1/4" per foot slope. Drain pan shall be individually piped down to drain pan located below, and bottom drain pan to be piped to hub drain at exterior of unit. Drain connection opening shall be flush with bottom of pan. Side pan connection located at lowest point of pan may be used only where bottom pan connection cannot be used. Drain pipe shall be 304 stainless steel with sufficient size, but not less than 1-1/2".
- H. Instead of drain pan under bottom coil, recessed pan, integral with unit floor shall be used. It shall be constructed as specified above including thermal insulation and drain lines, and shall incorporate required drain trap height.

2.12 FAN SECTION

- A. Fan and motor shall be provided as scheduled and meet requirements of appropriate Specification Sections.

- B. Fan and motor shall be factory mounted on vibration isolation equipment meeting requirements of Section 23 0550 - Vibration Isolation. Vibration base shall include integral adjustable motor base. If inertia bases are required, provide required concrete in factory.
- C. Motor Removal:
1. For motors 5 hp and larger, provide motor removal rail sized for L/400 deflection when fully extended and subjected to weight of motor at furthest extreme position.
 2. Removal rail shall be mounted in fan section, centered with the fan section access door, perpendicular to side of AHU.
 3. Removal rail shall be designed with roller so rail can extend a minimum of 24" beyond the exterior of the unit, to all motor to be fully removed from unit, and lowered onto dolly. Traversing arm shall be able to freely move while carrying motor weight.
 4. Motor shall be able to be removed through access door or access panel.
- D. Fan Array:
1. Fan array system shall consist of multiple, direct driven, arrangement 4 plenum fans constructed per AMCA requirements for duty specified. Fans shall be selected to deliver scheduled airflow quantity at scheduled operating total static pressure and scheduled fan/motor speed. Fan array shall be selected to operate at system total static pressure that does not exceed 90% of scheduled fan's peak static pressure producing capability at scheduled fan/motor speed. Each fan/motor cube shall include 11 ga, A60 Galvanized steel intake wall, 14 ga spun steel fan inlet funnel, and 11 ga G90 Galvanized steel motor support plate and structure. Fan intake wall, inlet funnel, and motor support structure shall be powder coated for superior corrosion resistance. Motors shall be standard pedestal mounted type, T-frame motors selected at specified operating voltage, rpm, and efficiency as needed to meet performance requirements. Motors shall include isolated bearings or shaft grounding. Each fan/motor cartridge shall be dynamically balanced to meet AMCA standard 204-96, category BV-5, to meet or exceed Grade 2.5 residual unbalance. Maximum allowable Fan motor size shall be 15HP.
 2. Fan array shall provide uniform air flow and velocity profile across entire air way tunnel cross section. Airflow and velocity shall not exceed scheduled cooling coil and/or filter bank face velocity when measured at a point 12" from intake side of fan wall array intake plenum wall, and distance of 48" from discharge side of fan wall intake plenum wall.
 3. Provide partition between fans to minimize system effect.
 4. Provide structural frame to support upper fans with solid floor panel partition between fans as shown on drawings to minimize system effect.
 5. Each fan/motor cube shall be equipped with metal grating fan outlet guard.
 6. Each fan in array shall be provided with back flow prevention means that produces less than 0.10" of static pressure drop and/or system effect when that fan is enabled. Any such system effects and/or pressure drops shall be submitted and included as component in determining fan system total static pressure as submitted. Manufacturer's pressure drop ratings of any such equipment, developed from straight run test conditions will not be accepted.
 7. Fan array shall be sized such that upon single fan failure, remaining fans could ramp up and provide same 100% design capacity.
 8. Provide local electrical disconnect and overload protection for each fan.
 9. Contractor shall provide all wiring to air handling unit components that require power.
 10. PVC coated LFMC is not allowed in environmental air plenum spaces or air handling equipment

2.13 HUMIDIFIER SECTION

- A. Provide humidifiers, piping and supports as specified, and indicated on drawings. Terminate piping outside of unit casing for connection by Trade Contractor.

- B. Pipe size, quantities, and routing shall be as recommended by manufacturer.
- C. Pipe support materials shall be hot dipped galvanized steel.
- D. Valves and specialties provided by humidifier manufacturer shall be turned over to the mechanical contractor for installation in piping external to the unit.
- E. Size and locate humidifier distribution tubes to receive uniform air flow on entire tube.
- F. Provide required absorption distance between humidifier and downstream equipment or housing wall.

2.14 BIPOLAR IONIZATION

- A. Provide bipolar ionization, similar to Global Plasma Solutions needle point ionization system, upstream of cooling coils.
- B. Provide ion detector, similar to Global Plasma Solutions iDetect, to provide BAS status of the ionization system.

2.15 DISCHARGE AIR SECTION

- A. Provide with framed discharge opening or spun bellmouth fitting conforming to size and configuration of the ductwork.

2.16 CONTROL DAMPERS

- A. Refer to Section 23 0902 - Control Valves and Dampers for control dampers.

2.17 FLOOR OPENING PROTECTION

- A. Floor openings shall have safety grates using 1" x 1/8" steel bar stock on 1-1/4" center spacing. Grates shall have same finish as floor. Provide 1-1/2" lip of galvanized steel at entire perimeter of opening.

2.18 CONTROLS

- A. Control devices shall be by same manufacturer providing control devices for the remainder of the building.
- B. Control devices will be furnished by Control Contractor and shall be field installed by Trade Contractor and as described in control section of specifications.

2.19 TESTING

- A. Owner and/or Owner's representative may elect to witness tests. Notify Owner and/or Owner's representative of test date at least 2 weeks in advance. Submit certified test data to Engineer for approval.
- B. Unit manufacturer shall provide factory tests to verify casing leakage after units are assembled.
- C. Unit manufacturer and installing contractor shall jointly provide field tests to verify casing leakage after units are installed at jobsite. Coordinate with Electrical Contractor for power to unit test fan.
- D. Casing leakage tests shall verify that unit casing leakage is less than 0.5% of design air flow at one and a half times design total static pressure (TSP).
 - 1. Seal duct openings in positive pressure section. Connect this section to fan developing 1-1/2 times the design positive static pressure and read air flow of this fan using approved air flow measuring device. Fan air flow measurement shall be considered casing leakage of this Section.

2. Seal duct openings in suction side of unit. Connect this section to fan developing in 1-1/2 times the design negative static pressure and read fan air flow of this fan using approved air flow measuring device. Fan air flow shall be considered casing leakage of this Section.
 3. Conduct casing leakage test individually for each air handling unit. Total casing leakage shall be calculated as sum of positive pressure section leakage and negative pressure sections leakage. Total casing leakage shall not exceed the allowable rate specified above.
- E. Unit manufacturer shall provide factory panel deflection test. Conduct this test in conjunction with casing leakage testing.
1. Panel deflection test for panels under positive pressure shall verify that unit casing deflection is less than 1/200 of the longest plane being measured at 1-1/2 times design static pressure or 10" WG positive, whichever is greater.
 2. Panel deflection test for panels under negative pressure shall verify that unit casing deflection is less than 1/200 of the longest plane being measured at 1-1/2 times design static pressure or 10" WG negative, whichever is more negative.
 3. Deflection shall be measured at 2 points for positive pressure sections and 2 points for negative pressure sections (total 4 points at panel seams) at mid-point of panel height

2.20 ELECTRICAL SERVICE

- A. Provide adequate lighting and switching so equipment can be observed and maintained in safe manner. Each unit section shall contain a minimum of one light fixture. Sections wider than 12 ft shall have multiple light fixtures with maximum spacing of 6 ft.
1. Provide light switch with pilot light for each access section. Locate switch near access door.
 2. Provide timer for light switch to automatically turn off lights after preset time. Timer shall be similar to Intermatic Model FF2H with 0-2 hour range and hold feature to override automatic shut-off function. A single timer wired to turn off all lights in the unit is acceptable.
 3. Light fixtures shall be: LED type. Provide bulbs for each fixture.
- B. Lights, switches, convenience outlets, wiring and conduit shall meet requirements of appropriate specification sections of Division 26.
1. Provide minimum of two convenience outlets on each unit, spaced evenly over length of unit.
- C. Wiring and conduit inside of unit shall be provided by unit manufacturer. Conduit shall be EMT and meet requirements of NEC and appropriate specification sections of Division 26. Provide junction box for each motor at outside of unit wall and provide single point of connection for both 480V, 3-phase and 120V, single-phase power for connection by Electrical Contractor.
- D. PVC coated LFMC is not allowed in environmental air plenum spaces or air handling equipment
- E. Seal electrical penetrations through unit air-tight.

2.21 PIPED SERVICE

- A. Piping and equipment installation inside the unit shall be complete. Piping shall be installed and tested per appropriate specification section. Unit manufacturer shall be responsible for any leaks, which occur in unit during system testing which occurs before system startup.
- B. Extend piping for each coil and humidifier if used through panel casing. Terminate piping with flange for pipe 2-1/2" and larger or threaded connection for pipe 2" and smaller with caps.

PART 3 EXECUTION**3.1 INSTALLATION**

- A. Units shall be assembled in modules in unit manufacturer's plant to allow for testing of complete unit.
- B. Unit manufacturer shall supervise installation of units and all field joining of the modules, including and sheet metal, electrical and piping.
- C. Joints in floor between modules shall be fully welded to be air and water tight.
- D. Unit manufacturer shall provide and install all equipment within unit as specified and/or scheduled, including fans, motors, coils, humidifiers, dampers, sound attenuating devices, piping, piping specialties, ductwork specialties, lights, switches and all equipment necessary to complete air handling equipment contained within housings. Mechanical and electrical connections (i.e., piping and conduit) shall be stubbed through housing so that appropriate contractor may provide service to air handling unit. Electrical wiring and control wiring shall terminate in junction boxes on accessible side of unit.
- E. Provide structural steel sub-base as required. Refer to Unit Base in Part 2.
- F. Field mounting of any equipment on housing walls or roof is not allowed without prior approval of Engineer. No field mounting of any services that will restrict access to fan and coil sections is permitted.
- G. Unit manufacturer and installing contractor shall coordinate with other trade Contractors, all necessary requirements to assure proper air handling unit installation including module sizes necessary for installation of units within space available and final housekeeping pad dimensions.
- H. Piped services to units, including electrical conduits, shall not cover fan and coil access sections.

3.2 INSTRUMENT TEST HOLES

- A. Provide instrument test holes at air entering and air leaving side of all internal air handling unit components for static pressure differential or temperature measurements. Refer to Section 23-3314 - Ductwork Specialties for instrument test holes.

3.3 PROTECTION OF OPENINGS

- A. Protect openings on housings during construction against entry of foreign matter and construction dirt.

3.4 FIELD TESTING & COMMISSIONING

- A. Unit manufacturer and installing contractor shall jointly perform field casing leakage tests on each completed housing assembly as previously specified and shall be responsible for repair of all leaks. Submit certified test data to Engineer for approval.
- B. Unit manufacturer shall be present for air handling unit commissioning. Coordinate date and time of commissioning with construction manager.
- C. Major equipment and system startup and operational tests shall be scheduled and documented in accordance with Section 01 91 00 Commissioning.
- D. System functional performance testing is part of the Commissioning Process as specified in Section 01 91 00. Functional performance testing shall be performed by the contractor and witnessed and documented by the Commissioning Authority.

3.5 BIPOLAR IONIZATION

- A. Provide lengths required for complete coverage of all cooling coils.

- B. Power supplies shall be mounted on the exterior of the unit.
- C. Install ion detector downstream of cooling coils and wire to exterior of the unit for connection to BAS by controls contractor.

END OF SECTION 237328

SECTION 23-8216 COILS

PART 1 GENERAL

1.1 RELATED WORK

- A. Section 23 7328 – Factory Fabricated Custom Air Handling Units

1.2 REFERENCE

- A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 SUBMITTALS

- A. Shop drawings including, but not limited to, the following:
 - 1. Manufacturer's name and model number
 - 2. Identification as referenced in the documents
 - 3. Capacities/ratings
 - 4. Flow rate and pressure drop
 - 5. Materials of construction
 - 6. Dimensions and weights
 - 7. Manufacturer's installation instructions
 - 8. All other appropriate data

1.4 DESIGN CRITERIA

- A. This Section covers coils in factory-packaged air handling unit, custom air handling units and field-erected air handling units.
- B. Coil sizes, capacities, configuration and operating characteristics to be as shown on plans and/or as scheduled. Coil performance data shall be certified in accordance with ARI Standard 410.
- C. Temperature profile of discharge air from entire coil face shall be uniform within 12" of coil face.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Buffalo, Carrier, McQuay, Trane, Marlo, Heatcraft, Aerofin, RAE, or Temtrol.

2.2 HOT WATER COILS

- A. Coils shall be constructed of 0.035" tube wall, 1/2" or 5/8" OD seamless copper tubes with 0.0095" aluminum fins suitable for working pressures to 200 psig and temperatures to 220°F. Coils shall be tested at 250 psig under water.
- B. Coil fins shall be continuous serpentine or plate fin type.
- C. Coil headers shall be cast iron with tubes expanded into headers, steel pipe with brazed tube connections, or heavy seamless copper with tubes brazed to header.

- D. Casings shall be minimum 16-gauge galvanized steel having galvanized steel end supports and top and bottom channels of rigid construction with allowance for expansion and contraction of finned tube section.
- E. Coils shall be equipped with bronze spring turbulators where required to provide capacities indicated.

2.3 CHILLED WATER COILS

- A. Coils shall be constructed of 0.035" tube wall, 1/2" or 5/8" OD seamless copper tubes with 0.0095" aluminum fins suitable for working pressures to 250 psig. Coils shall be tested at 250 psig under water.
- B. Coil fins shall be continuous plate fin type.
- C. Coil headers shall be constructed of cast iron with tubes expanded into headers, steel pipe with brazed tube connections, or heavy seamless copper with tubes brazed to header.
- D. Casings shall be minimum 16 ga stainless steel having stainless steel end supports and top and bottom channels of rigid construction with allowance for expansion and contraction of finned tube section.
- E. Select coils for tube velocity not less than 3.0 fps.
- F. Maximum allowable fin spacing shall be 10 fins per inch. Coil depth shall not exceed 8 rows.

PART 3 EXECUTION

3.1 GENERAL

- A. Install coils as indicated on drawings and/or as detailed. Pitch coils for proper drainage according to manufacturer's installation instructions. Install shims as required.
- B. Clean oil film from coil fins with hot water/detergent as recommended by coil manufacturer.
- C. Comb out fins when bent or crushed before enclosing coils in housing. Clean dust and debris from each coil to ensure its cleanliness.
- D. Provide flanges or joints in piping to facilitate coil removal. Unless otherwise specified, pipe coils for counter flow arrangement.
- E. Provide air vent and drain valve at each water coil. Refer to specification section 23 2118 Valves for details.

END OF SECTION 238216

SECTION 23-8413 HUMIDIFICATION EQUIPMENT

PART 1 GENERAL

1.1 REFERENCE

- A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturing company shall have five (5) years experience with application of the specified humidification/evaporative cooling system for HVAC Systems.
 - 2. Manufacturing company shall have field service support and local representation to provide continuing support of humidification/evaporative cooling system.
- B. Codes and Standards:
 - 1. UL and NEMA Compliance: Provide electrical components required as part of evaporative cooling system, which are listed and labeled by UL and comply with NEMA Standards.
 - 2. Provide electrical control panels assembled and labeled in UL qualified facility.
 - 3. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of evaporative cooling system.
 - 4. International Mechanical Code and State Mechanical Code Rules.

1.3 SUBMITTALS

- A. Shop drawings including, but not limited to, the following:
 - 1. Manufacturer's name and model number
 - 2. Identification as referenced in the documents
 - 3. Capacities/ratings
 - 4. Materials of construction
 - 5. CV of control valves
 - 6. Absorption distances
 - 7. Dimensions
 - 8. All other appropriate data
 - 9. Electrical data and wiring diagrams for electric type humidifiers
 - 10. Maintenance data
 - 11. All other appropriate data
 - 12. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating pipe routing, nozzle locations, solenoid valves, dimensions, weight loadings, required clearances, and methods of assembly of components.

1.4 WARRANTY

- A. Provide one (3) year manufacturers warranty for replacement of defective parts and one (1) year contractor's warranty for installation of replacement parts.

PART 2 PRODUCTS**2.1 STEAM HUMIDIFIERS**

- A. Manufacturers: Pure Humidifier Co., Armstrong, Dri-Steem, or Nortec
- B. Unit shall be of steam jacketed manifold type, providing clean, dry steam humidification without condensate drip or objectionable steam noise.
- C. Furnish unit complete with control valve, inlet strainer, inverted bucket trap or F & T trap according to manufacturer's recommendation. All valves and specialties shall be stainless steel.
- D. Humidifiers shall be designed for complete absorption of steam within 18" inches of distribution grid.
- E. Provide temperature switch to prevent humidifier from operating before start-up condensate is drained.
- F. Provide multiple dispersion tubes where indicated or required for uniform steam distribution.
- G. Steam Control Valve:
 - 1. Control valve shall be normally closed modulating type with equal percentage flow characteristic from closed to approximately 30% open and linear flow characteristic above 30% open. Valve trim shall be stainless steel and designed to resist erosion of seat and plug. Refer to Section 23-0902 for actuator requirements.
 - 2. Control valve full capacity shall not exceed scheduled humidifier capacity by more than 20%. Control valve rangeability (ratio of maximum controllable flow to minimum controllable flow) shall be tested in accordance with ISA 575.11 flow characteristic standards and shall be 10:1 minimum.
- H. Humidifier Dispersion
 - 1. Steam dispersion panel similar to DriSteem Ultra-Sorb:
 - a. Factory-assembled steam dispersion panel shall include the following components:
 - 1) Steam supply header/separator
 - 2) Condensate collection header
 - 3) Steam dispersion tubes spanning distance between two headers
 - b. Each dispersion tube shall be fitted with steam discharge tubelets inserted into tube wall. Each tubelet shall be made of thermal-resin material designed for high steam temperatures. Two rows of tubelets in each dispersion tube shall discharge steam in diametrically opposite directions, perpendicular to airflow.
 - c. Each tubelet shall extend through wall of and into center of dispersion tube and contain steam orifice sized for its required steam capacity.
 - d. Each packaged humidifier panel assembly of tubes and headers shall be contained within galvanized metal casing to allow convenient duct mounting, or to facilitate stacking of and/or end-to-end mounting of multiple humidifier panels in ducts or air handling unit casings.
 - e. Tubes and headers shall be 304 stainless steel and be Heli-arc welded.

PART 3 EXECUTION**3.1 STEAM HUMIDIFIERS**

- A. Mount units in air handling units as indicated on drawings. Provide additional support for distribution manifolds as recommended by manufacturer.

3.2 COMMISSIONING

- A. Refer to specification section 23 7328 Factory Fabricated Custom Air Handling Units for requirements.

END OF SECTION 238413

THIS PAGE INTENTIONALLY BLANK

SECTION 26-0519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED WORK

- A. Section 26-0000 - General Electrical Requirements
- B. Section 26-0533 - Raceway and Boxes for Electrical Systems
- C. Section 26-0533.13 - Surface Metallic Raceway System
- D. Section 26-0553 - Electrical Systems Identification
- E. Section 26 0812 Power Distribution Acceptance Tests
- F. Section 26 0813 Power Distribution Acceptance Test Tables
- G. Section 28-3116 - Multiplexed Fire Detection and Alarm Systems

1.2 REFERENCE

- A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

- A. Section includes conductors and cables rated 600 V and less, connectors, splices, and terminations rated 600 V and less, sleeves and sleeve seals for cables.
- B. Conductor and conduit sizes in these contract documents are based on copper wire, and only copper wire shall be used.

1.4 REFERENCE STANDARDS

- A. ASTM A 53/A 53M – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- B. ASTM B 1 – Standard Specification for Hand-Drawn Copper Wire.
- C. ASTM B 8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- D. NEMA WC 3 – Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-19-81).
- E. NEMA WC 5 – Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-61-402).
- F. NEMA WC 70 – Non-Shielded Power Cable 2000 V or less for the Distribution of Electrical Energy (ICEA S-95-668).
- G. NFPA 70 – National Electrical Code.
- H. UL 44 – Thermoset-Insulated Wires and Cables.

- I. UL 83 – Thermoplastic-Insulated Wires and Cables.
- J. UL 486A-486B – Wire Connectors.
- K. UL 486C – Splicing Wire Connectors.
- L. UL 486D – Standard for Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.
- M. UL 486E – Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation.
- C. Test Reports: Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.
- D. Closeout Submittals:
 - 1. Project Record Documents:
 - a. Record actual locations of components and circuits.
 - 2. Operation and Maintenance Data:
 - a. Include manufacturer’s recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with NFPA 70 for components and installation.
 - 2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.
- B. Wire and cable boxes and reels shall bear the date of manufacture.
 - 1. Date of manufacture shall not precede contract date by more than one year.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Protect from dirt, fumes, water, corrosive substances, and construction debris.

1.8 WARRANTY

- A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.
- B. Manufacturer shall provide standard 1 yr warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 PRODUCTS**2.1 MANUFACTURERS**

- A. American Insulated Wire Corp.; a Leviton Company
- B. General Cable Corporation
- C. Senator Wire & Cable Company
- D. Southwire Company
- E. VFD Cable: Aetna Insulated Wire, Americable, General Cable, Southwire

2.2 DESCRIPTION

- A. NEMA WC 70; single copper conductor insulated wire; 600V rated insulation; 90°C maximum operating temperature for dry and wet or damp locations.
 - 1. Thermoplastic-insulated wires and cables: NEMA WC 5, UL 83; Type THHN, THWN, THHW.
 - 2. Thermoset-insulated wires and cables: NEMA WC 3, UL 44; Type XHHW-2.
- B. VFD Cable:
 - 1. Cable
 - a. 600V/2000V rated, high stranded tinned copper conductors, shielded, engineered for use with Variable Frequency Drives.
 - b. Insulation shall be rated for 90 degrees Celsius Wet/Dry operating temperature.
 - 2. Conductors
 - a. Conductor shall be annealed fine wire flexible high strand count tinned copper or standard Class B stranded bare copper.
 - b. Three (3) phase conductors, three (3) ground conductors. Each of the three ground conductors shall be the same size as the single ground conductor shown on the drawings.
 - 3. Insulation
 - a. Flame-Retardant Cross-Linked Polyethylene.
 - b. Conductors shall be cabled together. Ground conductors shall be symmetrical. Fillers shall be included as necessary to make the cable round.
 - 4. Shielding
 - a. The following are acceptable:
 - 1) Overall tinned copper braid plus aluminum/polyester tape foil, 100% coverage.
 - 2) 5mil helically applied copper tape.
 - 3) Impervious corrugated welded continuous armor.
 - 5. Jacket
 - a. Flame-retardant Thermoplastic, suitable for 90°C use.
 - 6. Termination Kit
 - a. Pre-sized and pre-formed specifically for VFD cable constructions. Obtain from VFD cable manufacturer.

2.3 REMOTE CONTROL AND SIGNAL CIRCUITS

- A. Class 1

1. Copper conductor, single insulated wire.
 2. Insulation type THHN, THHW rated 90°C, 600 V insulation class.
 3. Type XHHW-2 for ambient temperature less than 32°F.
 4. UL 83 listed, ASTM B 1 for solid conductors; ASTM B 8 for stranded conductors.
- B. Classes 2 and 3
1. Copper conductor, multiple twisted conductors covered with an overall non-metallic jacket unless otherwise noted.
 2. Insulation type XLE, rated 105°C, 300 V insulation class.
 3. UL listed for use in space in which circuits will be installed.

2.4 CONNECTORS, SPLICES, AND TERMINALS

- A. Manufacturers:
1. AFC Cable Systems, Inc.
 2. Burndy Division of Hubbell Incorporated
 3. Hubbell Power Systems, Inc.
 4. Ideal Industries, Inc.
 5. O-Z/Gedney; EGS Electrical Group LLC.
 6. 3M; Electrical Products Division
 7. Thomas and Betts Division of ABB
 8. Tyco Electronics Corp.
- B. Description: UL 486A-486B, UL 486C, UL 486D, UL 486E; factory-fabricated connectors, splices, and terminals of size, ampacity rating, material, type, and class for application and service indicated.

2.5 TERMINATIONS

- A. Compression set, bolted or screw type lug, or direct to bolted or screw type terminal.

2.6 PLASTIC CABLE TIES

- A. Nylon or approved; locking type; metallic ties not permitted.

PART 3 EXECUTION

3.1 INSTALLATION OF CONDUCTORS AND CABLES

- A. Install conductors in a raceway system, unless otherwise specified or indicated.
- B. Install conductors only after:
1. Building interior is enclosed and weather tight
 2. Mechanical work likely to damage conductors has been completed
 3. Raceway installation is complete and supported
- C. Pull conductors into raceway at same time.
- D. Neatly train and lace conductors with non-metallic ties inside boxes, equipment, and panelboards .
1. Metallic ties not permitted.

- E. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- F. 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.
 - 1. Lubricants shall be UL listed
- G. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- H. Provide adequate support for conductors not in raceway. Do not support conductors from ceiling grid or from accessible ceiling support systems.
- I. Support conductors in vertical raceways using OZ type "S" cable supports for 600 volt conductors.
- J. Support conductors above 600 volts in vertical raceways using OZ type "R" cable supports.
- K. Identify conductors and cables according to Section 26 0553 - Electrical Systems Identification.
- L. Color code power wiring as follows:
 - 1. 208Y/120 volt, 3-phase, 4 wire: phase A-black, phase B-red, phase C-blue, neutral-white ground conductor-green.
 - 2. 480Y/277 volt, 3-phase, 4 wire: phase A-brown, phase B-orange, phase C-yellow, neutral-gray ground conductor-green.
- M. Wiring at Outlets: Install conductor at each outlet, with minimum 12" of slack.
- N. Limit conduit fill to a maximum of 9 current-carrying conductors.
- O. Install stranded conductors where conductors terminate in crimp type lugs. Do not place bare stranded conductors directly under terminal screws.
- P. Install VFD input wiring, output wiring and control wiring in their own separate conduit systems.

3.2 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders and Branch Circuits: Solid #12 AWG and smaller; stranded for #10 AWG and larger.
- B. Minimum conductor sizes shall be as follows:
 - 1. #12 AWG – Branch circuits of any kind.
 - 2. #14 AWG – Remote control and signal systems, fire alarm system.
 - 3. #10 AWG - Exit light circuits, emergency circuits, security lighting
- C. Branch wiring length limitations:
 - 1. 208Y/120 V circuits over 100' in length: Increase wire size one size for each 100' of length. Increase conduit size as required.

3.3 CONDUCTOR INSULATIONS AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Feeders: Type THWN, XHHW, rated 75°C, or 90°C rated cable sized at 75°C rating for connection to 100% rated devices. Single conductors in raceway.

- B. Branch Circuits: Type THHN, XHHW-2, rated 90°C for dry and wet or damp locations, single conductors in raceway.
- C. Motor Circuit Branch Wiring Between Motor and VFD: **VFD Cable**
 - 1. Terminate VFD cable using pre-sized and pre-formed termination kits supplied by cable manufacturer. Install per manufacturer's recommendations.

3.4 REMOTE CONTROL AND SIGNAL CIRCUITS

- A. Sizing – #14 AWG minimum.
- B. Installation:
 - 1. Install cables in cable tray and cable rings.
 - 2. Provide protection for exposed cables where subject to damage.
 - 3. Support cables above accessible ceilings; do not rest on ceiling tiles.
 - 4. Use suitable cable fittings and connectors.

3.5 CONNECTORS, SPLICES AND TERMINALS

- A. Connectors:
 - 1. Aluminum and aluminum alloy connectors are not allowed to be used.
 - 2. Except where equipment is furnished with bolted or screw type lug, use compression set pressure connectors with insulating covers. Use compression tools and die compatible with connectors being installed.
 - 3. 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.
 - 4. Joints, taps and splices sizes No. 10 and smaller:
 - a. Ideal-Nut Connectors or Scotchlok Spring connectors
 - 5. Joints, taps and splices sizes No. 8 and larger:
 - a. Copper compression connectors
 - 1) Install with hydraulic compression tool.
 - 6. Joints, taps and splices sizes larger than No. 1:
 - a. Tape with electrical tape to build up insulation level equivalent to cable insulation and cover with not less than two half lapped layers of plastic electrical tape.
- B. Splices:
 - 1. Splice wires and cable only in accessible locations such as within junction boxes.
 - 2. Make splices to carry full capacity of conductors with no perceptible temperature rise.
 - 3. Splices are to be made with compression barrel connector where no taps exist or allowance for future taps is being made.
 - 4. Where the splice includes provisions for taps, use Burndy insulated Unitap. Locate in pull or junction box sized for all conductors to be spliced and tapped.
 - 5. Make below-grade splices in manholes and handholes watertight with pre-stretched or heat-shrinkable insulating tubing, or resin-filled insulator.
 - 6. Use electrical tape to build up insulation level equivalent to cable insulation and cover with not less than two half-lapped layers of plastic electrical tape, for joints, taps, and splices of #1 AWG conductors and larger.
 - 7. Plastic snap-on or piercing type mechanical splice insulators are not allowed.

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

C. Terminals:

1. All terminals are to be compression type.
2. Train wires to eliminate fanning of strands, crimp with proper tool and die.
3. Insulate ends of spare conductors with electrical tape and identify spare circuit number where appropriate.
4. Eye type crimped terminal for removable screw type terminal. Forked torque terminal when screw terminal cannot be removed.
5. Torque screw termination per manufacturer's recommended values.
6. Terminate motor connections using the following methods:
 - a. 300V and below: Use compression-set, insulated eye terminal for screw lug connections or barrel type cable to cable connections.
 - b. Above 300V: Use 3M 5300 series insulated motor lead splicing kit.

3.6 CABLE TIES

- A. Neatly bundle conductors and cables together for support. Size cable ties sufficiently to accommodate the multiple cables being supported.

3.7 FIELD QUALITY CONTROL

- A. Testing by Testing Agency.
- B. Acceptance testing of 600 volt conductors and cables shall be per requirements in Sections 26 0812 – Power Distribution Acceptance Tests and 26 0813 – Power Distribution Acceptance Test Tables.
- C. Perform electrical acceptance testing on 600-volt feeders serving panelboards, switchboards and secondary voltage service entrance equipment.
 1. Acceptance testing shall include the following:
 - a. Verify tightness of accessible bolted connections.
 - b. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors.
 - 1) Applied potential to be 1000 volts DC for one minute
 - 2) Minimum insulation resistance shall be 50 megohms
 - 3) Correct deviations between adjacent phases and values below minimum
 - c. Perform continuity test to insure correct cable connection.
- D. Replace conductors and cables that are found defective, at no expense to Owner.

END OF SECTION 260519

THIS PAGE INTENTIONALLY BLANK

SECTION 26 0533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED WORK

- A. Section 26 0519 – Low-Voltage Electrical Power Conductors and Cables
- B. Section 26 0526 – Grounding and Bonding for Electrical Systems
- C. Section 26 0529 – Hangers and Supports for Electrical Systems
- D. Section 26 0553 – Electrical Systems Identification
- E. Section 26 0593 – Electrical Systems Firestopping
- F. Section 26 2726 – Wiring Devices
- G. Related sections in other Divisions of Work:
 - 1. Section 27-0528.33 - Raceway and Boxes for Communications Systems

1.2 REFERENCE

- A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

- A. Section includes raceways, fittings, wireways, outlet boxes, pull and junction boxes, floor boxes, and raceway seals.

1.4 REFERENCE STANDARDS

- A. ANSI/NECA 1 – Standard Practices for Good Workmanship in Electrical Contracting
- B. ANSI C80-1 – Rigid Steel Conduit-Zinc Coated (GRS)
- C. ANSI C80-3 – Electrical Metallic Tubing-Zinc Coated (EMT)
- D. ANSI C80-6 – Intermediate Metal Conduit-Zinc Coated (IMC)
- E. ASTM A 53/A 53M – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- F. ETL PVC-001 – Intertek ETL SEMKO High Temperature H²O PVC Coating Adhesion Test Procedure for 200hrs.
- G. NEMA 250 – Enclosures for Electrical Equipment (1000 V Maximum)
- H. NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
- I. NEMA OS 1 – Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
- J. NEMA TC 2 – Electrical Polyvinyl Chloride (PVC) Conduit
- K. NEMA TC 3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing

- L. NFPA 70 – National Electrical Code
- M. UL 1 – Flexible Metal Conduit
- N. UL 6 – Electrical Rigid Metallic Conduit-Steel
- O. UL 360 – Liquid-Tight Flexible Steel Conduit
- P. UL 514A – Metallic Outlet Boxes
- Q. UL 514B – Conduit, Tubing, and Cable Fittings
- R. UL 651 – Schedule 40 and 80 Rigid PVC Conduit and Fittings
- S. UL 797 – Electrical Metallic Tubing-Steel
- T. UL 870 – Wireways, Auxiliary Gutters, and Associated Fittings
- U. UL 1242 – Electrical Intermediate Metal Conduit-Steel
- V. UL 1660 – Liquid-Tight Flexible Nonmetallic Conduit
- W. BICSI – Telecommunications Reference Manual (TDMM), Latest Edition
- X. University of Kentucky - Communications and Network Systems – Telecommunications Standards

1.5 SUBMITTALS

- A. Product Data:
 - 1. Raceways
 - 2. Fittings
 - 3. Wireways
 - 4. Outlet boxes
 - 5. Pull and junction boxes
 - 6. Raceway seals
- B. Manufacturer’s Installation Instructions:
 - 1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.
- C. Closeout Submittals:
 - 1. Project Record Documents:
 - a. Record actual routing of raceways 2” and larger.
 - b. Record actual location and mounting heights of wireways, indoor service poles, floor boxes, tap boxes, outlet, pull and junction boxes.
 - 2. Operation and Maintenance Data:
 - a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
 - b. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with NFPA 70.

2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris, and traffic.
- B. Protect PVC conduit from sunlight.
- C. Comply with manufacturer's written instructions.

1.8 WARRANTY

- A. Manufacturer shall provide standard one-year written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 PRODUCTS

2.1 RIGID METAL CONDUIT (RMC)

- A. Rigid Steel Conduit (RSC): ANSI C80.1, UL 6; heavy wall galvanized steel.
- B. Intermediate Metal Conduit (IMC): ANSI C80.6, UL 1242; thinner wall, galvanized steel.
- C. Fittings (couplings, conduit bodies, connectors and bushings): NEMA FB 1, UL 514B; steel; threaded; connectors with double locknuts and steel insulating bushings; conduit body cover: stamped steel, with stainless steel screws and neoprene gaskets.
- D. Fittings Manufacturers: Cooper Crouse-Hinds; Carlon Electric Products; O-Z/Gedney; Appleton; Hubbell; Robroy Industries – Perma-Cote.

2.2 ELECTRICAL METALLIC TUBING (EMT)

- A. ANSI C80.3, UL 797; galvanized steel tubing
- B. Fittings (couplings, conduit bodies, and connectors): NEMA FB I, UL 514B; steel, watertight gland compression type connectors with double locknuts and insulated throat; conduit bodies cover: stamped steel, with stainless steel screws and neoprene gaskets. Indentor, drive-on, die-cast or pressure cast fittings not permitted.
- C. Fittings Manufacturers: Same as manufacturers listed in 2.1.D.

2.3 FLEXIBLE METAL CONDUIT (FMC)

- A. UL 1; interlocked steel
- B. Fittings: NEMA FB I, UL 514B; steel, squeeze-type (screw on are not acceptable)

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. UL 360; interlocked steel, with PVC jacket
- B. Fittings: Waterproof, NEMA FB 1, UL 514B; steel

2.5 OPTICAL FIBER CABLE RACEWAY AND FITTINGS

- A. Per requirements in Division 27.

2.6 METAL WIREWAYS

- A. NEMA 250, UL 870; galvanized sheet metal troughs with hinged or removable cover, Type 1 for indoor and 3R for outdoor, unless otherwise indicated.
- B. Size: Length as indicated on drawings.
- C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mated with wireways as required for complete system.
- D. Wireways Covers: Hinged type or as indicated.
- E. Knockouts: Manufacturer's standard.
- F. Finish: Manufacturer's standard enamel finish
- G. Manufacturers: Cooper B-Line, Hoffman, Square D Co.

2.7 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, UL 514A; galvanized steel with stamped knockouts.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; 1/2" male fixture studs, where required
 - 2. Concrete Ceiling Boxes: Concrete type
 - 3. Communications outlet boxes:
 - 1) Back Box: 5" square, 2-7/8" deep.
 - 4. Plaster ring: Match depth to provide flush faceplates.
- B. Cast-Metal Outlet Boxes: NEMA FB 1, cast aluminum or cast iron (galvanized), Type FD, with gasketed cover and threaded hubs
- C. Nonmetallic Outlet Boxes: NEMA OS 2
- D. Gangable type boxes are not allowed
- E. Manufacturers: O-Z/Gedney; Raco; Cooper Crouse-Hinds

2.8 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1; galvanized steel
- B. Cast-Metal, Pull, and Junction Boxes: NEMA FB 1; galvanized, cast iron with ground flange, gasketed cover and stainless steel cover screws
- C. Minimum size: 4" square by 2-1/8" deep for use with 1" conduit and smaller; 4-11/16" square by 2-1/8" for use with 1-1/4" conduit and larger
- D. Sheet Metal Boxes Larger Than 12" in any direction: Hinged cover or a chain installed between box and cover
- E. Field-fabricated boxes not allowed without prior approval of local authority having jurisdiction.
- F. Manufacturers: O-Z/Gedney; Raco; Cooper Crouse-Hinds; Hubbell-Weigmann; Hoffman; J&A Sheet Metal Inc. Austin Electrical Enclosures

2.9 B.A.S. HORIZONTAL CONNECTION POINT (HCP) BOXES

- A. BID ALTERNATE FOR B.A.S. CABLING ARCHITECTURE.
- B. Ceiling enclosure for BAS wiring blocks.
- C. Manufacturer: Chatsworth Products A1222-LP or approved equivalent.

2.10 EXPANSION FITTINGS

- A. Malleable iron, hot dip galvanized allowing 4" allowing 2" raceway movement.
- B. Manufacturers: OZ/Gedney AX Series; or equivalent by manufacturer listed in 2.1.D.

2.11 RACEWAY PENETRATION SEALS

- A. Thruwall and Floor Seals.
- B. Manufacturers: New construction – OZ/Gedney FSK Series; existing construction – OZ/Gedney CSM Series; or equivalent by manufacturer listed in 2.1.D.

2.12 RACEWAY SEALING FITTINGS

- A. For one through four conductors: Manufacturers: OZ/Gedney CSB Series
- B. For greater than four conductors: Manufacturers: OZ/Gedney EYA Series with sealing compound
- C. Low-temperature or hazardous locations: Manufacturers: OZ/Gedney EYA Series with sealing compound

2.13 CABLE SUPPORTS

- A. Manufacturers: OZ/Gedney Type S; or equivalent by manufacturer listed in 2.1.D.

2.14 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends, with integral water stop.
- B. Integral Water Stop: Manufacturer: Thunderline Corporation
 - 1. High density polyethylene (HDPE). Type Century-Line engineered sleeve with end caps.
 - 2. Steel. Type WS engineered sleeve.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052" or 0.138" thickness and of length to suit application.

2.15 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 EXECUTION**3.1 GENERAL**

- A. Division 27 Contractor shall provide all Division 27 pathway infrastructure as specified and shown on plans, including but not exclusive to back boxes, conduits, pull boxes, cable trays, surface raceways, and floor boxes.

3.2 COORDINATION

- A. Coordinate with Architect/Engineer size and location of required built-in openings in building structure, including those sleeved, formed or core drilled.
- B. Coordinate with Architect/Engineer cutting, removing, or piercing general or mechanical insulation, fire-rated walls, ceilings or steelwork.
- C. Verify with Architect/Engineer all surface raceway installations except in mechanical, electrical, and communications rooms.
- D. Coordinate with Architect/Engineer exact locations of floor boxes, where shown on drawings, prior to rough-in.
- E. Coordinate routing of any through-wall or through-roof conduits.
- F. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0593 – Electrical Systems Firestopping.
- G. Verify that exterior wall or wet location boxes are gasketed type cast boxes with matching cover.
- H. Verify with manufacturer that “touch-up” paint kit are available for use.
- I. Coordinate locations of Communications boxes, Nurse Call Boxes, B.A.S. Horizontal Connection Points with Owner, B.A.S. vendor, and architect prior to beginning work.

3.3 EXAMINATION

- A. Examine surfaces to receive raceways and boxes for compliance with installation tolerances and other conditions affecting performance of raceway’s installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.4 INSTALLATION

- A. Raceways:
 - 1. Comply with ANSI/NECA 1 and NFPA 70 for installation requirements applicable to products specified in Part 2 except where requirements on drawings or in this Section are stricter.
 - 2. Arrange raceways to maintain headroom and present neat appearance.
 - 3. Raceway routing is shown in approximate locations, unless dimensioned. Route to complete raceway installation before starting conductor installation.
 - 4. Keep raceways at least 12” away from parallel runs of fuels, steam, hot-water pipes or ductwork. Install horizontal raceway runs above water and steam piping. Install raceways level and square and at proper elevations: 6’-6” minimum headroom, except in exit pathways 7’-0” minimum headroom. Do not block access to junction boxes, mechanical equipment or prevent removal of ceiling panels, etc.
 - 5. Run raceways concealed in construction to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid materials and equipment of other trades, except where noted otherwise.
 - 6. Avoid exposed raceway runs. Run raceways exposed where impractical or impossible to conceal or where specific approval is obtained. Run exposed raceways grouped and parallel or perpendicular to

construction. Do not route exposed raceways over boilers or other high-temperature machinery or in contact with such equipment. Offset exposed raceways at boxes.

7. Route raceways installed above accessible ceilings parallel or perpendicular to construction.
8. Cut raceways square using saw or pipecutter.
9. Use hydraulic one-shot raceway bender or factory elbows for bends in raceway larger than 1", unless sweep elbows required. Bend raceways according to manufacturer's recommendations. Do not use torches or open flame to aid in bend of PVC conduit.
10. Use raceway fittings compatible with raceways and suitable for use and environment.
11. Provide bushings on all raceways.
12. Raceways minimum sizes:
 - a. Minimum raceway size 3/4", except as noted on drawings.
 - b. Minimum home run size: 1", except as noted on drawings.
 - c. Minimum size for flexible metal conduit is 3/4" except 1/2" for under-cabinet lights.
 - d. Minimum size for liquidtight flexible metal conduit is 3/4".
13. All Communications pathway shall be sized for 40% maximum fill, including 50% future growth.
14. Install empty raceways 2-1/2" and larger with No. 10 galvanized fishwire; install nylon pull cord in raceways smaller than 2-1/2"; leave at least 12" of slack at each end of pull wire.
15. Feed devices on same wall vertically from above or junction box in suspended ceiling.
 - a. No horizontal conduit is to be installed between or above junction boxes in walls for any boxes.
 - b. Do not install horizontal bends in conduit around corners.
16. Feed devices in exterior or load-bearing walls by horizontal conduit runs. Install horizontal conduit runs from device to device on same wall. Do not install horizontal bends in conduit around corners. Feed devices on same wall vertically from above or junction box in suspended ceiling.
17. Raceways Supports:
 - a. Independently support or attach raceway system to structural parts of construction. Suspended ceiling systems shall not be considered as structural parts of construction for raceway support. Do not attach raceways to piping system.
 - b. Raceway supports for horizontal or vertical single runs:
 - 1) Hot dipped galvanized heavy-duty sheet steel straps, mineralac clamps or steel slotted support channel system with appropriate components.
 - 2) Spring steel type pressure clamps for raceways 3/4" and smaller.
 - c. Raceway supports for horizontal and vertical multiple runs:
 - 1) Trapeze-type supports fabricated with steel slotted channel systems with appropriate components.
 - 2) Support horizontal runs with appropriately sized rods.
 - 3) Anchor vertical runs to structure.
 - 4) Spring-steel type pressure clamps for raceways 3/4" and smaller.
 - d. Vertical raceway runs passing through floors: Support at each floor with pipe riser clamps.
 - e. Do not support raceways with wire, perforated pipe straps or plastic tie-wrap. Remove wires used for temporary support.
 - f. Secure raceways in metal stud walls to prevent rattling.
 - g. Arrange raceway supports to prevent misalignment during wiring installation.
 - h. Do not fasten raceways to corrugated metal roof deck.
 - i. For fasteners and supports, including steel slotted support systems, support devices, support spacing, support of conductors in vertical raceways, and hanger rod size, refer to Section 26 0529 – Hangers and Supports for Electrical Systems and NFPA 70.
18. Identify raceways per requirements in Section 26 0553 – Electrical Systems Identification.

19. Ground raceways per requirements in Section 26 0526 – Grounding and Bonding for Electrical Systems.
 20. Flexible Conduit Connections: Use maximum of 72” of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - a. Use LFMC for connections to vibrating equipment.
 - b. Use LFMC in damp or wet locations subject to severe physical damage.
 - c. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
 - d. Use flexible metallic tubing in plenum spaces.
 21. Install stainless steel raceway clamps, mounting hardware, supports, hangers, etc., when located in wet areas.
 22. Power and Communications Raceways: Minimum 12” separation when run parallel, cross perpendicular.
 23. LB type junction boxes are prohibited in all conduits 1-1/4” or less. Use of LB junction boxes in conduits larger than 1-1/4” require approval by Medical Center Physical Plant division project representative prior to installation.
 24. Communications Raceway Requirements:
 - a. All Communications raceways shall conform to industry, BICSI, and UK-CNS standards.
 - b. All voice, data, video wiring inside rooms shall be protected by metallic conduit or other means such as surface raceway or in-floor troughs.
 - c. Bond conduits to cable tray to provide grounding continuity.
 - d. No more than an equivalent of 180 degrees of bend, including offsets, are allowed in a conduit run between junction boxes or pull boxes.
 - e. No “LBs” are allowed.
 - f. Pull boxes shall be provided in conduit runs longer than 100 feet.
 - g. Maximum individual conduit run including a pull box shall not exceed 150 feet.
 - h. All EMT fittings shall be compression type on conduits less than 2-1/2” in diameter.
 - i. Conduits ending at a cable tray shall have plastic bushings and be bonded to the tray.
 - j. Conduits terminating within a Communications room shall have plastic bushings and be bonded to the telecommunication grounding bus bar located in that room.
 - k. Each horizontal communications conduit shall be home-run to the nearest cable tray. No device to device conduit runs are allowed.
 - l. Communications conduit bend radii shall be:
 - 1) Six (6) times the internal conduit diameter for conduit 2" or less internal diameter.
 - 2) Ten (10) times the internal conduit diameter for conduit greater than 2" internal diameter.
 - m. Conduit bends shall be smooth, even, and free of kinks or other discontinuities that may have detrimental effects on pulling tension or cable integrity during or after installation.
- B. Wireways:
1. Install in accordance with manufacturer’s instructions.
 2. Use screws, clips and straps to fasten raceway channel to surfaces.
 3. Mount plumb and level.
 4. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
 5. Supports: Per manufacturer’s recommendations.
 6. Close ends of raceway channel and unused conduit openings.
- C. Boxes:

1. Install boxes to accommodate device indicated by symbol, in conformance with code requirements, number and size of conductors and splices and consistent with type of construction.
2. Install boxes to accommodate minimum Communications cable bend radii and service loop lengths.
3. Install each above-ceiling Communications outlet box for immediate accessibility after all trades are installed.
4. Install the appropriate cover on surface-mounted boxes:
 - a. Raised device covers on 4" square and 4-11/16" boxes and handy box covers on handy boxes, etc.
 - b. Device covers that are square drawn or square cut on boxes in block.
 - c. Tile covers on boxes in tile.
 - d. Round drawn device covers on boxes in lath and plaster walls or dry wall only.
 - e. Set front edge of device boxes flush with finished wall surfaces except on walls of non-combustible materials where boxes may have maximum set back of 1/4". Secure flush-mounted box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
5. Set outlet boxes parallel to construction and independently attached to same.
6. Do not install back-to-back and through-the-wall boxes. Install with minimum 6" horizontal separation between closest edges of the boxes. Install with minimum 24" separation in acoustic-rated walls and fire-rated walls.
 - a. All boxes installed in acoustic-rated walls shall be installed with acoustic putty pads.
7. Conduit penetrations plus inset boxes for panels, receptacles, or other functions shall not derate acoustical integrity of acoustical demising partitions. Provide acoustical sealant or resilient fire caulking for penetrations.
8. Install multi-ganged boxes where 2 or more devices are in same location, unless otherwise noted.
9. Box Support:
 - a. Mount boxes straight.
 - b. Install horizontal bracing at top or bottom of box for 3 or more gang device boxes in stud walls.
 - c. Install stud support one side, with short piece of stud, for up to 2 gang device boxes.
 - d. Do not support boxes with tie-wire.
 - e. For one and two gang box support, manufactured bracket supports shall be accepted alternate.
 - f. Support boxes independently of raceways.
 - g. Install adjustable steel channel fasteners for hung ceiling outlet box.
 - h. Install stamped steel bridges to fasten flush-mounted outlet box between studs.
 - i. Do not install boxes to ceiling support wires or piping systems.
10. Install partitions in multi-ganged boxes where different types of devices are installed, or devices installed operate at different voltages.
11. Mount boxes in block walls at block joint nearest to indicated height.
12. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
13. When boxes are installed in fire-resistive walls and partitions, provide 24" horizontal separation between boxes on opposite sides of wall. In addition, limit penetrations to 16 sq in per penetration and not to exceed a total of 100 sq in per 100 sq ft of wall area. Use FireBlok fire suppression gaskets or fire stop putty pads acceptable to the fire marshal.
 - a. Where architectural elevations require an installation that does not allow for required horizontal separation in fire-resistive walls, coordinate installation with Construction Manager.
 - 1) Boxes installed back-to-back under this condition shall be provided with fire stop putty pads.
14. Pull and junction boxes: Install as shown, or as necessary to facilitate pulling of wire and to limit number of bends within code requirements. Install above accessible ceilings and in unfinished areas.

15. Install boxes to be permanently accessible. Provide a minimum of 18" clear in front of Communications and Nurse Call pull boxes.
 16. Do not intermix conductors from more than one system in same junction box or pull box, unless shown or specifically authorized otherwise.
 17. Adjust box location up to 10' prior to rough-in to accommodate intended purpose.
 18. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726 – Wiring Devices.
 19. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6" from ceiling access panel or from removable recessed luminaire.
 20. The drawings do not necessarily show every outlet, pull or junction box required. Add all required boxes as necessary.
 21. Large junction boxes may not be used in electrical conductor conduit runs for more than 3 circuits.
- D. Expansion Fittings:
1. Install raceway expansion and deflection fittings in all raceway runs embedded in or penetrating concrete where movement perpendicular to axis of the raceway may be encountered.
 2. Use couplings and flexible connection made up of 24" length of flexible metal conduit, where EMT runs across expansion joints in ceiling spaces.
 3. Install raceway expansion fittings complete with bonding jumpers in raceway runs that cross expansion joints in structure and raceway runs mechanically attached to 2 separate structures.
 4. Install fitting(s) that provide expansion and contraction for at least 0.0004" per ft of length of straight run per °F of temperature change.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation.
- E. Raceway Penetration Seals:
1. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
 2. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Maintenance of Joint Protection" for materials and installation.
 3. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Section 26 0593 – Electrical Systems Firestopping.
 4. Roof: Install flashed and hot mopped weatherproof seal, or pitch pan filled and sealed to be weatherproof where raceway penetrates roof membrane. Install weatherhead on raceway stubups penetrating roof.
 - a. Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
 5. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1" annual clear space between pipe and sleeve for installing mechanical sleeve seals.
 6. Sleeve-Seal Installation: Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 7. Provide chrome- or nickel-plated escutcheons where raceways pass through walls, floors or ceilings and are exposed in finished areas. Size escutcheons to fit raceways for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitor's closets, storage rooms, etc., unless suspended ceilings are specified.
 8. Remove temporary sleeves, if used for form wall openings, prior to installation of permanent materials.

F. Raceway Sealing Fittings:

1. Install listed watertight seals to prevent the passage of moisture and water vapor through raceway, where raceway passes from interior to exterior of the building, where raceway passes between areas of different temperatures such as into or out of cold rooms, freezers and air handling units, where raceway enters room which at any time is subject to low or high temperatures and where raceway enters a room which at any time is subject to internal air pressures above or below normal.
2. Install watertight seals in interior of all raceways passing through building roof, ground floor slab (when the raceway does not extend beyond building footprint), or through outside walls of building above or below grade. Seal on the end inside building, using raceway sealing fittings manufactured for the purpose. Locate fittings at suitable accessible locations. For concealed raceways install each fitting in flush steel box with blank coverplate to match finish of adjacent plates or surfaces.

G. Sleeve Installation for Electrical Penetrations:

1. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0593 – Electrical Systems Firestopping.
2. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
3. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
4. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies, unless openings compatible with firestop system used are fabricated during construction of floor or wall.
5. Cut sleeves to length for mounting flush with both surfaces of walls.
6. Extend sleeves installed in floors 2" above finished floor level.
7. Size pipe sleeves to provide 1/4" annular clear space between sleeve and raceway, unless sleeve seal is to be installed.
8. Communications sleeve requirements:
 - a. Extend Communications sleeves installed in floors 6" above finished floor level.
 - b. Communications floor sleeves shall be rigid metallic conduit.
 - c. Communications floor sleeves shall have threaded bushings on both ends.
 - d. Communications floor sleeves shall be bonded to the Telecommunications grounding busbar.

3.5 APPLICATION

- A. Raceway uses permitted and not permitted per NFPA 70 requirements and as described below.
- B. Rigid Metal Conduit (RMC) permitted to be installed as follows:
 1. Installations below grade and in or under concrete slabs
 2. All locations except corrosive atmospheres
 3. Hazardous locations
 4. Locations requiring mechanical protection
 5. Stub up through slabs
- C. Intermediate Metallic Conduit (IMC) permitted to be installed as follows:
 1. Installation below grade and in or under concrete slabs
 2. All locations, except corrosive atmospheres
 3. Hazardous locations
 4. Locations requiring mechanical protection
- D. Electrical Metallic Tubing (EMT) permitted to be installed as follows:
 1. Interior partitions

2. Above suspended ceilings
 3. In concrete slabs
 4. 6 ft AFF in exposed areas of mechanical equipment rooms
 5. Exposed in areas not subject to damage
 6. Sizes 2" and smaller except as approved
- E. Flexible Metal Conduit (FMC) permitted to be installed as follows:
1. Use flexible metal conduit not over 4 ft in length for final connections for:
 - a. Final connections to recessed luminaires in lengths not to exceed 6 ft.
 - b. Connection to undercabinet lighting in lengths not to exceed 6 ft.
- F. Liquid Tight Flexible Metal Conduit (LFMC) permitted to be installed as follows:
1. Use liquid tight flexible conduit, not over 4 ft in length, for final connections to:
 - a. Vibrating equipment (including transformers and hydraulic, pneumatic, electric solenoid, or motor-driven equipment) in wet locations.
 - b. Instruments and control devices
 - c. PVC coated LFMC is not allowed in environmental air plenum spaces or air handling equipment.
- G. One-half inch raceway permitted:
1. Between controller and its control or pilot device
 2. Between lighting switch and nearest outlet for luminaire
 3. Control wiring where mounted on equipment where conduit must follow contour of equipment
 4. Protective and signal systems where noted
 5. Where shown on plans
- H. Flexible Metallic Tubing (FMT) permitted to be installed as follows:
1. Use liquid tight flexible metallic tubing, not over 6 ft in length, for final connections to:
 - a. Electrical equipment located internal to built-up air handling units within plenum spaces.

3.6 CONDUIT COLORS

- A. Conduits shall be pre-painted in the following colors for the systems identified:
- a. Life Safety Branch – Yellow
 - b. Critical Branch – Orange
 - c. Normal Branch – White
 - d. Equipment Branch – Silver
 - e. Fire Alarm System – Red
 - f. Controls – Green
 - g. Data/Communications - Blue

3.7 RACEWAY WIRING METHODS

- A. Outdoor Locations, Above Grade: Install galvanized rigid steel conduit; install cast metal or nonmetallic outlet boxes with threaded hubs.
- B. Wet and Damp Indoor Locations: Install galvanized rigid steel conduit or intermediate metal conduit; threaded conduit fittings; install cast metal or nonmetallic outlet, junction, and pull boxes with threaded hubs. Install flush mounting outlet boxes in finished areas.

- C. Concealed and Exposed Dry Locations Not Subject to Damage: Install rigid steel or intermediate metal conduit; install sheet-metal boxes; install flush mounting outlet box in finished areas; install hinged enclosure for large pull boxes.
- D. Exposed Subject to Damage: Install galvanized rigid steel conduit; threaded conduit fittings; install cast metal boxes with threaded hubs. Open public spaces such as parking garages and common areas are considered subject to damage.

3.8 FIELD QUALITY CONTROL

- A. Inspect raceway, boxes, indoor service poles, and wireways for physical damage, proper alignment, supports and seismic restraints, where applicable.
- B. Replace any damaged component of the raceway system, or install new raceway system.
- C. Inspect components, wiring, connections and grounding.

3.9 REPAINTING

- A. Repair damage to galvanized finishes with manufacturer-supplied zinc-rich paint kit. Leave remaining paint with Owner.
- B. Repair damage to paint finishes with manufacturer-supplied touch-up coating. Leave remaining coating with Owner.
- C. Wireways: remove paint splatters and other marks from surface; touch-up chips, scratches, or marred finished to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Owner.

3.10 ADJUSTING

- A. Adjust flush-mounted boxes pre-pour and after-pour to be flush with finished materials.
- B. Install knockout closures in unused openings in boxes.
- C. Align adjacent wall-mounted outlet boxes for switches and similar devices.
- D. Adjust outlet boxes to allow luminaires to be positioned as indicated on drawings.

3.11 CLEANING

- A. Clean interior and exterior of boxes, wireways, and indoor poles to remove dust, debris and other material.

3.12 LABELING

- A. All labeling shall comply with the published labeling UKPPDMC standard.
- B. Stencil systems pull boxes:
 - 1. Nurse Call as “NURSE CALL”
 - 2. Communications as “COMM”

END OF SECTION

LEFT BLANK

SECTION 26-2726 WIRING DEVICES

PART 1 GENERAL

1.1 RELATED WORK

- A. Section 26-0000 - General Electrical Requirements
- B. Section 26-0519 - Low-Voltage Electrical Power Conductors and Cables
- C. Section 26-0526 - Grounding and Bonding for Electrical Systems
- D. Section 26-0533 - Raceway and Boxes for Electrical Systems
- E. Section 26-0923 - Lighting Control Devices
- F. Section 26-5100 - Interior Lighting

1.2 REFERENCE

- A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION OF SYSTEM

- A. Provide devices such as switches, receptacles, plates, etc., as shown on drawings and specified.
- B. Openings shall be covered with either devices and matching plates, solid blank plates or blank plates with bushed opening.
- C. Devices shall be installed plumb, tight to wall surfaces and free of scratches or blemishes.
- D. Devices of same type shall be from same manufacturer, unless otherwise noted
- E. All receptacles in this project shall be hospital grade.

1.4 REFERENCE STANDARDS

- A. Federal Spec. W-C-596F Federal Specifications for Electrical Power Connections
- B. Federal Spec. W-S-896-E Federal Specifications for Endurance Testing
- C. ANSI NEMA WD-6 Wiring Devices - Dimensional Requirements
- D. NEMA WD-1 General Color Requirements for Wiring Devices
- E. UL 20 - General Use Snap Switches
- F. UL 94V2 - Flammability Testing
- G. UL 498 - Attachment Plugs and Receptacles
- H. UL 505 - Motor Starter Switches
- I. UL 943 - GFCI's 2003
- J. UL 1449 - Surge Suppression Devices

1.5 SUBMITTALS

- A. Submit shop drawings for equipment provided under this Section.
- B. Plate samples.
- C. Weatherproof cover plate samples.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Cooper (Arrow Hart, Eagle), Hubbell-Bryant, Leviton, Pass & Seymour.

2.2 FABRICATION AND MANUFACTURER

- A. Switches:
 - 1. Toggle:
 - a. 20 Ampere, 120-277 Volt AC, quiet type.
 - b. Ivory [Match other devices in area] colored.
 - c. Heavy duty toggle
 - d. Industrial-Institutional, heavy-duty specification grade
 - e. Color-coded face to indicate ampere rating
 - f. Heavy gage steel mounting strap
 - g. Green Ground terminal
 - h. Silver alloy contacts
 - i. Motor rated for 1 HP
 - 2. Keyed:
 - a. Meet requirements of Toggle switch
 - b. Provide 5 key for each switch
 - c. Provide switches keyed cam lock to building master systems.
 - 3. Pilot light:
 - a. 20 Ampere, 120-277 Volt, AC
 - b. Red handle
 - 4. Interchangeable type:
 - a. 20 Ampere, 120-277 Volt, AC
 - b. Mullion mounting only
 - c. Provide with back box
- B. RECEPTACLES
 - 1. Duplex
 - a. Hospital Grade
 - b. 2 pole, 3 wire grounding
 - c. Separate ground screw
 - d. 20 Ampere, 125 Volt, NEMA 5-20R configuration
 - e. Ivory colored
 - f. Solid 1-piece brass mounting strap with integral ground contacts

- g. RED bodies on Emergency or Standby power
 - h. Impact resistant thermoplastic face
 - i. Switched receptacles shall have upper half switched and lower half not switched.
- 2. Ground Fault Circuit Interrupter (GFCI):
 - a. Meet requirements of duplex in addition to:
 - 1) 20 Ampere, 125 Volt
 - 2) NEMA 5-20R configuration
 - 3) Trip level 4 to 6 mAmpere
 - 4) Trip time .025 seconds nominal
 - 5) Feed-through design to protect downstream devices on circuit.
 - 6) Reverse line-load function to prevent GFCI from functioning if wired incorrectly
- 3. USB Charging:
 - a. UL-498 and UL-1310 listed
 - b. Two USB 2.1 Amp or 3.0 Amp, 5VDC charging ports in addition to two 120V, 20A NEMA 5-20R outlets in one single gang device.
 - c. LED indicator for notification of USB port connection.
 - d. Auto-grounding connection type.
- 4. Locking type
 - a. Meet requirements of duplex in addition to:
 - 1) Back or side wired
 - 2) Accept up to #8 AWG
 - 3) Contact spring shall be 1 piece, no rivet construction
 - 4) Body of device shall be high temperature glass reinforced nylon, suitable for 140°C/284°F continuous use.
 - 5) Meet UL 175 C.T.I. test
 - 6) Configuration stamped on the face
 - 7) 20 and 30 Amp receptacle shall have 1.55" boss diameter
- 5. Hospital Grade:
 - a. Duplex
 - 1) Meet requirements of duplex in addition to:
 - a) UL insertion test
 - b) Green dot on face
 - c) 20 Ampere, 125 Volt
 - d) NEMA 5-20R configuration
 - e) High-impact and chemical resistant face
 - f) Nickel plated brass strap
 - b. Ground Fault Circuit Interrupter (GFCI):
 - 1) Meet requirements of Hospital Grade Duplex and GFCI in addition to:
 - a) 20 Ampere, 125 Volt
 - b) NEMA 5-20R configuration

C. WALL PLATES

- 1. Unbreakable Thermoplastic.
- 2. Color: Ivory

3. Emergency or Standby power shall be RED with the word "EMERGENCY" engraved or stamped in 1/4", white letters.
4. Locking cover:
 - a. Hinged steel cover with cylinder loc
 - b. Motor locking cover with padlock capability
- D. Tamper Resistant:
 1. Impact resistant thermoplastic
 2. Slide cover over receptacle
- E. Weatherproof covers:
 1. Receptacle:
 - a. Weatherproof when receptacle is in use
 - b. Cast aluminum
 - c. Suitable for type of box to be covered
 2. Switch:
 - a. Cast aluminum lift plate

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install devices at heights scheduled, and as indicated on drawings.
- B. Install duplex wall receptacles vertically with ground contacts up except where shown otherwise or where space problem occurs.
- C. Indicated dimension are to centerline of device.
- D. Install lighting switches vertically on latch side of door within 6" of frame edge.
- E. Install devices back box 2" above countertop, backsplash or fixed cabinet to bottom of back box.
 1. Install devices at same height above 1 countertop, backsplash or fixed cabinet.
- F. Verify locations prior to rough-in.
- G. Install devices plumb, level with finished surfaces and free from blemishes.
- H. Install special purpose receptacles and switches and fixed equipment connections according to shop drawings and rough-in drawings to be furnished by trade(s) providing such equipment.
- I. Verify locations prior to rough-in.
- J. Identify all receptacles with "Brady" clear vinyl polyester tape with black lettering on front and/or back of plate.
 1. Label shall indicate receptacle voltage, phase, and amperage for receptacles other than 20A, 120 Volt, at top of cover plate, and panel and circuit number at bottom of cover plate.
 2. Label body of all receptacles with panel and circuit number.
- K. Identify switches with "Brady" clear vinyl polyester tape with black lettering on front and back of plate.
 1. Label shall indicate switch voltage, phase, and amperage at top of cover plate, and panel, circuit number and switch designation at bottom of cover plate.

- L. Lab receptacles to be identified with "Brady" clear vinyl polyester tape with black lettering on front of plate.
 - 1. Label shall indicate receptacle voltage, phase, and amperage for receptacles other than 20A, 120 Volt, at top of cover plate, and panel and circuit number at bottom of cover plate.

END OF SECTION 26 2726

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 26 2816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 RELATED WORK

- A. Section 26-0519 - Low-Voltage Electrical Power Conductors and Cables
- B. Section 26-0526 - Grounding and Bonding for Electrical Systems
- C. Section 26-0529 - Hangers and Supports for Electrical Systems
- D. Section 26-0553 - Electrical Systems Identification
- E. Section 26-0800 - Commissioning of Electrical Systems
- F. Section 26 0812 - Power Distribution Acceptance Tests
- G. Section 26-0813 - Power Distribution Acceptance Test Tables
- H. Section 26-2813 - Fuses

1.2 REFERENCE

- A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

- A. This Section includes fusible and non-fusible disconnect switches and circuit breakers in individual enclosures.

1.4 REFERENCE STANDARDS

- A. ANSI/NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting
- B. NEMA AB 1 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breakers Enclosures
- C. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- D. NFPA 70 - National Electrical Code
- E. UL 98 - Enclosed and Dead Front Switches
- F. UL 486A - 468B - Wire Connectors
- G. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures
- H. UL 869A - Reference Standard for Service Equipment

1.5 SUBMITTALS

- A. Product Data:
 - 1. Submit catalog cut sheet indicating voltage, amperage, HP ratings, enclosure type, and dimension, fuse clip features, terminal lugs and accessories including interlock devices, short circuit current amperage rating and factory settings of individual protective devices.
- B. Manufacturer's Installation Instructions:
 - 1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- C. Test Reports:
 - 1. Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.
- D. Closeout Submittals:
 - 1. Project Record Documents:
 - a. Record actual locations of disconnect switches and ratings of installed fuses.
 - b. Record actual locations and continuous current ratings of enclosed circuit breakers.
 - 2. Operation and Maintenance Data:
 - a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
 - b. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.6 QUALITY ASSURANCE

- A. Obtain disconnect switches and enclosed circuit breakers from one source and by single manufacturer.
- B. Regulatory Requirements:
 - 1. Comply with NFPA 70 for components and installation.
 - 2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris, and traffic.
- B. Comply with manufacturer's written instructions.

1.8 WARRANTY

- A. Manufacturer shall provide standard 1-year written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. General Electric
- B. Cutler-Hammer

- C. Siemens.
- D. Square D

2.2 DISCONNECT SWITCHES

- A. NEMA KS 1, UL 98
- B. Load interrupter enclosed knife switch, heavy-duty type
- C. Fusible or non-fusible type as indicated.
- D. Switch Interiors:
 - 1. Switch blades that are visible in "OFF" position when switch door is open
 - 2. Plated current carrying parts
 - 3. Removable arc suppressors to permit easy access to line side lugs
- E. Switch Mechanism:
 - 1. Quick-make, quick-break, with visible blades and externally operable handle
 - 2. Lockable only in "OFF" position and accept three industrial type, heavy-duty padlocks
 - 3. Dual cover interlock to prevent unauthorized opening of switch door when handle is in "ON" position, and to prevent closing of switch mechanism with door open
 - 4. Defeater mechanism to bypass interlock
 - 5. Operating handle integral part of enclosure
 - 6. Handle to physically indicate "ON" and "OFF" position
- F. Ratings:
 - 1. Ampacity as indicated on drawings
 - 2. Horsepower rated
- G. Fusible Switches:
 - 1. Rejection clips for Class R fuses specified
 - 2. Provisions for Class J or Class L fuses, as applicable
 - 3. Fuses: per requirements in Section 26-2813 - Fuses

2.3 ENCLOSED CIRCUIT BREAKERS

- A. NEMA AB 1, UL 489
- B. Enclosed molded-case circuit breakers:
 - 1. Tripped indication clearly shown on breaker handle taking position between "ON" and "OFF".
 - 2. 225A frame size and below: thermal-magnetic trip
 - 3. 250A frame size and above: electronic (solid-state microprocessor-based) trip units interchangeable in field within frame size and field-adjustable long time pick-up, long time delay, short time pick-up, short time delay, and instantaneous current settings. Each adjustment shall have discrete settings and shall be independent of other adjustments.
 - 4. Locks on trip handles where indicated
 - 5. Molded-case switch in lieu of thermal-magnetic molded-case circuit breaker, where indicated
 - 6. Shunt trip, where indicated
- C. Breaker Mechanism:

1. Quick-make, quick-break

D. Ratings:

1. Ampacity as indicated on drawings
2. Listed as Type HACR for air conditioning equipment circuits
3. Listed as Type SWD for lighting circuits

2.4 LUGS

- A. Front removable lugs
- B. Labeled for 75°C copper conductors
- C. Multiple lugs to match number of conductors per phase
- D. Termination of field installed conductors: pressure wire connectors, except wire-binding screws for No. 10 AWG or smaller conductors

2.5 ACCESSORIES:

- A. Solid neutral assembly, where required
- B. Equipment ground kit
- C. 1 set of normally open (NO) auxiliary contacts, where disconnect switch is installed at remote motor served by variable frequency drive (VFD)

2.6 ENCLOSURES

- A. NEMA KS 1, NEMA AB 1, UL 98, UL 489, as applicable.
- B. NEMA Type 1, Type 3R (outdoor locations) Type 4X, stainless steel, kitchen areas, cooling towers, enclosure.
- C. Code-gauge galvanized steel
- D. Manufacturer's standard gray enamel finish over prime coat
- E. Surface-mounted. Flush-mounted, where indicated.

2.7 SHORT CIRCUIT CURRENT RATING

- A. Each circuit breaker shall have minimum short circuit current rating as indicated on drawings.

PART 3 EXECUTION

3.1 COORDINATION WITH MANUFACTURER

- A. Instruct manufacturer about location of incoming lugs, i.e., top or bottom feed based on incoming feeder entrance location.
- B. Verify that "touch-up" paint kit is available for repainting.

3.2 EXAMINATION

- A. Examine areas and surface to receive disconnect switches and enclosed circuit breakers for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Verify that space indicated for disconnect switches and enclosed circuit breakers mounting meets code-required working clearances.
- C. Notify Architect/Engineer of discrepancies prior to submittal of product data and shop drawings.

3.3 INSTALLATION

- A. Install disconnect switches and/or enclosed circuit breakers in accordance with ANSI/NECA 1.
- B. Install disconnect switches and/or enclosed circuit breakers level and plumb, in accordance with manufacturer's written instruction.
- C. Do not support disconnect switches and/or enclosed circuit breakers only by raceway.
- D. Install top disconnect switch and/or enclosed circuit breaker handle a maximum of 6 ft-6" above finished floor.
- E. Tighten electrical connectors and terminals according to equipment manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A - 486B.
- F. Install engraved plastic nameplates under provisions of Section 26-0553 - Electrical Systems Identification. Attach nameplate to exterior of each switch and/or enclosed circuit breaker using small corrosion-resistant metal screws or rivets. Do not use contact adhesive.
 - 1. Include switch and/or enclosed circuit breaker name, amperage, voltage, phase, and number of wires.
- G. Install fuses in fusible switches at job site per requirements in Section 26-2813 - Fuses.

3.4 CONNECTIONS

- A. Ground equipment according to Section 26-0526 - Grounding and Bonding for Electrical Systems.
- B. Connect wiring according to Section 26-0519 - Low-Voltage Electrical Power Conductors and Cables.

3.5 FIELD QUALITY CONTROL

- A. Inspect for physical damage, proper alignment connections, anchorage, and grounding.
- B. Correct malfunctioning units on-site and retest to demonstrate compliance. Remove and replace with new units and retest.
- C. Test disconnect switches and/or enclosed circuit breakers per requirements in Section 26-0812 – Power Distribution Acceptance Tests and Section 26-0813 - Power Distribution Acceptance Test Tables 1-12
- D. Interpret test results in writing and submit to Engineer.

3.6 REPAINTING

- A. Remove paint splatters and other marks from surface of equipment.
- B. Touch-up chips, scratches, or marred finishes to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Owner.

3.7 ADJUSTING

- A. Circuit Breakers: set field-adjustable trip settings or change the trip settings, as indicated on drawings.

3.8 CLEANING

- A. Vacuum dirt and construction debris from interior and exterior of equipment; do not use compressed air to assist in cleaning.

END OF SECTION 262816

SECTION 26-2913 ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 RELATED WORK

- A. Section 26-0519 - Low-Voltage Electrical Power Conductors and Cables
- B. Section 26-0526 - Grounding and Bonding for Electrical Systems
- C. Section 26-0529 - Hangers and Supports for Electrical Systems
- D. Section 26-0533 - Raceway and Boxes for Electrical Systems
- E. Section 26-0553 - Electrical Systems Identification
- F. Section 26-0800 - Commissioning of Electrical Systems
- G. Section 26 0812 - Power Distribution Acceptance Tests
- H. Section 26-0813 - Power Distribution Acceptance Test Tables
- I. Section 26-2813 - Fuses

1.2 REFERENCE

- A. The Work under this Section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.3 DESCRIPTION

- A. This Section includes enclosed manual and magnetic motor controllers and enclosed contactors.
- B. All motors shown on the drawings or specified in other Divisions of these Specifications shall be provided with the motorized equipment and connected under this section. Provide motor controllers and power circuit disconnect devices for all motors, unless shown or specified to be furnished with the motorized equipment under other Divisions of these Specifications, and/or by others, for installation by this Contract.
- C. Variable-frequency controllers furnished by Division 20, for installation by Division 26.
- D. Motor Voltage Information:
 - 1. Voltages available are: 208 and 480 volts, three phase and 120 and 208 volt single phase. Circuits are designed for motors with voltage ratings as follows:
 - a. Smaller than 1/2 HP motors: 115 volts, single phase.
 - b. 1/2 HP motors and larger: 200 and 460 volts, three phase.

1.4 REFERENCE STANDARDS

- A. ANSI/NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting
- B. NEMA AB 1 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breakers Enclosures
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

- D. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
- E. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks
- F. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices
- G. NEMA ICS 6 - Industrial Control and Systems: Enclosures
- H. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- I. NEMA MG 1 - Motors and Generators
- J. NFPA 70 - National Electrical Code
- K. UL 98 - Enclosed and Dead Front Switches
- L. UL 486A-486B - Wire Connectors
- M. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breakers Enclosures
- N. UL 508 - Industrial Control Equipment

1.5 SUBMITTALS

- A. Product Data:
 - 1. Motor controllers: Submit catalog cut sheets showing voltage, size, rating and size of switching and overcurrent protective devices, dimensions, and enclosure details.
 - 2. Contactors: Submit catalog cut sheets showing voltage, size, current rating, dimensions, and enclosure details.
 - 3. Factory settings and time-current curves of individual protective devices.
 - 4. Confirm motor sizes and voltages with submittals of other Divisions of these specifications, and/or by others, prior to this Section submittals.
- B. Manufacturer's Installation Instructions:
 - 1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and/or starting of product.
- C. Test Reports: Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.
- D. Closeout Submittals:
 - 1. Project Record Documents:
 - a. Record actual locations and ratings of enclosed motor controllers and enclosed contactors.
 - 2. Operation and Maintenance Data:
 - a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
 - b. Include spare parts data listing, source, and current prices of replacement parts and supplies.
 - c. Include Manufacturer Seismic Qualification Certification and Installation Seismic Qualification Certification.

1.6 QUALITY ASSURANCE

- A. Obtain motor controllers, and contactors from one source and by single manufacturer.
- B. Regulatory Requirements:
 - 1. Comply with NFPA 70 for components and installation.
 - 2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

1.8 WARRANTY

- A. Manufacturer shall provide standard 1-year warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

1.9 MAINTENANCE

- A. Extra Materials: Furnish extra materials described below that match product installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Spare pilot lights: Furnish 1 spare lamp for every 5 installed units, but not less than 1 set of 3 of each kind.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. General Electric
- B. Cutler-Hammer
- C. Siemens
- D. Allen Bradley
- E. Square D

2.2 MANUAL MOTOR CONTROLLERS

- A. Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for small motors, with melting alloy type overload relay, red pilot light, (NO) (NC) auxiliary contact, and pushbutton operator.

2.3 FRACTIONAL-HORSEPOWER MANUAL CONTROLLERS

- A. Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with melting alloy type overload relay, (red) pilot light, and toggle operator.

2.4 MOTOR STARTING SWITCHES

- A. Description: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, with (red) pilot light, and toggle operator.

2.5 FULL-VOLTAGE NON-REVERSING MAGNETIC MOTOR CONTROLLERS

- A. Description: NEMA ICS 2, AC general-purpose, Class A, magnetic controller for induction motors rated in horsepower, three-phase and single-phase, as scheduled, except where single-phase motors scheduled to be provided with built-in overload elements:
 - 1. Size 1 minimum.
 - 2. Control Voltage: 120 volts, 60 hertz.
 - 3. Overload Relays: NEMA ICS 2, solid-state bimetal, one overload relay per phase:
 - a. Solid-state type:
 - 1) Class 10, 20, 30 selectable inverse-time tripping characteristics
 - 2) Non-volatile operating memory
 - 3) 3:1 current adjustment range
 - 4) Phase loss/phase unbalance protection
 - 5) Ambient temperature insensitive
 - 6) Self-powered
 - 7) Manual reset. Automatic recent not acceptable.
 - 8) Manual trip
 - 9) Visible trip indication
 - 10) 1 normally open and 1 normally closed isolated auxiliary contact.
 - b. Bimetallic type:
 - 1) Class 10, 20, 30 inverse-time tripping characteristics
 - 2) Manual reset
 - 3) 1 normally open and 1 normally closed isolated auxiliary contact
 - 4. Features:
 - a. Auxiliary Contacts: NEMA ICS 2, each normally open and normally closed contacts in addition to seal-in contact.
 - b. Pushbuttons: Recessed type.
 - c. Pilot Lights NEMA ICS 5: push-to-test LED incandescent neon type.
 - d. Hand-Off-Auto (H-O-A) Selector Switches: Rotary type.
 - e. Control Power Transformers: 120-volt secondary, adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity in each motor controller, but not less than 100VA. Fused primary and secondary, and unfused leg of secondary bonded to enclosure.
 - f. Terminals: NEMA ICS 4.
 - g. Other accessories detailed or required by drawings.

2.6 COMBINATION CONTROLLERS

- A. Factory-assembled motor controllers with externally operable disconnect, fusible switch type, in common enclosure; means for locking disconnect handle and means for defeating cover interlock.

1. Fusible Switch: NEMA KS 1 and UL 98; enclosed knife switch, heavy-duty type, external operable handle, clips or pads to accommodate specified fuses:
 - a. Rejection clips for Class R fuses
 - b. Provisions for Class J or Class L fuses, as applicable
 - c. Fuses: Per requirements in Section 26-2813 - Fuses

2.7 FULL VOLTAGE NON-REVERSING MULTI-SPEED MAGNETIC MOTOR CONTROLLERS

- A. Description: Same as full voltage non-reversing single-speed magnetic motor controllers with addition of the following:
 1. Speed selector switch
 2. Auto-Off-Low-High selector switch

2.8 REDUCED VOLTAGE MOTOR CONTROLLERS

- A. Motor controllers for NEMA rated 200 volts motors 25 HP and above.
- B. Motor controllers for NEMA rated 460 volts motors 60 HP and above.

2.9 AUTOTRANSFORMER REDUCED-VOLTAGE CONTROLLERS

- A. Description: NEMA ICS 2, closed transition.

2.10 MOTOR CONTROLLER ACCESSORIES

- A. Factory installed devices in controller enclosure, unless otherwise indicated, as follows:
 1. "On-Off" and "Start-Stop" pushbutton stations, pilot lights, selector switches: NEMA ICS 2, heavy duty type.
 2. 120 volt control circuits and pilot light, unless noted otherwise.
 3. Red pilot light to indicate motor operation.
 4. Green pilot light to indicate motor stopped.
 5. Minimum wire size for control circuits: #14 AWG.
 6. Stop and Lockout Pushbutton Station: Momentary-break pushbutton station with a factory-applied hasp arranged so a padlock can be used to lock pushbutton in depressed position with control circuit open, where indicated.
- B. Control services: As scheduled on motor schedule or indicated.

2.11 GENERAL PURPOSE MAGNETIC CONTACTORS

- A. Description: NEMA ICS 2, same as magnetic controllers, except without overload protection.
- B. Poles: To match circuit configuration and control function.
- C. Configuration: Mechanically held
- D. Contact Rating: Match branch circuit overcurrent protection.

2.12 LUGS

- A. Labeled for 75°C copper conductors.

- B. Multiple lugs to match number of conductors per phase.
- C. Termination of field installed conductors: Pressure wire connectors, except wire-binding screws for No. 10 AWG or smaller conductors.
- D. For equipment specified in this section and for equipment furnished under other Divisions of this specification and/or by others.

2.13 MOTOR CONTROLLERS AND CONTACTOR ENCLOSURES

- A. NEMA 250, NEMA 1CS 6
- B. NEMA Type 1, Type 3R (outdoor locations) Type 4X, stainless steel, kitchen areas, Type 4, wet and damp indoor locations enclosure.
- C. Code-gauge galvanized steel.
- D. Manufacturer's standard gray enamel finish over prime coat.
- E. Surface-mounted. Flush-mounted where indicated.

PART 3 EXECUTION

3.1 COORDINATION

- A. Coordinate motor control wiring with Division 23 of these specifications.
- B. Coordinate motor sizes and voltages with submittals of other Divisions of these specifications and/or by others.
- C. Verify with manufacturer that "touch-up" paint kit is available for repainting.

3.2 EXAMINATION

- A. Examine areas and surface to receive motor controllers and contactors for compliance with requirements, installation tolerances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Verify that space indicated for motor controllers and contactors mounting meets code-required working clearances.
- C. Notify Architect/Engineer of any discrepancies prior to submittal of product data.

3.3 INSTALLATION

- A. Install motor controllers and contactors in accordance with ANSI/NECA 1.
- B. Install level and plumb, in accordance with manufacturer's written instruction.
- C. Motor controllers and contactors mounting and seismic restraints:
 - 1. Install motor controllers and contactors anchorage devices and seismic restraints based on design by an Engineer registered and licensed in the state of Kentucky, and to comply with Section 26-0548 - Vibration and Seismic Controls for Electrical Systems for seismic criteria.
 - 2. Fasten motor controllers and contractors firmly to walls and structural surfaces, ensuring they are permanently and mechanically anchored.

3. Anchor and fasten motor controllers and contactors and their supports to building structural elements (wood, concrete, masonry, hollow walls and nonstructural building surfaces) by the methods described in Section 26-0529 - Hangers and Supports for Electrical Systems.
 4. Install 2 rows of steel slotted channel, with minimum of 4 attachment points, for each motor controller and contactor.
 5. When not located directly on wall, install support frame of steel slotted channel anchored to floor and ceiling structure.
 6. Do not support motor controllers and contactors only by raceway.
- D. Tighten electrical connectors and terminals according to equipment manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- E. Install engraved plastic nameplates under provisions of Section 26-0553 - Electrical Systems Identification. Attach nameplate to exterior of each motor controller and contactor, using small corrosion resistant metal screws or rivets. Do not use contact adhesive:
1. Indicate motor served, nameplate horsepower, full load amperes, code letter, service factor, voltage/phase rating, and fuse size and type, when applicable.
- F. Connect each motor terminal box to rigid conduit system with maximum 18" of flexible liquid-tight metal conduit. Install conduit per requirements in Section 26-0533 - Raceway and Boxes for Electrical Systems.
- G. Check for proper rotation and phase relationship of each motor.
- H. Install fuses in fusible switch at job site per requirements in Section 26-2813 - Fuses.
- I. Control Wiring Installation:
1. Install wiring between motor control devices according to Section 26-0519 - Low-Voltage Electrical Power Conductors and Cables.
 2. Install motor control wiring in accordance with control wiring diagrams and in raceways where indicated or required by contract drawings.
 3. Bundle, train, and support wiring in enclosures.
 4. Connect hand-off-automatic switch and other automatic-control devices where applicable.
 - a. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
 - b. Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.4 APPLICATION

- A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, and configuration of pilot device and control circuit affecting controller functions.

3.5 CONNECTIONS

- A. Provide green wire ground through flexible conduit to interconnect motor frame and rigid conduit system.

- B. Ground and bond motor controller and contactor enclosures according to Section 26-0526 - Grounding and Bonding for Electrical Systems.
- C. Connect power and control wiring according to Section 26-0519 - Low-Voltage Electrical Power Conductors and Cables
- D. Connect control wiring for operation, control and supervision of motorized equipment as shown on drawings and/or specified in this and other Divisions of these specifications.

3.6 FIELD QUALITY CONTROL

- A. Inspect motor controllers and contactors for physical damage, proper alignment, connections, anchorage, seismic restraints and grounding.
- B. Correct malfunctioning motor controllers and contactors on-site and retest to demonstrate compliance. Remove and replace with new units and retest.
- C. Test continuity of each circuit.
- D. Test motor controllers per requirements in Section 26-0812 – Power Distribution Acceptance Tests and Section 26-0813 - Power Distribution Acceptance Test Tables 1-12.
- E. Interpret test results in writing and submit to Engineer.

3.7 REPAINTING

- A. Remove paint splatters and other marks from surface of equipment.
- B. Touch-up chips, scratches or marred finishes to match original finish, using manufacturer-supplied paint kit. Leave remaining paint with Owner.

3.8 ADJUSTING

- A. Set field-adjustable circuit breakers trip settings or change the trip settings as indicated on drawings.
- B. Adjust motor circuit protectors.

3.9 CLEANING

- A. Vacuum dirt and construction debris from interior and exterior of equipment; do not use compressed air to assist in cleaning.

END OF SECTION