

CIRCLE DESIGN GROUP, INC.

SECTION 23 05 01 GENERAL PROVISIONS

PART 1: GENERAL

1.01 SUMMARY OF WORK

- A. The requirements of the General Conditions, General Requirements, Special Conditions, Instructions to Bidders, Contract Documents and other information bound herewith form a part of and shall govern all work performed under these specifications. Contractor shall refer to the attached IU Standards Specification Section 15061 Airborne Contaminants Control for additional construction guidelines and requirements.
- B. The accompanying mechanical drawings are issued as part of this project manual. Any specification requirements shown on the drawings are equally affective as if included herein. Any omissions of specifications or on the drawings are not to be a basis for failure on the part of the Contractor, from installing mechanical components required by the systems to operate in the intended manner.
- C. The drawings depict the systems' components and distribution method. Every attempt is made to complete the distribution piping and ductwork, however discrepancies may develop in the process. The contractor, within reason, is required to prepare his bid and construct the project that the result is fully developed, complete and operable systems. (This includes obvious omitted piping and duct connections). In the event of discrepancies in duct or pipe sizes from drawing to drawing, the contractor shall include the cost for the larger size.
- D. Should any work be called for on the drawings, specifications or in the codes, in such a manner that the Contractor cannot, in his judgement, comply with the requirements, then the Contractor shall bring the matter to the attention of the Engineer before proceeding with the work.
- E. Work includes the installation of equipment, piping, ductwork and components necessary for complete and operable systems.
- F. This project includes the following systems:
 - 1. Toilet exhaust system

1.02 DEFINITIONS AND TERMS USED IN THE DIVISION 23 SPECIFICATIONS AND MECHANICAL DRAWINGS

- A. The word "Owner" shall mean the party mentioned in the prime contract agreement, or any representative of his party duly authorized to act in his behalf in the execution of the work.
- B. The word "Construction Manager" shall mean the person, firm or corporation entering into a contract with the Owner to manage construction operations.
- C. The word "Contractor" shall mean the person, firm or corporation entering into a contract to construct and complete the work as described herein.

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- D. The word "Engineer" shall mean Circle Design Group, Inc. and their representatives assigned to this project.
- E. The word "Architect" shall mean INFLUENCE architecture + interiors and their representatives acting as the Owner's appointed agent.
- F. The words "furnish" or "supply" shall mean to purchase and deliver to project site, ready for unloading, unpacking, assembly, installation and similar subsequent requirements.
- G. The word "install" shall mean operations at the project site, including unloading, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar requirements.
- H.. The word "provide" shall mean to furnish and install complete and ready for intended use.

1.03

CODES, FEES AND MISCELLANEOUS COSTS

- A. All materials and workmanship shall comply with all applicable codes, specifications, local ordinances, industry standards and utility company regulations.
- B. In cases of difference between building codes, specifications, state laws, local ordinances, industry standards and utility company regulations and the Contract documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such differences.
- C. Non-Compliance: Should the Contractor perform any work that does not comply with requirements of applicable building codes, states laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising for correction of non-complying items.
- D. Applicable Codes and Standards shall include all state laws, local ordinances, utility company regulations and applicable requirements of the following nationally accepted laws, codes and standards. These requirements are to be considered minimum and are to be exceeded when so indicated on the drawings or herein specified.
 - 1. Governing Agencies
 - a. Fire Prevention and Building Safety Commission
 - b. Indiana Department of Health
 - 2. Applicable Codes
 - a. Indiana Building Code (IBC), 2014, consisting of:
 - (1) International Building Code, 2012
 - (2) Indiana Amendments
 - b. Indiana Electrical Code (IEC), 2009, consisting of:
 - (1) NFPA 70, National Electrical Code, 2008
 - (2) Indiana Amendments
 - c. Indiana Mechanical Code (IMC) 2014 consisting of:
 - (1) International Mechanical Code 2012
 - (2) Indiana Amendments
 - d. Indiana Energy Conservation Code (IECC) 2010, consisting of:
 - (1) American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc. Standard 90.1, 2007 Edition

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- e. (2) Indiana Amendments
Indiana Fire Code (IFC), 2014, consisting of:
 - (1) International Fire Code, 2012
 - (2) Indiana Amendments
- 3. Standards
 - a. ASTM: American Society of Testing Materials
 - b. ANSI: American National Standards Institute
 - c. AMCA: Air Moving and Conditioning Association
 - d. ASME: American Society of Mechanical Engineers
 - e. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
 - f. NEC: National Electric Code
 - g. NECA: National Electrical Contractors Association
 - h. NEIS: National Electrical Installation Standards
 - i. NEMA: National Electrical Manufacturers Association
 - j. NFPA: National Fire Protection Association
 - k. OSHA: Occupational Safety and Health Act
 - l. SMACNA: Sheet Metal & Air Conditioning Contractors Assn.
 - m. UL: Underwriters Laboratories
 - n. ADAAG: Americans with Disabilities Act Accessibility Guidelines
- E. The Contractor shall be responsible for obtaining all permits, payment of all fees, necessary drawings and arranging and paying for all inspections, tests, etc. which may be required by any governing authority or utility company in connection with the furnishing or installation of any of his work.

1.04

WORK AND WORKMANSHIP

- A. All materials and equipment shall be of the highest quality in every respect. All materials and equipment shall be new and of the latest design and free of defects.
- B. Workmanship shall be by skilled workmen of highest standard in strict accordance with all applicable manufacturers' printed specifications (which, by reference, are made completely a part of these specifications as though herein repeated), performed under supervision of competent foremen at all times.
- C. The Owner has full power to condemn or reject any work, materials or equipment not in accordance with these specifications and construction drawings or not in conformance with the manufacturers' specifications or drawings which were approved by the Owner or Engineer.
- D. Work or equipment that is rejected shall be removed and replaced to the satisfaction of the Owner, at the Contractor's expense. Work or equipment that is rejected shall be so stated in writing by the Owner or Engineer.
- E. Such decisions that the Owner or Engineer may make with respect to questions concerning the quality, fitness of materials, equipment and workmanship shall be binding upon the parties thereto.

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- F. Special attention shall be given to accessibility of working parts and controlling parts. Adjustable parts shall be within easy reach. Removable parts shall have space for removal.

1.05 DEVIATIONS FROM DRAWINGS

- A. Mechanical drawings show the intended arrangement and routing of all piping, ductwork, equipment and appurtenances. They shall be followed as closely as actual building construction and work of other trades will permit.
- B. The Contractor shall investigate structural and finish conditions affecting his work and shall provide any fittings, offsets and accessories required to accommodate said conditions.
- C. Adjustments as a result of coordination with other trades or for reasons to improve performance, etc. may be made upon receiving the approval of the Engineer. The Contractor shall document that the adjustment has been coordinated with all parties concerned.

1.06 OCCUPATIONAL SAFETY AND HEALTH ACT

All work shall comply with the current requirements of the U.S. Department of Labor Occupational Safety and Health Administration, entitled Occupational Safety and Health Standards; National Consensus Standards and Established Federal Standards.

1.07 COORDINATION BETWEEN CONTRACTORS

- A. The Contractor and his subcontractors shall study all drawings and specifications for this project so that complete coordination between trades will be obtained. Special attention shall be given to points where ducts cross other ducts, piping or telephone cables, where lights fit into ceilings and where pipe, ducts and conduit pass through walls and structural elements.
- B. It is the responsibility of the contractor and his Subcontractors to leave necessary room for other trades. No extra compensation will be allowed to cover the cost of relocating piping, conduit, ducts or equipment found encroaching on space required by other trades.
- C. The Contractor shall review the electrical requirements of the final equipment selections to ensure such items receive proper electrical services or connections.
- D. The Contractor shall provide complete information and cooperation to the other Contractors and trades pertaining to his work to accomplish coordination for the complete project.
- E. The Contractor shall provide the necessary sleeved openings, excavations, etc. Cutting and patching shall be held to a minimum.
- F. The Contractor and his Subcontractors shall be required to attend the periodic progress meetings to accomplish coordination with the Owner, Architect and Engineer.

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1.08 INSPECTION

At the appropriate intervals of the mechanical installation, the Contractor shall inform the local and state authorities to arrange inspections of his work. Provide Certificates of Inspection when completed.

1.09 REPORTS AND FINAL SUBMISSIONS

- A. The Contractor shall submit, for attachment to the Substantial Completion Certificate, a letter certifying that the mechanical systems are in accordance with the Indiana Mechanical Code, as amended by the State of Indiana.
- B. Submit all other test reports, as hereinafter specified.

1.10 COORDINATION WITH COMMISSIONING

- A. The purpose of the commissioning process is to provide the Owner of the facility with a high level of assurance that the mechanical and electrical systems have been installed in the prescribed manner, and operate within the performance guidelines set in the Construction Documents. The Commissioning process is intended to enhance the quality of system start-up and aid in the orderly transfer of systems for beneficial use by the Owner.
- B. Each trade contractor shall review the procedures in the specification sections and include the necessary cooperation and coordination.

PART 2: PRODUCTS

2.01 PRODUCT AND MATERIAL APPROVAL

- A. When Manufacturer's model numbers are listed they are for reference only and are not to be considered a basis of design. The model numbers listed are the best information made available to the designer by the manufacturer and not intended to supplant or be inclusive of the criteria defined in the specifications and drawings. The Contractor/Manufacturer shall review the complete construction documents to assure the products proposed are appropriate and meet the system design criteria, including dimensional restrictions.
- B. The performance requirements listed in the specifications, or shown on the drawings are the basis of design and will be the benchmark used for submittal review and approval as well as determining if work is accepted or rejected.

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- C. A specification followed by one or more manufacturers is limited to those manufacturers. Names of other proposed manufacturers may be submitted for approval to the Engineer a minimum of ten (10) days prior to receiving bids. Approval will be granted only if issued by Addendum (no exceptions).
- D. A specification followed by one or more manufacturers and "or approved equal" is open to equal products or materials. However, the Contractor shall supply one of the listed manufacturers at no additional cost if Engineer determines substituted product unsatisfactory.
- E. Any substituted equipment offered for consideration shall be stated as a separate item with the bid. State any additive or deductive cost.
- F. If changes in piping, ductwork, equipment, layout or electrical service are brought about by the use of equipment which is not compatible with the layout shown on the drawings, the Contractor shall include the cost of the necessary changes in his bid.

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2.02 SUBCONTRACTORS AND MATERIAL LIST

- A. The Contractor shall submit, with his bid, a completed list of subcontractors, manufacturers and suppliers of each item listed. No substitutions will be allowed, by the Contractor, after award of contract.
- B. Failure to submit a fully completed list within the stated time may be cause to reject the bid.
- C. Remove or copy the following list and attach it to the bid form.

2.03 LIST FOR MECHANICAL CONTRACTOR: _____
(The Contractor)

- A. Sub-Contractors SUBCONTRACTORS AND MATERIALS
 Sheetmetal Subcontractor _____
 Insulation Subcontractor _____
 Balancing Subcontractor _____
 Temperature Control Subcontractor _____

B. Material and Suppliers List

<u>SECTION</u>	<u>MATERIAL</u>	<u>MANUFACTURER</u>	<u>SUPPLIER</u>
23 05 53	Equipment and Pipe Labels	_____	_____
23 07 13	Duct Insulation	_____	_____
23 33 00	Balancing Dampers	_____	_____
23 34 00	Fans	_____	_____

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2.04 EQUIPMENT DELIVERY SCHEDULE

- A. Submit a schedule listing equipment and materials required for complete installation, quantity ordered, date of placing order and the promised delivery dates.
- B. Any and all probable delivery delays shall be identified at the pre-construction meeting.

2.05 SUBMITTALS

- A. The Contractor shall submit shop drawings, fabrication drawings, and specific product literature for all products specified and shown on the drawings.
- B. Approval of submittals does not relieve the Contractor of the responsibility for ordering proper quantities and miscellaneous appurtenances required for operation and/or installation of the respective material, equipment or system.
- C. The following general information is required with each submittal as applicable:
 - 1. Contractor's stamp, signature and date shall be affixed to the submittal with indication of his review and approval.
 - 2. The full manufacturer's model number of each item
 - 3. Identification of each item's performance, physical size and construction data.
 - 4. Identification of finishes. Furnish two (2) chips for each color for items requiring color/finish selections.
 - 5. Indicate any modifications made to manufacturers' standard design which are required by these specifications.
 - 6. Location of connection points for external piping, duct or electrical connections.
 - 7. Rough-in, foundation and support point dimensions.
 - 8. Complete wiring diagrams and connection identifications, specific to this project.
- D. In addition submit any detailed or specific information as stated in the respective specifications sections.

2.06 RECORD DRAWINGS

- A. The Contractor shall submit record drawings as stated in the General Conditions, and as specified herein.
- B. During construction, maintain a complete and legible set of drawings, at the job site showing changes and deviations between actual construction and Engineer's drawings.
- C. Submit to Engineer for review at the 50% and 100% completion of the work a complete, accurate and neat set of marked-up blueline drawings showing the complete "as built" construction.
- D. This marked-up set shall be returned to the Contractor as many times as necessary in order to obtain desired results.

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2.07 MAINTENANCE MANUALS

- A. The Contractor shall submit maintenance manuals as stated in the General Conditions and as described in further detail herein.
- B. Maintenance manuals are to include all information relative to maintenance and operating instructions for all new mechanical equipment.
- C. Maintenance manuals shall be assembled in the following sections:
 - 1. Section 1
 - a. Title of project
 - b. Name and addresses of:
 - (1) Owner
 - (2) Engineer
 - (3) Contractor
 - 2. Section 2: Index of complete contents
 - 3. Section 3:
 - a. List of all equipment with model number and serial number
 - b. Warranty of each piece of equipment with start and completion dates.
 - 4. Section 4: valve tag chart
 - 5. Section 5:
 - a. Air balance report
 - 6. Section 6: Products
 - a. Incorporate data sheets, operating instructions, maintenance instructions, parts list, installation instruction and performance characteristics on each piece of equipment or system in individually tabbed subsections.
 - b. Label and assemble tabbed sections in numerical order by corresponding specification section number.
 - c. Include a copy of the final approved submittals for each piece of equipment.
- D. Each section shall be separated by a pasteboard tabbed divider. Each section tab shall identify equipment by same name as listed in the index. Tabs shall extend outside of sheet size.
- E. All information shall be arranged in as many three-ring (3" D configuration) vinyl coated notebooks as necessary. Do not overload capacity of binder.

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PART 3: EXECUTION

3.01 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handle equipment and components carefully to prevent damaging, breaking, denting and scoring. Do not install damaged equipment or components; replace with new.
- B. Store equipment and components in clean dry place. Protect from weather, theft, dirt, fumes, water, construction debris and physical damage at all times.

END OF SECTION

SECTION 15061

AIRBORNE CONTAMINANTS CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. IUPUI airborne contaminants control policy and procedures.

1.2 POLICY

A. Contractor shall limit dissemination of airborne contaminants produced by construction-related activities in order to provide protection of personnel, operations and equipment from possible undesirable effects of exposure to such contaminants.

1. The use of hazardous or irritating materials must be properly controlled where it may affect individuals. Measures shall be taken to ensure that dusts, mists, fumes, gases and vapors of these materials are eliminated, isolated, or captured.
2. If access into the ceiling in occupied areas is required, approved procedures must be followed.

1.3 DEFINITIONS

A. Contaminant-producing activities include, but are not limited to:

1. Demolition and removal of walls, floors, carpeting, ceilings and other building finish material.
2. Demolition of plumbing, mechanical and electrical systems and equipment.
3. Finish operations such as sanding, painting, and application of special surface coatings.
4. All routine construction activities that can generate dust or fumes.
5. Site operations.

- B. Containment Areas: As determined by IUPUI Environmental Health and Safety and as shown on drawings. Includes area of construction, adjacent staging and storage areas, and passage areas for contractors, suppliers and waste.
- C. Protection areas: As determined by IUPUI Environmental Health and Safety and as shown on drawings as Protection Areas. Includes areas adjacent to Containment Area, either occupied or used for passage, as well as areas connected to construction area by mechanical system air intake, exhaust and ductwork.
- D. “Minor” ceiling access is defined as visual observation or minor adjustments or other activity that does not disturb dust. Acoustical panels shall be replaced or access panel shall be closed immediately when the construction worker leaves the work site.
- E. “Major” ceiling access describes any other access not defined as “minor”.
- F. “Thorough” cleaning of surfaces which become exposed to dust shall be accomplished by use of either a HEPA-filtered vacuum cleaner or a wet mop.
- F. Negative Air Machine: Portable mechanical units to provide negative air pressure in the containment area as specified in this section.

1.4 PROTECTION

- A. Exercise caution when handling fluids, particularly heating water, in an interstitial space. When working with fluids provide a water-tight barrier beneath the work area to catch and retain all spillage before it reaches the ceiling below.
- B. Notify the Owner’s Representative at least three(3) working days prior to commencement of work in ceilings or interstitial spaces above occupied areas in order to allow for the relocation or protection of occupants.

1.5 SUBMITTALS

- A. Schedules: Submit work areas and procedure schedules for containment of airborne contaminants.
- B. Work Plan: Drawings and details of construction of necessary temporary

barriers, and description of procedures to be used to achieve and maintain control of construction-related airborne contaminants.

- C. Work plan must be approved by IUPUI Environmental Health and Safety prior to commencement of work.
- D. Provide IUPUI Environmental Health and Safety copies of Material Safety Data Sheets for all products being used.

1.6 GENERAL CEILING ACCESS DIRECTIVES

- A. Contractor shall notify IUPUI Environmental Health and Safety of work requiring access to the ceiling outside the containment area a minimum of three(3) working days prior to commencement of work.
- B. Spray top of ceiling panels to be removed, and surrounding affected panels with fine detergent/water mist to settle dust prior to removal.
- C. Owner's representative shall be contacted for all ceiling access problems.

1.7 QUALITY CONTROL

- A. Pre-Construction Meeting: Before commencement of construction the contractor shall attend an orientation session held by IUPUI Environmental Health and Safety for instructions on required precautions.
- B. Notification: Three(3) working days notification to owner's representative of construction activity causing potential airborne contaminants in a Protection Area.

1.8 TESTING

- A. IUPUI Environmental Health and Safety may conduct periodic air sampling of Protection Areas during construction to monitor the effectiveness of containment procedures.
- B. Air Pressure: Contractor shall verify the maintenance of negative air pressure in the Containment Area relative to the Protection Area on a continuous basis utilizing differential pressure monitors.

1.9 PERFORMANCE REQUIREMENTS

- A. Contractor's Responsibilities shall include but not be limited to:

1. Compliance with IUPUI requirements and use of installation procedures and methods which satisfy applicable code requirements and referenced controls and procedures.
2. Formulation of specific means and methods of achieving and maintaining control of airborne contaminants during construction.
3. Proposal of work plan and procedures for control of airborne contaminants as noted in the contract documents.
4. Submission of proposed work plan to IUPUI Environmental Health and Safety for review prior to the performance of construction activities.
5. The contractor shall provide all required labor and material to install and maintain the approved plan.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Abatement Technologies HEPA-AIRE Portable Air Scrubbers or equal.
 1. Units shall include pre-filters, final filters, HEPA filters and filter static pressure gauges.
 2. HEPA filter shall be 99.9% efficient at .3 micron particle size.
- B. Carpet or Mats: Provide carpet or mats at enclosure entrances vacuumed or changed as often as necessary to prevent accumulation of dust. At contractor's option, provide adhesive-faced contamination control mats with disposable sheets in lieu of vacuumed mats. All vacuuming outside areas not under negative pressure shall be performed with a certified HEPA-filtered vacuum.
- C. Polyethylene shall be fire retardant type listed by Fire Underwriter's Laboratories affixed with fire retardant tape.
- D. Air Pressure Monitors shall be differential switch/gauge equal to Dwyer Model 3000-0 with a range of 0 to .25 inches of water gauge and high-low adjustable set points.

PART 3 EXECUTION

3.1 FUNCTIONAL REQUIREMENTS

- A. Dust control: The contractor shall take appropriate steps throughout the course of the project to prevent airborne dust due to his/her work. Water shall be applied whenever practical to settle and hold dust, particularly during demolition and removal of materials. Care shall be exercised to prevent the accumulation of standing water or the saturation of any materials. No chemical palliative shall be utilized without the written consent of Indiana University.
- a. Isolation of construction areas in occupied buildings: Accomplished by using plastic sheeting materials or dry wall.
 - b. Ventilation of construction areas to create negative pressure: The use of fans and negative pressure machines can contain airborne materials to the construction zone. Exhaust of airborne materials to the outside of the building must be done carefully so that it doesn't affect individuals in the same building or in adjacent buildings. The contained area shall be kept under negative pressure relative to the surrounding areas. A minimum of -.02 column inches of water pressure differential, relative to outside pressure, shall be maintained within the work area as evidenced by manometer measurements provided by the contractor on a continuous basis.
 - c. Air Quality Assurance: Employ local exhaust when dust, hazardous vapors, fumes, or gases are generated. If local exhaust is not feasible, portable air cleaning devices (such as the use of HEPA-filtration) may be used. Minimize dust generation by using wet methods for cutting or sanding.
 - d. Scheduling the use of hazardous and irritating materials: Work planning must include the scheduling of material use that creates hazardous or irritating conditions to times when buildings are less occupied (evening, nights, holidays, and weekends). This includes the spraying of external building materials, such as sealants.
 - e. Notification for use of solvent-based materials: Notification must be made prior to the use of solvent-based paints, (including electrostatic painting) cleaning materials, and other solvent-based products. A permit for the use of solvent-based materials must be approved by the Department of Environmental Health and Safety prior to the use of these materials.

- f. Use safer, low-emitting materials: Many paints and other building materials are available with safer or non-solvent formulations.

- B. Exterior Work: Direct exhaust from equipment away from building air intakes.
 - a. Use or application of chemical/odorous materials shall be located at least 25 feet away from all outside air intakes (if feasible).
 - b. When work including chemical/odorous materials must be done at or near air intakes, outside air intake should be minimized or the task should be performed when the building is not occupied (such as evenings or weekends).
 - c. Locate dumpsters for debris away from operating HVAC outdoor air intakes and exterior doors to occupied areas where possible
 - d. For long-term projects that use chemicals or produce combustion exhaust near air intakes, install charcoal filters in the air handling units serving the occupied space of the building.
- C. Provide a thorough cleaning of any surfaces that become exposed to dust.
- D. Removal of water-saturated construction materials: promptly remove and dispose of material saturated with water as a result of construction activity or leakage within the project area. Failure to comply will result in the contractor being held liable by Indiana University for any required mold abatement.

3.2 ENFORCEMENT

- A. In the event that the contractor fails, in the owner's opinion, to comply with this specification, the owner shall have the right to stop work on the project and correct any and all deficiencies at the expense of the contractor.

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SECTION 23 05 02 ASSIGNMENTS OF MISCELLANEOUS WORK

PART 1: GENERAL

1.01 PAINTING

Painting of patched and new ceiling and wall surfaces shall be by Mechanical Contractor.

1.02 WALL OPENINGS

- A. Wall openings for mechanical work not noted on the Architectural or Structural drawings shall be arranged for and provided by the Mechanical Contractor.
- B. Lintels for wall openings required by mechanical work will be furnished and installed by the Contractor constructing the wall. Mechanical Contractor is responsible for notifying that Contractor of locations and sizes of openings requiring lintels prior to wall construction. Openings not coordinated and provided shall be arranged for and provided by the Mechanical Contractor.
- C. Final sizes and locations of mechanical penetrations in walls are the responsibility of the Mechanical Contractor.
- D. Provide approved fire stops for fire rated wall openings.

1.03 WALL AND CEILING ACCESS PANELS

- A. Wall and ceiling panels shall be furnished by the General Contractor.
- B. Mechanical Contractor is responsible for coordinating and assisting in locating all access panels, for installation by the General Contractor, prior to his wall or ceiling construction, to obtain access to equipment, dampers and valves, etc.
- C. The panel locations shall be also coordinated with, and receive the approval of, the Architect and Engineer.

1.04 CUTTING AND PATCHING

- A. Cutting and patching of finished areas for mechanical work shall be provided by the Mechanical Contractor. Mechanical Subcontractors shall coordinate responsibility for cutting and patching with Mechanical Contractor prior to bidding.
- B. Cutting and patching of finished areas shall be provided by the Contractor requiring same, however, the work shall be performed by the trade responsible for this type of work.
- C. Patched surfaces shall be finished to match existing unless the surface is scheduled to receive new finish.

PART 2: PRODUCTS

NOT USED

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PART 3: EXECUTION

3.01 ATTACHING TO BUILDING CONSTRUCTION

- A. Equipment and ductwork shall be attached to structural members (beams, joists, etc) rather than to floor or roof slabs.
- B. Where equipment is suspended from concrete or masonry construction, use expansion shields to attach supports to construction. Expansion shield bolt diameter shall be the same size as support rod diameter, hereinafter specified.
- C. Where existing masonry is not suitable to receive and hold expansion shields or where other means of attachment is advantageous, Contractor shall submit alternate method for approval of Architect and/or Engineer.
- D. Where supports are attached to structural members coated with fireproofing, the contractor shall clean the fireproofing, attach the support and patch the fireproofing with like material.

3.02 ELECTRICAL CONNECTIONS TO EQUIPMENT

- A. In the event that equipment furnished requires a larger starter or disconnect than that which is indicated on the documents, the Contractor supplying the larger equipment shall reimburse the Electrical Contractor supplying the larger starter or disconnect for the difference in labor and material cost.
- B. Detailed diagrams and instructions shall be provided by Contractor supplying equipment. If connections are different from those shown on the drawings, the contractor shall notify the electrical contractor prior to start of his related work.
- C. Relays, switches, contactors, etc. which may be required in addition to those specified or indicated on the electrical drawings shall be furnished by the supplying contractor for installation by the Electrical Contractor. These devices shall be mounted by the Electrical Contractor at the apparatus to be installed and the contractor supplying these additional devices shall reimburse the Electrical Contractor for his labor and material costs.
- D. In the event that several pieces of mechanical equipment from different suppliers are combined into one system, Contractor shall furnish complete interface wiring and control diagram to enable the Electrical Contractor to make proper connections. Diagrams shall be submitted to the Engineer for approval prior to actual wiring.
- E. Contractor shall furnish to Electrical Contractor written notice of approval and acceptance of all control wiring which was installed by the Electrical Contractor for his system(s). Such approval shall be given within thirty (30) days of completion of all such control wiring. The letter shall be copied to the Engineer.

END OF SECTION

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SECTION 23 05 03 COMPLETION AND STARTUP

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Furnish material and labor required to perform startup of equipment and systems installed and modified in this project and provide operating and maintenance instructions to the Owner. Coordinate, schedule and perform this work with the Commissioning Engineer.
- B. Furnish labor and material required to inspect the installed duct systems and correct deficiencies as specified herein.
- C. Furnish labor and equipment required to maintain clean work areas throughout the project and to perform final cleanup.

1.02 RELATED WORK

- A. General Provisions: Section 23 05 01
- B. Assignment of Miscellaneous Work: Section 23 05 02
- C. Testing, Adjusting and Balancing: Section 23 05 93

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

3.01 GENERAL COMPLETION REQUIREMENTS

- A. Adhere strictly to the following procedures in completing mechanical systems.
 - 1. Adjust tension in V-belt drives, adjust vari-pitch sheaves and drives for proper equipment speed. Remove any foreign materials from sheaves or belts before starting operations, adjust drives for alignment of sheaves and V-belts.
 - 2. Adjust direct drives for proper alignment of flexible couplings, provide lubrication of particular couplings so required, check security of couplings to driver and driven shafts, set drive components to assure free rotation with no undesirable stresses present on coupling or attached equipment.
 - 3. Inspect bearings for cleanliness and alignment and remove any foreign materials found. Grease as necessary and in accordance with manufacturer's recommendations. Replace bearings that run rough or noisy.
 - 4. After completion of equipment test and balance, replace air filters in all units.

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5. Repair pipe and duct insulation or duct liner that may have been damaged during construction period.
 6. After air balance is complete, replace any variable pitch sheaves to fixed pitched sheaves.
- B. Complete all applicable startup procedures described in preceding paragraphs and in the associated articles for particular systems prior to occupancy of spaces served.
- C. Provide such continuing adjustment services as necessary to insure proper functioning of all mechanical systems after building occupancy and during warranty period.

3.02

STARTUP

- A. A pre-startup construction meeting shall be scheduled by the Mechanical Contractor for the specific purpose of achieving a coordinated systems startup with the Commissioning Engineer and Owner.
- B. The Commissioning Engineer, Owner, Mechanical Contractor, Sheetmetal Contractor, Temperature Control Contractor, Balancing Contractor and Electrical Contractor shall be present at the pre-startup meeting and at the initial startup of each mechanical system and air handling unit.
- C. The Mechanical Contractor shall bear prime responsibility for startup of all mechanical systems.
- D. Perform a startup of each system installed in this project in strict accordance with manufacturer's printed procedure.
- E. Check for proper rotation of all fans and pumps.
- F. Check for proper electrical services and usage during the startup procedure.
- G. Perform operational tests on all equipment as specified in Specifications Section 23 05 93, Testing, Adjusting and Balancing.
- H. If a piece of equipment is not performing satisfactorily during testing and balancing, the Balancing Contractor shall notify the Installing Contractor for corrective action.
- I. All involved contractors shall submit to the decision of the Owner/Engineer of any conflict of responsibility.

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3.03 TEMPORARY USE OF NEW EQUIPMENT

- A. The permanent heating and cooling systems shall not be utilized as the temporary tempering source for constructing the building, prior to full enclosure.
- B. When it becomes necessary to operate any equipment during the construction period for system checkouts, or maintaining reasonable temperatures or humidity levels for finishes, the Contractor will be required to do so, but only after proper adjustments, trial operation and Owner or Engineer's approval in writing.
 - 1. When this occurs, the contractor shall prepare a written procedure for the temporary operation to the Owner/Engineer for acceptance. The procedure shall address the following issues:
 - a. All ductwork openings shall be protected with filter media to prevent dust, dirt, and debris from entering. The media shall be maintained and replaced periodically to obtain protection.
 - b. Fire alarms and smoke detectors shall be protected and isolated during operation of air handling equipment. Temporary detectors shall be installed for fire protection to shut down air handling equipment.
 - c. Variable frequency drives shall be protected and isolated from the construction atmosphere (dust).
 - d. All equipment intended to run shall be protected for operation with all safeties intact and operational.
- C. The warranty on the equipment will not begin until the date of Owner's final acceptance at the completion of the project.
- D. Should the Owner elect to receive beneficial operation of the equipment prior to final acceptance, he may do so. The warranty period may begin then upon the Contractor receiving written approval from the Owner accepting the equipment with conditions of any incomplete portions of the work.

3.04 TOUCH-UP

- A. All mechanical equipment, cabinets, control panels and other enclosures shall be cleaned and paint touched up as necessary to duplicate factory finished appearance. Touch-up paint shall exactly match color, composition and quality of factory applied finish.
- B. Equipment furnished with factory applied finish shall be protected from injury by the installing contractor. Any damaged surface shall be repaired by the installing contractor to match original finish or shall be replaced before final acceptance.

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3.05

CLEANING

- A. Maintain a clean project site throughout the construction period. Provide personnel to regularly remove debris and unused materials. Coordinate this cleaning effort with your subcontractors.
- B. Remove all debris and unused materials from job site created by mechanical work.
- C. Clean all mechanical equipment to a "like new" condition prior to systems startup, prior to balancing and in preparation of final inspection. Vacuum clean all internal components.
- D. Clean all mechanical rooms and/or areas of debris and unused material. Vacuum clean mechanical room floors.
- E. Clean the exterior surfaces of all ductwork and piping systems. Vacuum clean if appropriate. Damp/wet clean with soap (chemical if necessary) and water where required or directed by Owner/Engineer.

END OF SECTION

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SECTION 23 05 04 DEMOLITION

PART 1: GENERAL

1.01 RELATED WORK

- A. General Provisions: Section 23 05 01
- B. Assignment of Misc. Work: Section 23 05 02

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

3.01 DEMOLITION AND REMOVAL OF EQUIPMENT

- A. Contractor shall remove all equipment, controls, piping, ductwork, hangers and support for portions of mechanical system in present building as shown on drawings and/or implied by nature of work indicated to be removed.
- B. Contractor shall properly support remaining portions of work. Contractor shall provide valves, plugs, vents, etc. as required to maintain an operating system. All materials removed shall become the property of the Contractor and shall be removed from the premises unless specified otherwise. Contractor shall pay all costs associated with government regulations concerning disposal of material.

3.02 DUST PROTECTION

- A. Temporary partitions or barriers required to protect existing building or facilities will be provided. This Contractor shall provide dust protection for his specific operations which are in addition to those provided. Dust partitions or barriers are required to protect existing equipment finishes and furnishings. Operations which could cause dust shall not be performed until dust barriers are erected.
- B. Contractor shall provide a daily sweep up of work areas.

3.03 ROOF PROTECTION

- A. Provide roof protection for all operations on or over existing roof surfaces.
- B. Provide fire retardant plywood sheets on roof during all operations for walkways and work areas. The Contractors working on the roof shall be responsible for roof protection and assuring the warranty on the roof system is maintained.

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3.04 CONTINUOUS OPERATION

- A. All work is to be performed in such a manner as to allow Owner to operate existing facility on continuous basis. Temporary piping and ductwork shall be provided as required to maintain continuous operation of the Owner's facility.
- B. Should outage be required or work that could possibly create an outage of systems serving areas outside of the construction area, the Contractor shall submit a written work procedure two (2) weeks in advance of outage. This work procedure shall indicate step-by-step procedure which Contractor expects to follow to perform his work. Each step shall indicate condition of system, calendar day and time of day from commencement to completion of work.
- C. All outages shall be scheduled with the project superintendent and shall be performed at the Owner's convenience.

3.05 DISPOSITION OF EXISTING EQUIPMENT

- A. Existing equipment which is to be removed and not reused shall become the property of the Contractor, unless designated specifically to be retained by the Owner, and shall be removed from the site.
- B. Owner will prepare list to contractor of all items to be retained.
- C. Contractor shall deliver retained items to Owner's storage facility.

END OF SECTION

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SECTION 23 05 13 COMMON MOTOR REQUIREMENTS

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Provide open drip-proof or totally enclosed fan cooled motors for mechanical equipment of the type and efficiency as specified herein.
- B. This section is applicable to motors on the following equipment:
 - 1. Fans

1.02 QUALITY ASSURANCE

All motors shall be designed, selected and applied in accordance with the latest applicable standards of NEMA, IEEE, ANSI, and the current edition of the National Electric Code.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 23 05 01
- B. HVAC Fans: Section 23 34 00

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Specification Section 23 05 01, General Provisions.
- B. Submit shop drawing of motor with each applicable piece of equipment as stated in Item 1.01B above.
- C. Submittal shall indicate full load efficiencies and minimum power factor.

PART 2: PRODUCTS

2.01 SINGLE PHASE MOTORS (THRU 0.5 HP)

Single Phase Motors shall be the highest energy efficiency available, permanent split-capacitor where possible or as approved. Provide capacitor start or two-capacitor type motor for high torque applications. Provide automatic resetting in-built thermal protection unless otherwise specified.

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2.02 THREE PHASE MOTORS (3/4 HP AND ABOVE)

- A. Motors three quarter horsepower and larger shall be three phase unless specifically noted otherwise on the drawings. Motors may be open drip proof or totally enclosed fan cooled.
- B. Motors shall be designed for Premium Efficiency and tested in accordance with IEEE 112, Test Method B. The Guaranteed Minimum Efficiency values shall be equal to or greater than the qualifying levels listed in Table M1.
- C. Motors shall have a service factor of not less than 1.15.
- D. Motors shall be T-Frame unless otherwise specified.
- E. Motors shall not exceed 1800 RPM as standard whenever possible unless otherwise specified.
- F. Motors shall be constructed using Class "F" Insulation.
- G. Motors shall be designed with a Class "B" temperature rise over an Ambient temperature of 40°C.
- H. Motors shall utilize greaseable-bearings.
- I. Motors shall utilize NEMA Design B as standard whenever possible. NEMA Designs C and D may be used when appropriate for special applications. Motors shall not utilize NEMA Design A unless specifically approved by the specifying engineer.
- J. Specialty motors shall be the highest efficiency available. The motor construction, i.e. design, type, frame, RPM, etc., shall be as appropriate for the application in question while providing reliability and long life expectancy.
- K. Motor nameplate voltage shall match the Nominal System Voltage as closely as possible.
- L. Motors over 5 horsepower shall have grounded rotors where used with variable frequency drives.

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M. Efficiencies: Motors shall have efficiencies meeting or exceeding the following:

OPEN DRIP PROOF (ODP) 3 HP AND ABOVE

1800 RPM

MOTOR SIZE	GUAR.	NOMIN
3	86.5	88.5
5	87.5	89.5
7.5	88.5	90.2
10	89.5	91.0
15	91.0	92.4
20	91.0	92.4
25	91.7	93.0
30	92.4	93.6
40	93.0	94.1
50	93.0	94.1
60	93.6	94.5
75	94.1	95.0
100	94.1	95.0
125	94.5	95.4
150	94.5	95.4
200	95.6	95.4

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TOTALLY ENCLOSED FAN COOLED (TEFC) 7-1/2 HP AND ABOVE

1800 RPM

MOTOR SIZE	GUAR.	NOMIN
7.5	89.5	91.0
10	89.5	91.0
15	91.0	92.4
20	91.0	92.4
25	92.4	93.6
30	92.4	93.6
40	93.0	94.1
50	93.0	94.1
60	93.6	94.5
75	94.1	95.0
100	94.5	95.4
125	94.7	95.6
150	95.0	95.8
200	95.0	95.8

- N. Manufacturers
1. Baldor Super E
 2. General Electric Energy Saving CI
 3. Louis-Allis Spartan
 4. Reliance Duty Master E-2000 or XE
 5. Marathon Blue Chip XRI
 6. Siemens PE 21+
 7. Toshiba EOP

PART 3: EXECUTION

3.01 MOTOR SIZING

Motors shall be rated for 1.15 service factor, but shall be selected for operation within their full load rating without applying the service factor.

END OF SECTION

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SECTION 23 05 50 NOISE CONTROL

PART 1: GENERAL

1.01 WORK INCLUDED

- A. This section establishes the criteria for acceptable sound levels from mechanical equipment and systems.
- B. Sound controls are applied to modify the sound transmission paths to obtain the specified sound levels in the various spaces of the building. The sound transmission paths are defined in the 2011 ASHRAE HVAC Handbook Applications.
- C. HVAC related sound criteria for this project are established as follows:

<u>Room Type</u>	<u>Criterion</u>
Corridors and Lobbies	NC40
- D. The above NC levels shall serve as the gauge to determine the installation quality and workmanship.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 23 05 01
- B. HVAC Ducts and Casings: Section 23 31 00
- C. HVAC Fans: Section 23 34 00

1.03 SUBMITTALS AND QUALITY ASSURANCE

- A. Submit data or shop drawings on all components specified in this section.
- B. Product data shall clearly indicate where and how the product is used and quantities as applicable.
- C. Submit sound performance on equipment. Performance shall be established by agency procedures as follows:
 - 1. Air Handling Units: AMCA Standard 330/ASHRAE Standard 68 or ARI 260P
 - 2. Fan Coil Units: AMCA Standard 350
 - 3. VAV Terminal Units: ANSI/ARI 880-89
 - 4. Fans: AMCA Standard 300 or 301
 - 5. Diffusers and Grilles: ADC 1062 GRD and ADC/ARI Standard 885
 - 6. Sound Attenuators: ASTM E-477096
 - 7. Duct Liner: ASTM C423-90
 - 8. Acoustical Louvers and Plenum Housings: ASTM E90, E413, E795 and C423
 - 9. Duct Lagging: ASTM E413 and E90
- D. Test reports shall be certified from an accredited laboratory maintaining membership in NVLAP (National Volunteer Laboratory Accreditation Program).

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1.04

STANDARDS

- A. In addition to complying with all pertinent codes and regulations, all work of this Section shall conform to the following Standard Specification requirements:
1. ADC 1062GRD-84 Test Code for Grilles, Registers and Diffusers.
 2. ADC 1062R4 Equipment Test Code for Air Terminal Units (VAV).
 3. AMCA Standard 300-1996 Reverberant Room Method for Sound Testing of Fans.
 4. AMCA Standard 301-1990 Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 5. ANSI S12.2-1995 Criteria for Evaluating Room Noise.
 6. ANSI S12.34-1988 Engineering Method for the Determination of Sound Power Levels of Noise Sources for Essentially Free-Field Conditions over a Reflecting Plane.
 7. ANSI/ARI 880-89P Air Terminals.
 8. ARI Standard 260P Sound Rating of Ducted Air Moving and Conditioning Equipment.
 9. ARI Standard 270 Sound Rating of Outdoor Unitary Equipment.
 10. ARI 890/ASHRAE 70-91 Rating of Air Diffusers Assemblies.
 11. ARI Standard 885-90 Method for Estimating Occupied Space Sound Levels in the Application of Terminals and Air Outlets.
 12. ARI Standard 575-94 Method of Measuring Machinery Sound Levels within Equipment Rooms.
 13. ARI Standard 350-86 Sound Rating of Non-Ducted Indoor Air Conditioning Equipment.
 14. ASHRAE Standard 68-86/AMCA Standard 330-86 Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
 15. ASTM C423-90 a Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 16. ASTM C1071-91 Thermal and Acoustical Insulation (Mineral Fiber, Duct Lining Material).
 17. ASTM E90-90 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
 18. ASTM E413-87 Classification for Determination of Sound Transmission Class (STC).
 19. ASTM E477-96 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials.
 20. ASTM E795-92 Practices for Mounting Test Specimens During Sound Absorption Tests.
 21. ASTM E1222-90 Test Method for Laboratory Measurement of Insertion Loss of Pipe Lagging Systems.
 22. CTI Code ATC-128 Code for Measurement of Sound from Water-Cooling Towers.
 23. ISO 7235-199 Acoustics - Measurement procedures for Ducted Silencers - Insertion Loss, Flow Noise and Total Pressure Loss.
- B. Addresses
1. ADC Air Diffusion Council, Chicago, IL 312-372-9800.
 2. AMCA Air Movement and Control Association, Arlington Heights, IL 847-394-0150.
 3. ANSI American National Standards Institute, New York, NE 212-354-3300.
 4. ARI Air Conditioning and Refrigeration Institute, Arlington, VA 703-524-8800.

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5. ASHRAE American Society of Heating, Refrigeration and Air-Conditioning Engineers, Atlanta, GA 404-636-8400.
6. ASTM American Society for Testing Materials, West Conshohocken, PA 610-832-9500.

PART 2: PRODUCTS

2.01 ACOUSTICAL FLOOR, CEILING AND WALL SEAL

Type M

- A. Description: Where piping passes through equipment walls, floors or ceilings, provide a split seal consisting of two bolted pipe halves with 3/4" or thicker neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240EF, 10# density fiberglass may be used in lieu of the sponge.
- B. Manufacturers: Mason Industries Model No. SWS; or approved equal

PART 3: EXECUTION

3.01 PIPE PENETRATIONS AND ISOLATION

- A. Penetration Type A: Any pipe penetrating a wall, floor or ceiling in the locations identified below shall be sleeved and packed with glass fiber, foam rod and permanently flexible acoustical sealant to form a resilient and airtight penetration:
 1. Penetrations through walls or slabs when crossing Acoustic Isolation Joints.
 2. Penetrations through Acoustically Isolated Construction floor, wall or ceiling components.
 3. Penetrations through walls or slabs within 8 feet of crossing Acoustic Isolation Joints and/or Acoustically Isolated Construction
 4. Penetrations through walls, floors or ceilings of Noise Producing Rooms.

All wall, floor or ceiling penetrations within 30 feet of a NPR. Wall, floor or slab openings for Type A penetrations shall be oversized and sleeved to provide an inner diameter 1 to 2 inches greater than the outside dimension of the pipe. The pipe shall be centered in the opening and shall not contact the wall, floor or ceiling, even after filling. The resulting gap shall be packed with glass fiber packing material and foam rod. The gap shall be caulked to an airtight seal using permanently flexible acoustical sealant.

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- B. Penetration Type B: Where the use of Firestop is required in the conditions noted above, the packing materials and sealant indicated for Type A penetrations may be replaced with an approved permanently flexible Firestop sealant, creating a resilient and airtight penetration that is also compliant with fire code.
- C. Penetration Type B (Multiple): In locations not common to Acoustically Sensitive Rooms requiring airtight and resilient penetrations of multiple pipes passing through a wall, floor or ceiling, it is acceptable to utilize the penetration Type B detail for multiple pipes, as shown on the Contract Drawings.
- D. Penetration Type C: Pipes serving Acoustically Sensitive Rooms which do not meet the conditions for Type A or B, resilient and airtight, penetrations shall be grouted and caulked into the structure as follows, forming an airtight penetration:
 - 1. Before grout has set, rake a groove around the pipe on each side of the wall or slab.
 - 2. The groove shall be ½-inch wide and ½-inch deep (12mm x 12mm).
 - 3. After grout has set, fill the groove full depth with permanently flexible acoustical sealant.
- E. All pipes requiring support within 8 feet of an Acoustic Isolation Joint or Acoustically Isolated Construction shall be supported or hung using Type G hangers or mounts.

3.02

DUCT PENETRATIONS AND ISOLATION

- A. Penetration Type A: Any duct penetrating a wall, floor or ceiling in the locations identified below shall penetrate the structure without rigidly contacting the structure. The opening shall be oversized by 1 inch for each dimension and packed with glass fiber, foam rod and permanently flexible acoustical sealant to form a resilient and airtight penetration:
 - 1. Penetrations through walls or slabs when crossing Acoustic Isolation joints.
 - 2. Penetrations through Acoustically Isolated Construction floor, wall or ceiling components.
 - 3. Penetrations through walls or slabs within 8 feet of crossing Acoustic Isolation Joints and/or Acoustically Isolated Construction
 - 4. Penetrations through walls, floors or ceilings of Noise Producing Rooms.
 - 5. All wall, floor or ceiling penetrations within 30 feet of a NPR.
- B. Penetration Type B: Where the use of Firestop is required in the conditions noted above, the packing materials and sealant indicated for Type A penetrations may be replaced with an approved permanently flexible Firestop sealant, creating a resilient and airtight penetration that is also compliant with fire code.
- C. Ducts shall be connected to fans, fan casings and fan plenum by means of flexible connectors. Flexible duct connectors shall not be used outside the mechanical room in systems serving Acoustically Sensitive Rooms unless expressly shown on the drawings.
- D. All ducts requiring support within 8 feet of an Acoustic Isolation Joint or Acoustically Isolated Construction shall be supported or hung using Type 3 hangers or mounts.

END OF SECTION

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SECTION 23 05 53 IDENTIFICATION OF PIPING AND EQUIPMENT

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Label all mechanical equipment furnished and/or installed in this project.
- B. Label all electrical equipment furnished by the Mechanical Contractor.
- C. Label all temperature control conduits (Temperature Control Contractor). See Specifications Section 26 05 02.

1.02 RELATED WORK

General Provisions: Section 23 05 01

1.03 SUBMITTALS

- A. In accordance with Specifications Section 23 05 01, General Provisions, submit manufacturer's data on labels. Include a listing of labels ordered with name of equipment or control device.
- B. Submit manufacturer's data on valve tags including a list of all valves to be tagged on the project.

PART 2: PRODUCTS

2.01 MECHANICAL EQUIPMENT LABELS

- A. Labels shall be engraved, laminated plastic plates. Height of letters shall be as scheduled herein.
- B. Letters shall be black; plates shall be white.
- C. Manufacturers
 - 1. Seton Nameplate Corporation
 - 2. Brady
 - 3. Or approved equal

2.02 ELECTRICAL AND CONTROL EQUIPMENT LABELS

- A. Labels shall be engraved, laminated plastic plates. Height of letters shall be as scheduled herein.
- B. Letters shall be black; plates shall be white
- C. Manufacturers
 - 1. Seton Nameplate Corporation
 - 2. Brady
 - 3. Or approved equal

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CONSTRUCTION DOCUMENTS

IDENTIFICATION OF PIPING AND EQUIPMENT

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PART 3: EXECUTION

3.01 MECHANICAL EQUIPMENT LABEL INSTALLATION

- A. Schedule of Mechanical Equipment Labels (List is not necessarily inclusive of all equipment on this project to be labeled).

<u>Equipment</u>	<u>Example Wording</u>	<u>Letter Height</u>
Fans	EF-1, SR-1, SP-1-(CFM)	1/2"

- B. Labels shall be secured to the equipment in a readily apparent location with a minimum of four (4) screws for 1" size labels and two (2) screws for 1/2" and smaller. (Glue shall not be used.) Drill holes for screw openings. Cracked labels shall be replaced.
- C. Equipment which is not suitable to receive the above fastening method shall be labeled on an adjacent wall, chain hung from the ceiling, or on a readily sighted disconnect switch, at the direction of the Designer.

3.02 ELECTRICAL AND CONTROL EQUIPMENT LABEL INSTALLATION

- A. Items to be labeled include:
1. Temperature control panels
 - a. Letters to be 1" high.
 - b. Panels shall be labeled to represent equipment controlled.
 2. Motor starters: 1/2" high
 3. Remote pushbutton stations: 1/8" high
 4. Motors which cannot be readily identified by their starter label when observer is standing by the motor: 1/2" high
 5. Room sensors, thermostats and humidistats
 - a. Letters shall be 1/8" high. Plate shall be attached to cover as directed by Engineer.
 - b. Terminal unit designations shall match the equipment label wording as scheduled.
 6. Temperature Control Conduits and Junction Boxes:
 - a. Labeling consistent with electrical conduit.
 - b. Reference applicable Division 26 Sections.
- B. 1" and 1/2" letter size labels shall be secured to the devices with appropriately sized screws or rivets. (Glue shall not be used.) Screw holes shall be drilled. Cracked labels shall be replaced.
- C. 1/4" and 1/8" letter size labels shall be glued to the device.

END OF SECTION

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SECTION 23 05 93 TESTING, ADJUSTING AND BALANCING

PART 1: GENERAL

1.01 GENERAL REQUIREMENTS

- A. Balancing Contractor to monitor the job progress to schedule his work in conjunction and cooperation with other trades involved and comply with the project completion date.
- B. Balancing Contractor shall prepare and submit pencil copies of air systems to Engineer and Commissioning Engineer as the work completes.
- C. Provide assistance and cooperation to Engineer as the Commissioning progresses. Provide labor to assist in troubleshooting and fine tuning of the HVAC systems to suit the final building conditions.
- D. Prepare and submit the final report as defined herein.

1.02 WORK INCLUDED

- A. Provide equipment, materials, labor and services necessary for complete balancing of systems as shown on the drawings and as specified herein.
- B. Test, balance and adjust every system and piece of equipment installed on this project. They shall include:
 - 1. Toilet exhaust systems
- C. The Mechanical and/or Sheet Metal Contractor shall furnish to the Balancing Contractor a fan curve for each fan serving systems of 2000 cfm or greater and a pump curve for each circulating pump of 50 gpm or greater. Copies of these curves shall be included in the final balance report.
- D. Record all test readings on a standard test outlet form which includes room name or number, terminal device designation, manufacturer, model number, size and Ak factor. Include the design conditions, the initial and each follow-up test readings and the final test results.

1.03 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. General Provisions : Section 23 05 01
- B. Completion and Startup: Section 23 05 03

1.04 RELATED WORK

- A. Sequence of Operation for HVAC Controls: Section 23 09 93
- B. HVAC Fans: Section 23 34 00
- C. HVAC Ducts and Casings: Section 23 31 00

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1.05 QUALITY ASSURANCE

- A. Balancing of the Heating and Air Conditioning Systems: Contractor shall be either:
 - 1. Registered in Indiana, a current member of TABB, NEBB or AABC with 5 years experience, or
 - 2. A registered professional engineer licensed in Indiana that specializes in the adjusting and balancing of systems specified with a minimum of 10 years documented experience.
 - 3. TABIC Certified Contractor
- B. Testing, adjusting and balancing shall be performed under direct field supervision of a Certified TABB, NEBB Supervisor, a Certified AABC Supervisor, Mechanical Engineer, or TABIC Certified Contractor.
- C. Work shall be performed only by a Contractor which employs certified testing and balancing Technicians. If Contractor cannot meet this criterion, then the following information shall be provided for each technician before contract is awarded.
 - 1. Identify each Technician by name.
 - 2. The Technicians shall have successfully completed testing, adjusting and balancing classes and shall present for review their certification of training.
 - 3. The Technician's previous work experiences shall not be less than five years.
 - 4. Technician's references (including contact names and phone numbers) from all jobs during the past 12 months shall be presented.
 - 5. No Technician substitutions will be made without prior approval from the Owner.
- D. Instruments shall be in first class state of repair and have been calibrated within a period of six months prior to starting the job.
- E. Test and Balance Contractor shall not be owned by any of the Contractors on this project which includes the General, Mechanical and Electrical Contractors.

1.06 SUBMITTALS: BALANCING REPORT

- A. Each distribution system shall be schematically drawn (single line diagram) on 8-1/2"x11" sheets of paper. Larger systems may require several sheets. All components and terminal devices shall be shown and labeled. Room names or numbers shall be included.
- B. Record operating data for each piece of equipment on 8-1/2"x11" report form. Data shall include pressures, temperatures, amperages, rpm, etc. as outlined below under Part 2 (2.02) and Part 3.

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- C. Submit report to Contractor of conditions experienced with any piece of equipment or device which did not perform satisfactorily or which required special settings. Include in report, any proposed corrections. Copy the Engineer on all correspondence.
- D. All final reports shall be signed and sealed by the certified Test and Balance Engineer.
- E. Data Sheets
 - 1. Submit data sheets on each item of testing equipment to be used.
 - 2. Include name of device, manufacturer's name, model number, latest date of calibration, and correction factors.
- F. Final Report
 - 1. Upon completion, all information shall be neatly printed and three (3) copies submitted to the Engineer through the Mechanical Contractor with accompanying schematic diagrams of systems tested.
 - 2. All test reports shall be assembled, numbered, indexed, and submitted in vinyl covered loose-leaf, 3-ring notebooks with project name and Balancing Contractor's name permanently printed thereon.

1.07

BALANCING REQUIREMENT: AIR SYSTEMS

- A. The requirement of the air system balance is to direct the specified air quantities as shown on the plans to each of the rooms and zones detailed on the plans. The supply system must be set to provide proper quantities and the return system must be adjusted proportionately for an overall balance of supply air, return air and outside air. A balance of $\pm 5\%$ of total design volume shall be the requirement in overall system balance. But beyond this requirement is providing a comfortable, controlled environment of temperature, humidity, noise, ventilation and air motion.
- B. Should noise problems develop when obtaining design air flow, the Balancing Contractor shall aid the Engineer in determining the cause and assist in determining the solution. If in the opinion of the Balancing Contractor, noise occurs due to poor field duct arrangements, the Balancing Contractor shall also report to the Engineer and Sheet Metal Contractor suggested solutions.

1.08

COORDINATION WITH CONTRACTORS

- A. The Balancing Contractor shall review the fabrication drawings to verify and coordinate the location of all necessary dampers, access doors and duct arrangements to assure a proper air balance can be obtained.
- B. The Balancing Contractor shall review all duct pressure test reports and comment on the results and methods.
- C. Readjustments
 - 1. Should corrective measures caused by faulty installation require retesting, adjusting and balancing, such work shall be at no additional expense to the Owner.
 - 2. Corrective measures, other than the above, shall be made only as directed by the Engineer

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1.09 COORDINATE WITH COMMISSIONING ENGINEER

- A. The Test and Balance Contractor shall include cooperation and coordination with the activities of the Commissioning Engineer in verifying and adjusting systems performance.
- B. Attend commissioning meetings scheduled by the Commissioning Engineer.
- C. Submit the Test and Balance procedures and preliminary Test and Balance report to the Commissioning Engineer, for review at least two weeks prior to beginning Test and Balance work. The preliminary Test and Balance report set-up will be reviewed prior to HVAC equipment startup, in order to assure that the final Test and Balance report format and content is acceptable. Use report forms developed by the Commissioning Agent.
- D. Notify the Commissioning Engineer a minimum of two weeks in advance of scheduled Test and Balance work.
- E. Test and Balance work will be monitored so that any problems that prevent or hinder proper air balance can be addressed and corrected with minimal delays.
- F. A pencil copy of the Test and Balance report shall be reviewed prior to submission of the final Test and Balance report. A written review will be submitted to the Test and Balance Contractor and to the Mechanical Engineer for their comments. A Test and Balance report approved by the Engineer will be required before Functional Performance Testing can be carried out. The Commissioning Engineer will periodically observe the Test and Balance process in order to assist Test and Balance Contractor and Temperature Control Contractor in the effective completion of their scopes of work.
- G. Assist the Commissioning Engineer in system verification and performance testing.
- H. Monitor and respond to deficiency reports distributed by the Commissioning Engineer in order to expedite corrective actions necessary to achieve design intent.
- I. Participate in verification of the Test and Balance report, which will consist of repeating any selected measurement contained in the Test and Balance report where required by the Commissioning Engineer for verification of diagnostics purposes.
- J. Participate in the Functional Performance Testing as required to achieve design intent.
- K. Participate in O&M Training.

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1.10 SYSTEM STARTUP AND INITIAL DUCT TESTING

- A. The Balancing Contractor shall attend scheduled pre-startup meetings.
- B. The Balancing Contractor shall participate in the startup of each system on the project.
- C. After successful startup of each system, perform an initial total air distribution test to determine the system duct leakage. The project requirement is a maximum allowable leakage of 5% total cfm. Should leakage exceed this amount, stop work on that system and notify the Engineer and the contractor. Reference Section HVAC Ducts and Casings, Section 23 31 00.

1.11 RE-INSPECTIONS

Make two (2) return re-inspections during one (1) year warranty period. Each re-inspection shall include a check test of all critical balance conditions including correction or adjustment as required on each system. Coordinate these re-inspections with Owner. These shall be during weather extremes. Send written reports to the Owner and Engineer.

PART 2: PRODUCTS

2.01 INSTRUMENTS

- A. Quality
 - 1. The minimum instrumentation for testing, adjusting and balancing shall be the "TABB", "AABC and/or NEBB Approved Minimum Field Instrumentation".
 - 2. Instruments used for testing and balancing must have been calibrated within a period of six (6) months and checked for accuracy prior to start of work.
 - 3. Instruments must be maintained and carried in such manner to protect them from excessive vibration and moisture conditions.
- B. Approval: All products and instrumentation used shall be subject to approval of the Engineer.

2.02 EQUIPMENT DATA CARDS

- A. Record operating data for each piece of equipment on a card, laminated in plastic and attached to the equipment. Operating data should include all final appropriate data such as pressures, temperatures, amperages, revolutions per minute, which are significant to the normal operating points of the equipment.
- B. Cards shall be 5"x8" and shall include Balancing Contractor's name, address, phone number and date of test.

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PART 3: EXECUTION

3.01 GENERAL PROCEDURES

- A. Balance and adjust the systems to obtain the flow quantities shown on the drawings.
- B. Maintain coordination and communication with the Engineer, Owner, Suppliers and Contractors.
- C. Schedule work so that it may be done while the Contractors are on the job site.
- D. If a piece of equipment is not operating in a satisfactory manner, proactively assist the installing contractor in repairing or adjusting. After corrections have been made, proceed with balancing.
- E. Submit reports to the Engineer if a system or piece of equipment cannot be adjusted to operate satisfactorily.

3.02 BALANCING PROCEDURE: EXHAUST SYSTEMS

- A. Drill probe holes for static pressure duct velocity readings.
- B. Check exhaust fan:
 - 1. Check motor electric current supply and rated running amperage and voltage.
 - 2. Check initial fan and motor speed.
 - 3. Determine available adjustment tolerance.
- C. Proceed through entire duct system, opening all dampers to full open position. If dampers are missing, notify the Sheet Metal Contractor to add the dampers.
- D. Perform main system traverse to determine total air flow. Record initial readings including fan rpm, cfm, total static pressure and motor amperage and voltage.
- E. Adjust belt drive fans to obtain specified total air flow (allow for maximum 5% total system duct leakage). If adjustment in the fan is not available, size a new drive and coordinate the installation of sheaves and belts with the installing contractor.
- F. Upon obtaining specified air flow, proceed with balancing the distribution system.
 - 1. Set all terminal devices at design air flow.
 - 2. Perform as many total system readings until a balance is obtained. Record all readings.
- G. Recheck main system traverse to verify total air flow.
- H. If the distribution system balance is inadequate, determine probable cause. Check duct system for connection integrity and leakage. Notify Sheet Metal Contractor of deficiencies for correction.

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- I. Record the final operating conditions of the exhaust fan including:
 1. Fan rpm and cfm
 2. Motor run amperes
 3. Fan inlet and discharge (if applicable) static pressure

3.03 GENERAL COMPLETION REQUIREMENTS

- A. Reinstall belt guards on fan equipment.
- B. Install plugs in all holes drilled for traverse readings and static pressure readings.
- C. Repair insulation torn or removed as a result of obtaining readings.

END OF SECTION

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SECTION 23 07 13 DUCT INSULATION

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Work shall include all labor, equipment, accessories, materials and services required to furnish and install all insulation, fittings and finishes for ducts and related mechanical equipment in the heating, ventilating and air conditioning systems.
- B. Duct insulation shall be provided for the following systems.
 - 1. Exhaust air ducts

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 23 05 01
- B. HVAC Ducts and Casings: Section 23 31 00

1.03 QUALITY ASSURANCE

- A. Insulation shall be installed by skilled workmen regularly engaged in this type of work.

1.04 SUBMITTALS

- A. Submit product brochures in accordance with Specifications Section 23 05 01, General Provisions.
- B. Submit shop drawings which indicate complete material data, a list of materials proposed for this project and thickness of material for individual services.

1.05 JOB CONDITIONS

- A. Deliver material to job site in original non broken factory packaging, labeled with manufacturer's density and thickness.
- B. Perform work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Repair insulation separated at joints or cracked due to thermal movement or poor workmanship.

1.06 SCHEDULING

- A. Work shall be scheduled by the Mechanical Contractor.
- B. Maintain communication with Mechanical Contractor throughout construction period to assure coordination of the insulation installation with the progress of the duct systems.

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1.07 DEFINITION OF TERMS

- A. Concealed: shall mean hidden from sight and/or access such as in trenches, chases, furred spaces, pipe shafts, or above suspended ceilings.
- B. Exposed: shall mean that duct or equipment is not "concealed" as defined above. Ductwork and equipment in service tunnels, mechanical equipment rooms, storage areas or unfinished rooms are to be considered as "exposed".
- C. Accessible: shall mean above suspended lay-in type ceilings.
- D. Inaccessible: shall mean above suspended ceilings not readily accessed from most areas.

PART 2: PRODUCTS

2.01 GENERAL

Duct insulation coverings and adhesives used shall have a flame spread rating not exceeding twenty five (25) and a smoke developed rating not exceeding fifty (50).

2.02 INSULATING MATERIALS - DUCTWORK

- A. Flexible Blanket: 3/4# density, lightweight, highly resilient, blanket-type thermal and acoustical insulation designed for use to 250°F faced with reinforced foil and paper FSK (foil-skrim-kraft).
- B. Rigid board fiberglass duct insulation: shall be .22 maximum "K" factor at 75 degrees F mean temperature, minimum density 3.00# per cubic feet with integral non-asphaltic fire resistant, laminated vapor barrier jacket of .001" thick aluminum reinforced foil facing glass fiber skim, flameproof laminate, UL approved.
- C. Adhesives: adhesives or mastics used in manufacturer of insulating materials or in application of same shall be fire retardant.

2.03 MISCELLANEOUS JACKET MATERIALS

- A. Flame Resistant: 2 layer laminate of flame resistant creped kraft laminated to .0007 aluminum foil.
- B. Reinforced foil and paper: FSK (foil-skrim-kraft) aluminum foil reinforced with fiberglass yarn mesh and laminated to 40# chemically treated, fire resistant kraft. UL rated.
- C. Exterior jackets: vinyl

2.04 ACCEPTABLE INSULATION MANUFACTURERS

- A. Owens-Corning
- B. Johns-Manville

Cavanaugh Hall – Restroom Renovations– Phase 2

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C. Armstrong

D. Knauf

2.05 ACCEPTABLE INSULATION SUNDRIES/ADHESIVES MANUFACTURERS

A. Benjamin Foster

B. Childers

C. Vimasco

2.06 ACCEPTABLE EXTERIOR MASTIC MANUFACTURERS

A. Childers CP-10

B. Benjamin Foster 3500

PART 3: EXECUTION

3.01 SCHEDULE OF DUCT INSULATION

A. Service

1. All exhaust ducts for ten (10) lineal feet upstream of the penetration thru exterior wall or roof: Type (1)

	<u>TYPE (1)</u>
Insulation	3/4# Flexible Fiberglass
Jacket	FSK
Insulation thickness for all duct sizes	1-1/2"

3.02 PREPARATION

- A. Apply insulation only after ductwork has been tested and cleaned.
- B. Protect furniture, equipment, ducts, pipes, etc. with tarpaulins. Keep premises clean.
- C. Insure surface is clean and dry prior to installation. Insure insulation is dry before and during application.

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3.03 GENERAL INSTALLATION

- A. Application of insulation materials to duct shall be performed in accordance with manufacturers' written recommendations. Where thickness of insulation is not specified, use applicable thickness recommended by manufacturer for specific use.
- B. Provide removable sections of insulation at access points for servicing of the equipment or duct accessories.
- C. All insulation shall be continuous through wall and ceiling openings and sleeves. All covered ductwork is to be located a sufficient distance from walls, pipes, ductwork and other obstacles to permit the application of the full thickness of insulation specified. (If necessary, extra fittings are to be used).
- D. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal.

END OF SECTION

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**SECTION 23 09 93
SEQUENCE OF OPERATION**

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Provide the engineering and documentation required to obtain the sequence of operation for each system as described herein.
- B. Systems include:
 - 1. Toilet exhaust fans on roof
- C. All instruments, room sensors and thermostats shall be field calibrated.

1.02 WORK INCLUDED BUT SPECIFIED ELSEWHERE

Instrumentation and Control Devices: Section 23 09 13

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

3.01 EXHAUST FAN

Toilet exhaust fan shall be reconnected to existing building BMS system and operated on an occupied/unoccupied time schedule as determined by the Owner. Coordinate times and program into BMS associated time schedule.

Existing power and controls to be disconnected and reconnected to replacement fan.

END OF SCHEDULE

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SECTION 23 31 00 HVAC DUCTS AND CASINGS

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Furnish and install equipment, specialties and accessories to provide ducted systems as shown on the drawings and herein specified.
- B. Systems in this section include:
 - 1. Exhaust air
- C. Ductwork shall be constructed to meet the following classification(s).
 - 1. Return air, exhaust air, outside air and mixed air ductwork: negative 2"W.G.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 23 05 01
- B. Assignment of Misc. Work: Section 23 05 02
- C. Noise Control: Section 23 05 50
- D. Testing, Adjusting and Balancing: Section 23 05 93
- E. Duct Insulation: Section 23 07 13
- F. Sequence of Operation for Controls: Section 23 09 93

1.03 REFERENCE MANUALS

- A. SMACNA - HVAC Duct Construction Standards, Metal and Flexible, second edition, 1995.
- B. ASHRAE Guide and Data Book, 2013 Fundamentals edition, Chapter on Air Duct Design.
- C. SMACNA HVAC Air Duct Leakage Test Manual

1.04 GENERAL REQUIREMENTS

- A. Ductwork shall be constructed of galvanized steel or aluminum as noted on the drawings.

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PART 2: PRODUCTS

2.01 RECTANGULAR AND ROUND DUCT

- A. Construct duct of first quality materials in strict accordance with the SMACNA HVAC Duct Construction Standards Manual, Second Edition - 1995, for pressure classification specified herein, unless a more stringent requirement is specified herein.
- B. Duct sizes 19" wide and larger, which have more than 10 square feet of unbraced panels shall be cross braced, unless ducts are noted to be internally lined. This requirement is applicable to 20 gauge or less thickness and 3" W.G. or less.
- C. Fittings
 - 1. Elbows (30" wide and less): use standard radius elbow. Inside radius shall be same as width of duct, unless specifically noted otherwise on the drawings.
 - 2. Elbows greater than (31" wide): use radius elbow where shown on drawings with inside radius the same as the duct width. Otherwise use square elbows with turning vanes. Elbows less than 36" wide shall have single bladed vanes. Elbows 36" and over shall have double blade vanes in airfoil pattern.
 - 3. Main tee connections
 - a. Rectangular to rectangular: radius or 45° inlet
 - b. Round to rectangular: conical connection
 - 4. Branch tee connections: 45° tap in. Provide balancing damper in branch duct to diffuser or grille.
 - 5. Transitions, raises and drops: built so that change in direction does not exceed 20° angle measured at centerline of air flow.

2.02 ALUMINUM DUCTWORK CONSTRUCTION

Apply the conversions applicable to a comparable steel duct gauge of the pressure classification specified, to determine aluminum thickness, reinforcement, and joint connectors.

2.03 T-24, T-24a and T-25b JOINT SYSTEMS

- A. Contractor has option to fabricate the duct system utilizing "Ductmate Industries, Inc."; Lockformers T.D.C., or Engles T.D.F. Joint Systems.
- B. Ducts: Lock forming quality steel with G-90/Z275 zinc coating to A.S.T.M. A525-79.
- C. Fabrication: Ducts and fittings configuration in accordance with performance requirements of SMACNA, and this specification.

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2.04 PENETRATION FIRE STOPPING

- A. Refer to Section 078413 Penetration Firestopping

PART 3: EXECUTION

3.01 GENERAL REQUIREMENTS

- A. All duct dimensions shown on the drawings are inside dimensions, including ducts insulated on inside.
- B. All ductwork shall be installed tight to walls, partitions or underside of the structure except where specific elevations are noted on the plans. Provide offsets to accomplish this and to avoid conflicts with other trades. Provide coordination with electrical, plumbing and sprinkler contractors prior to and during fabrication drawing period. No extra compensation from the Owner or Engineer will be approved for duct sizing and routing revisions required for structural or coordination purposes.
- C. Support ducts suspended from floor and roof structural members with band type hangers if maximum width is 47" or less and with trapeze type hangers if 48" and over. Do not support main ducts from roof decking. Hanger rods shall be minimum of 3/8".
- D. Duct support spacing shall comply with local seismic requirements and in accordance with SMACNA, but in no case greater than 6'-0" O.C.

3.02 DUCT SEALING REQUIREMENTS

- A. All return air, relief air and exhaust ductwork in pressure classification negative 2" w.g. shall be sealed to SMACNA seal Class B: all transverse joints and longitudinal seams.
- B. Neatly caulk all joints, slips and keys to insure an absolutely tight system, suitable to the pressure classification specified.

3.03 DUCT PRESSURE TESTING

- A. Provide equipment and perform duct pressure tests on all completed air distribution systems, to assure the systems are sealed adequately. The Sheet Metal Contractor shall include such tests in his bid. Refer to notes on drawings.
- B. Maximum allowable total system leakage is 10% of the air system volume, for each system, when duct is under the scheduled pressure classification.
- C. Provide temporary caps and seals as required to perform the test(s). The test shall be performed on each complete distribution system as follows:
 - 1. Exhaust air systems from the inlets thru the exhaust fans to the termination point. Note: perform an initial test and submit a report to the commissioning engineer prior to the chase wall construction. Perform a final test when the system is complete and the construction is complete.

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- D. Test procedure shall utilize a calibrated fan assembly to pressurize the duct and record the leakage flow rate in CFM.
- E. Record in report form for each system, the pressure maintained in the duct and the leakage flow rate. Include the date and time of the test and names of those present. Highlight a drawing reflecting extent and number of each test corresponding to the report.
- F. Should the initial air balance reflect that the total system duct leakage exceeds 10% of the total CFM, the contractor will be required to:
 - 1. Notify Owner and Engineer
 - 2. Determine the leakage source(s).
- G. All duct pressure tests shall be witnessed by Owner, Engineer or Construction Manager. Reports shall be submitted to Engineer, Owner, TAB Contractor and Commissioning Engineer. Submit reports within 5 days of test date, complete with drawing reflecting tested duct system.

3.04 COMPLETION REQUIREMENTS

Contractor shall neatly caulk all joints to insure an absolutely tight system. Neatly tape off straight edge lines on duct perimeter prior to applying sealant. Remove tape and trim excess caulking. Clean all exterior surfaces.

END OF SECTION

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SECTION 23 33 00 AIR DUCT ACCESSORIES

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Provide duct system accessories as shown on drawings and as specified herein.
- B. Accessories shall be constructed of the same material as the duct system served.
- C. Accessories included:
 - 1. Volume dampers
 - 2. Balancing dampers
 - 3. Access doors
 - 4. Test holes

1.02 ALLOWANCES

Provide ten (10) access doors of various sizes beyond the quantity defined in the documents. Installation shall be where instructed by the Engineer.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 23 05 01
- B. Testing, Adjusting and Balancing: Section 23 05 93
- C. HVAC Ducts and Casings: Section 23 31 00

1.04 REFERENCE MANUALS

- A. SMACNA - HVAC Duct Construction Standards, Metal and Flexible, second edition, 1995.
- B. ASHRAE Guide and Data Book, 2009 Fundamentals edition, Chapter on Air Duct Design.
- C. SMACNA HVAC Air Duct Leakage Test Manual

1.05 SUBMITTALS

Submit shop drawings on all accessories per Specifications Section 23 05 01, General Provisions.

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PART 2: PRODUCTS

2.01 VOLUME DAMPERS

- A. Furnish and install opposed blade dampers where shown on drawings.
- B. Damper blade construction to be minimum 16-gauge die formed, galvanized steel. Shaft shall be steel with brass or nylon, bronze oilite bearings. Blades shall not exceed 6" wide and 48" long. Frames shall be minimum 16-gauge, die formed, welded channel.
- C. Damper Operators: volume dampers to have external, lock type damper operator and linkage as best suits construction and access conditions. Operators to be provided with locking damper quadrants complete with locking nuts and graduated scale.
- D. Operators to have standoff for thickness of insulation.
- E. Design Base:
 - Low Pressure Rectangular: AWV Model VC-31
 - Low Pressure Round: AWV Model VC-24
 - Medium Pressure Rectangular: AWV Model DAA-P-3274
- F. Manufacturers
 - 1. American Warming and Ventilating, Inc.
 - 2. Ruskin
 - 3. Cesco
 - 4. Arrow
 - 5. Louvers & Dampers, Inc.
 - 6. Nailor Industries
 - 7. Greenheck

2.02 BALANCING DAMPERS (RECTANGULAR)

- A. Furnish and install in each branch takeoff to diffusers or grilles and where shown on drawings.
- B. Dampers to be opposed blade.
- C. Damper blade construction to be minimum 16-gauge die formed, galvanized steel. Shaft shall be steel with brass or nylon, bronze oilite bearings. Blades shall not exceed 6" wide and 48" long. Frames shall be minimum 16-gauge galvanized, die formed, welded channel.
- D. Damper Operators: balancing dampers to have external, lock type damper operator and linkage as best suits construction and access conditions. Operators to be provided with locking damper quadrants complete with locking nuts and graduated scale.

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- E. Operators to have standoff for thickness of insulation.
- F. Manufacturers
 - 1. Ruskin Model #MD35
 - 2. Cesco-Advanced Air #CDS-OB
 - 3. Arrow #1772-OB
 - 4. Louvers & Dampers, Inc. #CD-400
 - 5. AWV #VC-21
 - 6. Nailor Industries
 - 7. Greenheck

Note: Model numbers will vary for aluminum.

2.03 COUNTERBALANCED BACKDRAFT DAMPERS

- A. Furnish and install counterbalanced type automatic backdraft dampers where shown on the drawings.
- B. Dampers assembly shall be heavy duty construction
 - 1. Frame shall be extruded aluminum with minimum wall thickness of .125".
 - 2. Blades shall be extruded aluminum with minimum wall thickness of .070". Blades shall be equipped with vinyl edge seals. Blades shall be linked with aluminum tie bars.
- C. Counterbalance shall be provided on each blade and shall be field adjustable. Damper shall be suitable for relieving at .02 inches w.g. and above.
- D. Operators to have standoff for thickness of insulation.
- E. Manufacturers
 - 1. Ruskin Model #CBD6
 - 2. Nailor Industries
 - 3. Greenheck
 - 4. Or approved equal.

2.04 DUCT ACCESS DOORS (A.D.)

- A. Furnish and install access door at each fire damper, temperature control/motorized damper, upstream of duct mounted coils, and at air flow measuring stations. (Note: Not all access doors are depicted in the drawings.) Coordinate with wall access door locations needed for shafts with the General Contractor.
- B. Construction: double wall 24 gauge galvanized steel or aluminum (same construction as duct) with 1" fiberglass insulation, 1-1/2 lb./cu.ft. density between door and door liner.

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- C. Polyurethane rubber or neoprene gasketing to be on inside of door frame and between duct and door frame. Door metals to be of sufficient gauge for minimizing leakage at various duct pressures. Provide continuous hinges and minimum of two handle type latches. Unhinged access panels are acceptable only where obstructions inhibit door swing.
- D. Access doors shall be 24" x 24" unless duct size is smaller. Access doors for ducts smaller than 24' shall be 2" less than duct size in length and 24" in width.
- E. Manufacturers
 1. Ruskin Type #ADH-2
 2. Duro-Dyne Type #1AD
 3. Curb
 4. Greenheck
 5. Kees

2.05 ACCESS DOORS (FOR DUCT CLEANING)

- A. Fabricate and install access doors for internal duct cleaning, no further apart than 40 lineal feet of duct run, in accessible locations, and where shown on the drawings. Clearly mark all access door locations on the sheet metal fabrication drawings and the record drawings.
- B. Construction: double wall 24 gauge galvanized steel or aluminum (same construction as duct) with 1" fiberglass insulation, 1-1/2 lb./cu.ft. density between door and door liner.
- C. Polyurethane rubber or neoprene gasketing to be on inside of door frame and between duct and door frame. Door metals to be of sufficient gauge for minimizing leakage at various duct pressures. Doors shall be mounted with a duct collar and bolted.
- D. Access doors shall be 24" x 24" unless duct size is smaller. Access doors for ducts smaller than 24' shall be 2" less than duct size in length and 24" in width.
- E. Label these access doors: "ACCESS FOR CLEANING". A purchased glued-on label or stenciled paint maybe used.

2.06 TEST HOLES

- A. Test holes shall be provided before and after coils, filters, mixing plenums and main duct traverse points.
- B. Manufacturer: Duro-Dyne Model TH-1 #8036. Note: Model number will vary for aluminum.

PART 3: EXECUTION

NOT USED

END OF SECTION

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SECTION 23 34 00 HVAC FANS

PART 1: GENERAL

1.01 WORK INCLUDED

- A. Furnish and install fans as scheduled on the drawings and specified herein.
- B. The fan types used on this project are:
 - 1. Rooftop centrifugal belt drive fan

1.02 DESIGN BASE

- A. The construction drawings indicate a system based on the information available to Engineer by a selected manufacturer of equipment. Electrical services, size, configuration and space allocations are consistent with that manufacturer's information.
- B. This manufacturer and other listed or approved manufacturers are encouraged to provide equipment on this project; however, it shall be the Contractor and/or Supplier's responsibility to assure the equipment is consistent with the design base. No extra compensation will be approved for revisions required by the manufacturer for any different services, space, clearances, etc.

1.03 COORDINATION

- A. Provide coordination with the project Air Balance Contractor in the final balance of the fans.
- B. Fan Speed Adjustment: external resistance (static pressure loss) for each fan system has been estimated and noted on the drawings. Fan speed and fan to motor drive will be selected based on this estimated static pressure loss. The static pressure loss is an estimate; actual loss of completed system may vary above or below estimate. Mechanical Contractor shall change pulleys or sheaves, as required, to suit actual job conditions at no additional cost to the Owner. Refer to Specifications Section 23 05 93, Testing, Adjusting and Balancing, for other requirements.
- C. Should corrective work be required after the initial balance, the Contractor shall reimburse the Balancing Contractor for re-balancing. Refer to Specifications Section 23 05 93, Testing, Adjusting and Balancing.

1.04 SPARE PARTS

- A. Furnish a spare set of belts for each, belt driven, fan in the project. Store the belts, clearly marked, as to the fan served, in the respective nearest mechanical room to the fan.

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1.05 QUALITY ASSURANCE

Fans shall bear AMCA Certified Ratings Seal for both air and sound performance.

1.06 RELATED WORK SPECIFIED ELSEWHERE

- A. General Provisions: Section 23 05 01
- B. Assignment of Misc. Work: Section 23 05 02
- C. Completion and Startup: Section 23 05 03
- D. Common Motor Requirements: Section 23 05 13
- E. Identification for Piping and Equipment: Section 23 05 53
- F. Sequence of Operations for Controls: Section 23 09 93
- G. Electrical: Division 26

1.07 SUBMITTALS

- A. Submit shop drawings for each fan to be furnished on this project in accordance with Specifications Section 23 05 01, General Provisions.
- B. Submittals shall include fan curve (graphic) for each fan with the design conditions plotted. (Tables are not acceptable). Forward a copy of each fan curve to the project Balancing Contractor.
- C. Submit installation instructions, parts lists and operation/maintenance data for each fan size and type.

PART 2: PRODUCTS

2.01 CENTRIFUGAL ROOF EXHAUST FAN

- A. Provide, where shown on the drawings, roof type, belt drive centrifugal exhaust fan with a spun aluminum housing of the size and capacity shown on the schedule.
- B. Fans shall have a backward inclined wheel statically and dynamically balanced, heavy gauge bird screen.
- C. Spun aluminum housing shall be secured with stainless steel fasteners.
- D. Fan wheel, drive and motor shall be mounted on rubber-in-shear and compression isolators.
- E. Motor compartment shall be force cooled type.

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- F. Belt drive shall have adjustable cast iron pulleys and single screw adjustable belt tightener.
- G. Motors shall be continuous duty, high efficiency type in accordance with Specification Section 23 05 13, Common Motor Requirements. Motor shall be installed on an adjustable base.
- H. Fan shall be factory primed and painted with two (2) coats of baked enamel. Color by Architect.
- I. Furnish NEMA-3R disconnect
- I. Manufacturers
 - 1. Acme
 - 2. Greenheck
 - 3. Jenn Air
 - 4. Loren Cook
 - 5. Penn Ventilator Domex V-Belt Drive
 - 6. Twin City

PART 3: EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Refer to drawings for location, size, capacity, mounting arrangement, and electrical characteristics for fans.
- B. All fans shall be installed, aligned, lubricated, started and balanced all in accordance with the manufacturer's published instructions.
- C. Maintain the cleanliness of the fans throughout the construction period, internally and externally. At completion, clean and restore the fans to new condition.
- D. Single speed motor starters shall be furnished by Electrical Contractor. Coordinate electrical characteristics with Electrical Contractor.
- E. Fans shall be installed with vibration isolators (where suspended from or supported on structure) and leveled.
- F. Provide a roof curb of the same manufacturer as the fan.
- G. Installed motorized dampers and actuators as shown on the drawings. Include all wiring, conduit and control from the fan starter.

END OF SECTION

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SECTION 26 05 01 GENERAL PROVISIONS

PART 1: GENERAL

1.01 SUMMARY OF WORK

- A. The requirements of the General Conditions, General Requirements, Special Conditions, Instructions to Bidders, Contract Documents and other information bound herewith form a part of and shall govern all work performed under these specifications.
- B. The accompanying electrical drawings are issued as part of this project manual. Any specifications requirements shown on the drawings are equally affective as if included herein. Any omissions of specification are not to be a basis for failure on the part of the Contractor, from installing electrical components required by the systems to operate in the intended manner.
- C. The drawings depict the systems' components and distribution method. Every attempt is made to complete the distribution, however discrepancies may develop in the process. The contractor, within reason, is required to prepare his bid and construction to develop complete and operable systems. (This includes obvious omitted conduit and wire to equipment and fixture connections). In the event of discrepancies in sizes from drawing to drawing, the contractor shall include the cost for the larger size.
- D. Should any work be called for on the drawings, specifications or in the codes, in such a manner that the Contractor cannot, in his judgment, comply with the requirements, then the Contractor shall bring the matter to the attention of the Engineer before proceeding with the work.
- E. The Contractor shall receive, unload, store, protect and install all electrical equipment whether supplied by the Contractor or by the other trades. Equipment furnished by others and received prior to the start of work by the Contractor will be unloaded and stored by others. During the progress of the work, the Contractor shall load and transport such material and equipment to the job site as required. The Contractor shall keep all stored materials clean and protected from the weather.
- F. The Contractor shall be responsible for complete assembly and wiring of all equipment which is purchased disassembled or disassembled for shipping purposes.
- G. Work includes the installation of equipment, conduit and wire and components for complete and operable systems.
- H. This project includes the following systems:
 - 1. Lighting
 - 2. Receptacles