Non-Lab Ductwork | 23 30 00

The following information shall be included in specifications prepared for use on all University of Cincinnati projects. This information is supplemental and not intended to be a complete specification.

GENERAL STANDARDS

General Criteria
This standard section, “Non-Laboratory Ductwork and Accessories” contains the requirements specific to the design and selection of supply air, return air, and exhaust air ductwork and accessories.

This standard section applies to the following AIA/CSI sections:

- 23 31 13 METAL DUCTS
- 23 31 19 HVAC CASINGS
- 23 33 00 AIR DUCT ACCESSORIES

Performance Requirements

Duct Pressure Class - The duct pressure class for all systems shall meet or exceed the maximum anticipated pressure in each section of ductwork and be no lower than 1” water gauge or any of the values stated below. The duct pressure class shall accommodate system malfunctions such as a closed terminal or fire damper that would cause the fan to work against a near dead head.

The design of alternative methods to accommodate system malfunction, such as pressure relief devices, must receive prior approval.

Variable volume systems:
- Design the entire supply air duct system, upstream of the terminal units, to be at the same pressure class. This pressure class shall not be less than 3” water gauge.

Duct Sealing - Ducts shall be sealed according to the duct seal class and maximum leakage class as scheduled in Part 4 of this standard – “FIGURES AND DETAILS”

Acoustical Considerations - Design duct systems to not exceed the NC or RC levels of the spaces served by, penetrated by, and adjacent to the duct systems.

Do not use duct liner in any duct system.

Non fibrous duct liner in attenuating transfer elbows and fittings in return air plenums is permitted.

Materials Installed in Plenums - All materials installed in supply air plenums, return air plenums, or mechanical rooms used as supply or return air plenums shall have a 25/50 flame spread and smoke developed rating as per ASTM E-84.
All ceiling and floor cavities with the potential of conversion to supply or return plenums with future renovations shall utilize the flame spread and smoke developed ratings required for plenums.

**Duct Sizing and Layout** - Size and configure duct systems to minimize the total fan pressure required and accommodate the acoustical requirements discussed in Part 1 – GENERAL of this standard.

Size and configure duct and fan systems that exhaust or relieve air to the outside, or bring in air from the outside, to ensure enough total system pressure to minimize wind-assisted and wind-opposed effects on air balance stability.

Limit duct velocity to 1500 feet per minute for all ducts within occupied spaces, and within plenums and ceiling cavities serving occupied spaces.

**System and Product Coordination**

**Existing Conditions** - The design engineer shall field verify the sizes, quantities, locations, and conditions of all existing ductwork and duct accessories that will be affected by the project. Perform this verification at the start of design.

On renovation projects, obtain the existing supply, return, and exhaust air quantities affected by the renovation. Incorporate these quantities into the new design, where appropriate.

**Access** - Provide access to the interior of ductwork at all locations that require testing, inspection, maintenance, or cleaning. These locations include but are not limited to:

- Fire and smoke dampers
- Turning vanes
- Reheat coils and electric duct heaters

Show all duct access panels and doors on the drawings.

Coordinate all duct access locations with the Architect. Verify the provision of ceiling or wall access at every location of duct access.

**PRODUCT STANDARDS**

**Product Requirements**

**Duct Material** - Lock forming quality G90 galvanized steel as per SMACNA.

**Duct Liner** - Duct liner shall be used only in attenuating transfer elbows and fittings in return air plenums. Use closed cell flexible elastomeric insulation, (AP Armaflex or equal by Rubatex). Mount to the inside of ductwork adhesive and pins.

All duct liner shall meet the 25/50 flame spread and smoke developed ratings as per ASTM E-84.

**Sealant and Gaskets for Metal Ductwork** - Use water based joint and seam sealant for seams and non-gasketed joints.
Flange gaskets shall be Butyl rubber, neoprene, or EPDM with polyisobutylene plasticizer.

All sealants and gaskets shall meet the 25/50 flame spread and smoke developed ratings as per ASTM E-84. Do not use duct tape on any mechanical system for any purpose.

**Product Accessories**

**Manual Volume Dampers** - Provide opposed blade dampers for rectangular ducts and butterfly dampers for round ducts. Each damper shall have a lockable handle oriented parallel to the damper blade. The damper handle shall be large enough to allow visual observation of damper position from the floor level.

**Duct Silencers** - Use packed dissipative type sound attenuators. Glass fibers shall be isolated from the air stream by one of the following methods:
- The system shall utilize a factory applied Mylar or Tedlar film between the perforated interior metal wall and the insulation.
- The insulation shall have a factory applied erosion resistant acrylic coating.

Duct silencers shall meet the 25/50 flame spread and smoke developed ratings as per ASTM E-84.

**Flexible Ducts** - Flexible ductwork shall be helical wire frame, insulated with 1-1/2" glass fiber insulation. Flexible ductwork exposed to view through diffusers and grilles shall be black or dark grey.

**EXECUTION STANDARDS**

**Construction & Installation of Ductwork**

**Duct Schedule** - Galvanized Steel - Ductwork shall be rectangular, round spiral, or oval spiral. The design of duct systems composed of materials other than galvanized steel must be pre-approved. Avoid design or installation of below grade ducts. If below grade ducts cannot be avoided, obtain prior approval for below grade design and obtain prior approval for the duct material. Below grade ducts shall be concrete encased and have provisions for drainage. All joints and seams shall be sealed water tight. Materials that may be accepted include:
- PVC-coated, galvanized steel with thicker coating on duct exterior
- Stainless steel

**Ducts Conveying Unfiltered Air Streams** - Do not design or install devices or obstructions in return or exhaust ductwork that have the potential to collect dust, lint, or other particulate matter. These devices include but are not limited to the following.
- Turning vanes
- Splitter dampers
- Air extractors
- Equalizing grids
- Screens
- Perforated plates

Short radius elbows with splitter vanes are permitted in return air ducts.
**Painting** - Paint the interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat black latex paint over a primer compatible with the duct material.

**Elbows - Rectangular Supply ducts** – Design and install standard radius elbows (R/D = 1.5) wherever possible. If available space will not allow standard radius elbows use mitered elbows with turning vanes.

**Round and oval supply ducts** – Design and install standard radius elbows wherever possible. If available space will not allow standard radius elbows, R/D value may be reduced, as long as the design engineer accounts for acoustical, pressure, and downstream turbulence issues caused by the elbow. In no case, shall the R/D value be lower than 0.75.

**Return and Exhaust Ducts** – Design and install radiused elbows wherever existing space will allow. If space will not allow the use of radiused elbows, mitered elbows may be used as long as the design engineer accounts for acoustical, pressure, and downstream turbulence issues caused by the elbow.

**Turning Vanes** - Use single thickness turning vanes in all elbows requiring turning vanes up to a vane length of 36”. Where duct depth requires turning vanes longer than 36”, use airfoil shaped turning vanes. Do not use standard double thickness vanes or turning vanes with trailing edges.

Turning vanes at fan inlets to reduce system effect may be used with prior approval.

**Branch Configuration** - Design and install takeoffs from mains to branch ducts to minimize pressure drop, and accommodate the acoustical requirements of the space the branch duct serves and the space where the takeoff is located. The following minimum requirements apply:

- Design and install takeoffs from rectangular mains to rectangular branch ducts with 45 degree entry fittings.
- Design and install each takeoff to VAV terminals with a pressure drop that will not limit the required operating range of the VAV terminal. This maximum allowable pressure drop shall be calculated at the terminal design flow and maximum coincident flow in the main duct.
- Do not install air extractors at takeoffs.

**Duct Seal Class and Leakage Class** - Refer to Part 4 Figures and Details, Figure – 1.3.02 Construction & Installation of Ductwork Accessories

**Manual Volume Dampers** - Install balancing dampers at branch duct take-off point for each air inlet and outlet and at all locations in ductwork as required to perform a complete system air balance. When installing butterfly dampers, align the damper axis parallel to the airflow in the main duct, so that the damper cannot act as an air scoop or extractor.

If balancing damper cannot be located at the branch duct take-off point install the damper as far away from the air inlet or outlet as possible.

**Duct-Mounted Access Doors** - All duct access doors shall be installed to open against duct air pressure. Where this is not feasible install removable access panels.

**Remote Damper Operators** - Install remote damper operators for balancing dampers installed above plaster or drywall ceilings. All components of the remote operator shall be exterior to any ductwork.

**Flexible Connectors** - Do not use flexible ducts as flexible connectors.
Flexible connectors are not required at the inlets of non-fan powered terminal units.

Do not use flexible connectors to change the direction of ductwork or to align ductwork with equipment.

Use flexible connectors to connect ductwork to all equipment containing fans, motors, or any other rotating or vibrating devices.

**Flexible Ducts** - Use flexible duct for the alignment of diffusers and take-off ducts only. Flexible duct developed length shall not exceed 5 (five) feet. Total bending shall not exceed 90 degrees. Each bend in flexible duct shall have a center line radius of curvature equal to or greater than the duct diameter. Attach flexible duct to diffusers and ducts with water soluble duct sealant and metal draw bands. Secure insulation at all joints with aluminized tape. Support flexible duct to keep from sagging. Do not support flexible duct from below. Refer to SMACNA HVAC duct construction standards.

Do not use flexible ducts as flexible connectors.

Flexible duct shall not be installed anywhere in the high-pressure side of any Variable Air Volume system (upstream of the terminal units) regardless of the flexible duct pressure ratings. This restriction includes the inlets to VAV boxes.

**Testing & Commissioning**

**Dampers** - Fully demonstrate all dampers and operable devices, after installation, to assure proper operation

**Fire and Smoke Dampers** - Demonstrate the proper operation of 10% of all fire and smoke dampers, at final acceptance inspection. The University Architect shall randomly select the dampers to be demonstrated. Failure of any one of the demonstrated dampers shall require the contractor to check and demonstrate all dampers. Specify that the contractor certify, in writing, that all fire and smoke dampers were demonstrated to operate, and were checked to be in proper position and functional order, after installation

**Leakage Tests** - Test ducts with a pressure class of 4-inch water gauge or higher. Test representative duct sections, selected by the Architect from the sections installed, totaling no less than 50 percent of the total installed duct area for each designated pressure class.
### Figure 1

**DUCT SEAL CLASS / MAXIMUM LEAKAGE CLASS**

\( (C_L) \)

<table>
<thead>
<tr>
<th>NON-LABORATORY DUCTWORK</th>
<th>DUCT PRESSURE CLASS</th>
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<tbody>
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<tr>
<td>INTERIOR</td>
<td></td>
</tr>
<tr>
<td>supply, return, relief, &amp; negative pressure exhaust</td>
<td>rectangular</td>
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<tr>
<td></td>
<td>round / oval longitudinal seam</td>
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<tr>
<td></td>
<td>round / oval spiral seam</td>
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<tr>
<td>EXTERIOR</td>
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<tr>
<td>supply, return, relief, &amp; negative pressure exhaust</td>
<td>rectangular</td>
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<tr>
<td></td>
<td>round / oval longitudinal seam</td>
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<td></td>
<td>round / oval spiral seam</td>
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<tr>
<td>positive pressure portion of exhaust ductwork</td>
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<td></td>
<td>round / oval longitudinal seam</td>
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<td></td>
<td>round / oval spiral seam</td>
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**NOTES:**

Seal class C requires the sealing of all transverse joints
Seal class B requires the sealing of all seams and joints
Seal class A requires the sealing of all seams, joints, and penetrations of ductwork.

Maximum leakage class is the maximum allowable air leakage (cfm / 100 sq. ft.) at 1" W.G. duct static pressure. \( C_L = (\text{cfm} / 100 \text{ sq. ft.}) / (SP)^{0.65} \)

This table is derived from Table 5-2 of HVAC Systems Duct Design, SMACNA – 1990

Tabulated values are not identical to the published SMACNA values.