# SECTION 23 31 00

# HVAC DUCTS and CASINGS

# BASED ON DFD MASTER SPECIFICATION DATED 06/19/2020

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

# P A R T 1 - G E N E R A L

## SCOPE

This section includes specifications for all duct systems used on this project. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

Reference

Reference Standards

Quality Assurance

Shop Drawings

Design Criteria

Delivery, Storage And Handling

PART 2 - PRODUCTS

General

Ductwork Pressure Class

Ductwork System Class

Materials

High Pressure Ductwork (Pressure class 3 inch and over)

Low Pressure Ductwork (Maximum 2 inch pressure class)

Exhaust Duct (Moisture laden air)

Exhaust Subduct

Kitchen Hood Exhaust Duct Construction

Dishwasher Exhaust Duct Construction

Fume Exhaust Duct Construction

Perchloric Acid Exhaust Duct Construction

Dust Collection Exhaust Duct

Duct Sealant

Gaskets

PART 3 - EXECUTION

Installation

Ductwork Support

High Pressure Duct (Pressure class 3 inch and over)

Low Pressure Duct (Maximum 2 inch pressure class)

Exhaust Duct (Moisture laden air)

Kitchen Hood Exhaust Duct Installation

Fume Exhaust Duct Installation

Perchloric Acid Exhaust Duct Installation

Dust Collection Exhaust Duct Installation

Cleaning

Leakage Test

Structural Test

Construction Verification

APPENDIX

Duct Leakage Test Report

Duct Structural Test Report

## RELATED WORK

Section 23 01 30.51 – HVAC Air Duct Cleaning

Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC

Section 23 08 00 – Commissioning of HVAC

Section 23 33 00 – Air Duct Accessories

## REFERENCE

Applicable provisions of Division 1 govern work under this Section.

## REFERENCE STANDARDS

ANSI SS-EN 485-2 Aluminum and Aluminum Alloys-Sheet, Strip and Plate-Part 2: Mechanical Properties

ASTM B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles

ASTM A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A623 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

ASTM A527 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality

ASTM 924 Standard Specification for General Requirements for Sheet Steel, Metallic-coated by the Hot-dip Method

ASTM C 1071 Specification for Fibrous Glass Duct Lining Insulation

ASTM C 411 Test Method for Hot Surface Performance of High Temperature Thermal Insulation

ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials

ASTM C 1338 Test Method for Determining Fungal Resistance of Insulation Materials and Facings

ASTM G 21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

ASTM C 916 Standard Specification for Adhesives for Duct Thermal Insulation

NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems

UL 181 Standard for Safety for Factory Made Air Ducts and Air Connectors.

NAIMA Fibrous Glass Duct Liner Standard

## QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

## SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Include manufacturer's data and/or Contractor data for the following:

* Fabrication and installation drawings.
* Schedule of duct systems including material of construction, gauge, pressure class, system class, method of reinforcement, joint construction, fitting construction, and support methods, all with details as appropriate.
* Duct sealant and gasket material.
* Duct liner including data on thermal conductivity, air friction correction factor, and limitation on temperature and velocity.

## DESIGN CRITERIA

Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.

Use material, weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA publications, unless noted otherwise:

* HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005
* HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012
* HVAC Systems - Duct Design, 4th Edition, 2006
* Rectangular Industrial Duct Construction Standard, 2nd Edition, 2004
* Round Industrial Duct Construction Standards, 2nd Edition, 1999
* Thermoplastic Duct (PVC) Construction Manual, 2nd Edition, 1995

Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

## DELIVERY, STORAGE AND HANDLING

Promptly inspect shipments to ensure that Ductwork is undamaged and complies with the specification.

Protect Ductwork against damage.

Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end caps/packaging are provided, take precautions so caps/packaging remain in place and free from damage.

Offsite storage agreements do not relieve the contractor from using proper storage techniques.

Storage and protection methods must allow inspection to verify products.

# P A R T 2 - P R O D U C T S

## GENERAL

All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral ductwork and spiral duct take-offs 12” and below may be 26 gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005.

Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.

## DUCTWORK PRESSURE CLASS

Minimum acceptable duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G. positive or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure class is 1 inch W.G. positive or negative, depending on the application. Duct system pressure classes not indicated on the drawings to be as follows:

Specify pressure classes in accordance with SMACNA pressure classification equal to 150% of calculated static pressure for the section. Note that this is NOT the static pressure at which the fan is scheduled. When applying the 150% requirement, contact DFD engineering personnel when the pressure classification exceeds 4 inches.

|  | **Calc. S.P. in** | **Pressure Class in** |
| --- | --- | --- |
| Supply duct upstream of VAV boxes |  |  |
| Supply duct downstream of VAV terminals |  |  |
| Transfer air ducts |  |  |
| Exhaust air ducts |  |  |
| Return air ducts |  |  |
| Relief air ducts |  |  |
| Outside air ducts |  |  |
| Mixed air ducts |  |  |
| Other duct systems |  |  |

Consultant should modify the above information as required, paying special attention to unique applications such as dust collection, central fume exhaust, and large central supply systems where higher pressure classes may be necessary. In some cases, it may be clearer to indicate the pressure classes on the drawings in accordance with SMACNA recommendations.

## DUCTWORK SYSTEM CLASS

Duct system classes not indicated on the drawings to be as follows:

Dust Collection Exhaust \_\_\_\_\_ System class

## MATERIALS

Galvanized Steel Sheet:

Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces per square foot, both sides of sheet, G90 in accordance with ASTM A90. Provide “Paint Grip” finish or galvanneal sheet metal for ductwork that will be painted.

Aluminum Sheet:

Use ANSI/ASTM B209 aluminum sheet, alloy 3003H-14, capable of double seaming without fracture.

Stainless Steel Sheet:

Use ASTM A167, Type 304 or 316 stainless steel sheet as specified, 316L if welded ductwork, with No. 2B finish for concealed work and No. 3 finish for exposed work.

Uncoated Black Steel Sheet:

First quality, soft steel sheet capable of welding or double seaming without fracture.

Polyvinylchloride Coated Steel Sheet:

Use hot-dipped galvanized steel sheet with prime coat and a polyvinyl chloride film on both sides. Thickness of coating to be a minimum of 4 mils on each side. United Sheet Metal Uni-Coat, made by United McGill Co., may be used at contractor's option.

Where any duct surface is scratched, marred, or otherwise damaged, paint with PVC aerosol spray.

All couplings shall be slip-joint construction with a minimum 2 inches insertion length. Seal all couplings with sealants as specified.

Prefabricated Grease Ducts:

Dual wall construction with stainless steel inner liner, insulation and stainless steel (for exposed locations) or aluminized steel (for concealed locations) shell. Furnish all items which form a part of the assembly, including, tee sections, straight sections, elbows, end caps, cleanouts, expansion joints, fan/hood transitions, supports, flashing, counter flashing, and insulated roof thimble where required. Each section shall bear the factory applied Underwriters Laboratories Label.

## HIGH PRESSURE DUCTWORK (Pressure class 3 inch and over)

Manufacturers:

Ajax, Semco, United Sheet Metal, Sheet Metal Connectors or approved equal.

Machine formed round and/or flat oval spiral lock seam duct constructed of galvanized steel.

Rectangular high pressure duct using a transverse joint system as manufactured by Ductmate, Nexus, TDC, TDF, or approved equal, may be used at contractor's option. Duct to be flanged, gasketed and sealed.

Contractor fabricated ductwork meeting specified construction standards is acceptable with prior approval of Architect/Engineer. Submit construction details, a description of materials to be used, type of service, reinforcing methods, and sealing procedures.

Use a perforated inner liner on double wall high-pressure duct. Annular space between inner liner and outer duct to be filled with 1 inch glass fiber insulation.

Use cemented slip joints with 2 inch minimum overlap, flanged connections, or welded/brazed connections, unless noted otherwise for special applications. Prime coat welded joints.

Provide standard 90 degree conical tee takeoffs except for exhaust at velocities over 2000 feet per minute, use 45° lateral connections; straight taps or bullhead tees are not acceptable.

Internal bracing will not be accepted on ductwork below 48 inches.

Use turning vanes as specified in Section 23 33 12.

Provide bellmouth fittings or expanded fittings at each duct connection to air plenums.

Provide pressure relief fittings as indicated on the plans and/or details.

Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

## LOW PRESSURE DUCTWORK (Maximum 2 inch pressure class)

Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as modified below.

Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.

Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in accordance with SMACNA publications, Type RE 3. Where space will not allow and the C value of the radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in Section 23 33 00. Square throat-radius heel elbows will not be acceptable. Straight taps or bullhead tees are not acceptable.

Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00.

Provide expanded take-offs or 45 degree entry fittings for branch duct connections with branch ductwork airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not be accepted.

Button punch snaplock construction will not be accepted on aluminum ductwork.

Round ducts may be substituted for rectangular ducts if sized in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission of the Architect/Engineer.

Rectangular duct attenuates noise better than round ductwork. Prior to approving the substitution, verify that substituting round duct for rectangular will not cause a noise problem.

Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

## EXHAUST DUCT (Moisture laden air)

Moisture laden ductwork systems include \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The consultant should define which duct systems fall under this category and/or indicate on the drawings which systems or partial systems are considered moisture laden air exhaust duct.

Exhaust ducts conveying moisture laden air, other than dishwasher exhaust, to be constructed of sheet aluminum in accordance with the pressure class listed in this specification.

Seal all joints and seams watertight

## EXHAUST SUBDUCT

Exhaust subducts shall be constructed from 26 gauge or heavier galvanized steel in accordance with the pressure class listed in this specification.

## KITCHEN HOOD EXHAUST DUCT CONSTRUCTION

Safety and Professional Services SPS 364/IMC 506.3.4 requires that duct systems serving Type 1 grease hoods be sized to provide a duct air velocity of not less than 500 fpm. Size ductwork accordingly.

In concealed locations use minimum 16 gauge black steel or minimum 18 gauge stainless steel with all joints welded liquid tight or prefabricated grease duct, Underwriters Laboratory, Inc listed with aluminized steel shell

Factory prefabricated duct may still require a 2-hr fire rated enclosure or fire stop insulation where concealed and serving a Type I hood (grease vapors or smoke). As of the date of the updated version of this specification section, grease duct manufacturers do not have a product that is Ul listed for grease vapor and smoke application.

In exposed areas, use 18 gauge or heavier stainless steel with a number 3 finish and with all joints welded liquid tight or prefabricated Underwriters Laboratory, Inc listed duct with stainless steel shell. Grind and polish all welded joints and seams to a number 3 finish.

Provide expanded take-offs for branch duct connections or 45 degree entry fittings. Square edge 90 degree take-off fittings or straight taps will not be accepted.

Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits shall be used wherever possible. Shorter radius elbows may be used in areas with limited space with prior approval of the Architect/Engineer.

No turning vanes may be used in kitchen exhaust duct.

Supporting steel and hangers shall not be lighter than the duct gauge.

## DISHWASHER EXHAUST DUCT CONSTRUCTION

Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as indicated below.

Use 18 gauge or heavier stainless steel with all seams and joints welded and ground smooth. In exposed areas, joints and seams to be polished to a #3 finish (minimum).

Use elbows and tees as specified for the appropriate duct pressure class.

Provide expanded take-offs for branch duct connections or 45 degree entry fittings. Square edge 90 degree take-off fittings or straight taps will not be accepted.

## FUME EXHAUST DUCT CONSTRUCTION

Select appropriate materials from among the following items:

Use PVC coated steel or stainless steel duct and fittings. Use stainless steel for all exposed installations below suspended ceilings.

Use 316 stainless steel for flanged gasketed connections.

Use 18 gauge or heavier 316L stainless steel sheet for externally welded ductwork. Grind and polish joints and seams to a #3 finish minimum.

## PERCHLORIC ACID EXHAUST DUCT CONSTRUCTION

Use 18 gauge or heavier, 316 stainless steel with internally and externally welded, ground and polished joints and seams.

***Where exterior appearance is not of concern, polishing of exterior joints and seams may be deleted. All interior joints and seams must be ground and polished to avoid collection of perchlorates that present an explosion hazard.***

## DUST COLLECTION EXHAUST DUCT

Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as modified below.

Use material thickness and reinforcements for the static pressure classification and duct system classification specified.

Provide (partial/complete) penetration welds at all seams and joints.

All flanged connections shall be gasketed. Caulking is not allowed.

All flanges and stiffeners will be of compatible material to that of the attached ductwork.

## DUCT SEALANT

Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peal & Seal, Lockformer cold sealant, Mon-Eco Industries, United Sheet Metal, or approved equal. Silicone sealants are not allowed in any type of ductwork installation.

Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.

## GASKETS

2 Inch Pressure Class And Lower:

Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.

3 Inch Pressure Class And Higher:

Butyl gaskets.

Fume Hood Exhaust:

Butyl gaskets.

# P A R T 3 - E X E C U T I O N

## INSTALLATION

Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with Architect in the event of any interference.

Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Transform, divide or offset ducts as required, in accordance with SMACNA HVAC Duct Construction Standards, Figure 4-7, except do not reduce duct to less than six inches in any dimension and do not exceed an 8:1 aspect ratio. Where it is necessary to take pipes or similar obstructions through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards, Figure 4-8, Fig. E. In all cases, seal to prevent air leakage. Pipes or similar obstructions may not pass through high pressure or fume exhaust ductwork.

Test openings for test and balance work will be provided under Section 23 05 93.

Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in duct systems, and make all connections to such equipment including equipment furnished by others. Secure frames with gaskets and screws or nut, bolts and washers.

Install duct to pitch toward outside air intakes and drain to outside of building. Solder or seal seams to form watertight joints.

Where two different metal ducts meet, the joint shall be installed in such a manner that metal ducts do not contact each other by using proper seal or compound.

Install all motor operated dampers and connect to or install all equipment furnished by others. Blank off all unused portions of louvers, as indicated on the drawings, with 1-1/2 inch board insulation with galvanized sheet metal backing on both sides.

Make sure that the drawings show which louvers require blankoffs and how much of the louver remains active.

Do not install ductwork through dedicated electrical rooms or spaces unless the ductwork is serving this room or space.

Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

Provide adequate access to ductwork for cleaning purposes.

Provide temporary capping of ductwork openings to prevent entry of dirt, dust and foreign material.

Protect diffusers, registers and grilles with plastic wrap or some other approved form of protection to maintain dirt and dust free and to prevent entry of dirt, dust and foreign material into the Ductwork.

Install prefabricated grease ductwork assemblies in accordance with manufacturer requirements and NFPA 96.

During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

## DUCTWORK SUPPORT

Support ductwork in accordance with SMACNA HVAC Duct Construction Standards, Figure 5-5, except supporting ductwork with secure wire method is not allowed.

Stainless steel air-craft cable hanging systems are allowed on round ductwork under 12 inches diameter if installed utilizing two fasteners with two cable loops. Support with 3/32 inch, 7 x 7, stainless steel air-craft cable, with matching serrated spring loaded wedge mechanism fasteners rated for actual load. Comply with the manufacturer’s installation instructions.

## HIGH PRESSURE DUCT (Pressure class 3 inch and over)

Seal all duct in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.

Single wall high pressure ductwork shall be installed as shown on the plans from \_\_\_\_\_ to \_\_\_\_\_.

Double wall high pressure ductwork shall be installed as shown on the plans from \_\_\_\_\_ to \_\_\_\_\_.

## LOW PRESSURE DUCT (Maximum 2 inch pressure class)

Seal all ducts, except for transfer ducts, in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.

Install a manual balancing damper in each branch duct and for each diffuser or grille. The use of splitter dampers, extractors, or grille face dampers will not be accepted for balancing dampers.

Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheet metal screws or pop rivets. Trapeze hangers may be used at contractor's option.

## EXHAUST DUCT (Moisture laden air)

Pitch duct to drain back to equipment or exhaust grille.

Provide watertight drain pan at low points or at locations where moisture may collect. Pipe drain pan to nearest floor drain.

## KITCHEN HOOD EXHAUST DUCT INSTALLATION

Where welded joints are used with black steel duct, coat all external welded joints and seams with paint. Grind and polish to #3 finish all exposed stainless steel joints and seams.

Apply bracing and reinforcement to the outside of the duct to prevent breathing, rattling, vibration or sagging of duct.

Install without forming dips, sag or traps which might collect residue by supporting at not greater than 5 foot intervals; fasteners at hangers shall not penetrate the duct. Do not use sheet metal screws on supports; use bolted, riveted or welded connections. Where ductwork is listed, install in accordance with listing.

Construct grease tight access doors of the same material and thickness as the duct and as large as possible, up to 24 inches in any dimension. Locate on duct sides for ease of inspection and cleaning at each change in direction, not less than every 10 lineal feet of duct, including risers, and not less than 1-1/2 inches from the bottom of the duct.

Insulation or fire protection enclosure shall be removable at each access door and clean out.

Pitch horizontal ducts back to hood at 1 inch per foot.

## FUME EXHAUST DUCT INSTALLATION

For all rectangular duct and round duct 36 inch diameter and larger, apply a bead of PCD sealant at the corrosive side of the gasket. For round duct less than 36-inch diameter, use slip coupling connection sealed with PCD sealant.

Apply duct sealer on male end connectors before insertion, and afterwards to cover the entire joint.

Use 316 stainless steel fasteners to provide mechanical strength at all couplings; galvanized mechanical fasteners will not be accepted. Maximum screw spacing shall be 12 inches o. c. with a minimum of 3 equally spaced screws per joint.

Do not locate screws, rivets, or bolts on the bottom of the duct.

Condensation can form in some fume exhaust systems. Since the fumes being conveyed can be very corrosive, the condensation would be more likely to leak at a fastener location on the bottom of the duct. Fasteners are acceptable "near" the bottom but should never be located at the six o'clock position.

Repair any damage to the PVC coating with a PVC aerosol spray or similar PVC product as soon as installation of the piece with a damaged coating is completed.

## PERCHLORIC ACID EXHAUST DUCT INSTALLATION

Interior and exterior joints and seams shall be ground and polished smooth.

***Where exterior appearance is not of concern, polishing of exterior joints and seams may be deleted. All interior joints and seams must be ground and polished to avoid collection of perchlorates that present an explosion hazard.***

Pitch duct to drain back to hood or other drain point detailed on the drawings.

Proper operation of hood and duct washdown system must be demonstrated prior to acceptance by owner.

Pipe washdown drains to location indicated on plans.

Label perchloric acid exhaust ducts with 4 inch high red stenciled "Perchloric Acid Exhaust" legend every ten feet.

## DUST COLLECTION EXHAUST DUCT INSTALLATION

Provide access doors and cleanout doors where specified and indicated on the drawings and necessary for routine maintenance and replacement of parts or inspection of items concealed in the ductwork.

Construct access and cleanout doors of the same material and thickness as the duct. Size as large as possible, up to 0.5 times the diameter of the ductwork, as measured along its circumference and a maximum of 24 inches. Locate on duct sides for ease of inspection and cleaning at each change in direction, at junctions with vertical ducts, and at devices requiring periodic inspection and maintenance. Locate not less than every 10 lineal feet of duct, including risers. Removable caps may be installed at termination ends on ducts less than 12 inch in diameter.

## CLEANING

Remove all dirt and foreign matter from the entire duct system and clean diffusers, registers, grilles and the inside of air-handling units before operating fans.

Clean duct systems with high power vacuum machines where systems have been used for temporary heat, air-conditioning, or ventilation purposes during construction. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.

## LEAKAGE TEST

Test all ductwork in accordance with test methods described in Section 4 of SMACNA HVAC Air Duct Leakage Test Manual. Do not insulate ductwork until it has been successfully tested. Test pressure shall be equal to the duct pressure class.

Testing of all duct may not be necessary. Verify requirements with DFD engineering.

If excessive air leakage is found locate leaks, repair the duct in the area of the leak, seal the duct, and retest.

Leakage rate shall not exceed more than 5% of the system air quantity for low pressure ductwork, determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.

Leakage rate shall not exceed more that 1% of the system air quantity for high pressure ductwork, determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.

Leakage test for ductwork downstream of air terminal devices may be omitted but will not relieve the contractor from duct sealing requirements.

Submit a signed report to the Division's Construction Representative, indicating test apparatus used, results of the leakage test, and any remedial work required to bring duct systems into compliance with specified leakage rates.

## STRUCTURAL TEST

Random test all ductwork per DFD direction. Do not insulate ductwork until it has been successfully tested. Test pressure shall be equal to the duct pressure class.

Deflection limits shall not exceed those listed in accordance with Chapter 11 of SMACNA HVAC Duct Construction Standards, 3.0 Performance Requirements.

Submit a signed report to the Division's Construction Representative, indicating test apparatus used, results of the structural test, and any remedial work required.

## CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

# APPENDIX

## DUCT LEAKAGE TEST REPORT

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **State of Wisconsin** | |  |  |  |  |  |  | **DFD Project Number:\_\_\_\_\_\_\_\_\_** | | | |  |
| **Department of Administration** | | |  |  |  |  |  |  |  |  |  |  |
| **Division of Facilities Development** | | | |  |  |  |  | **Date Submitted:\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Project** |  | **Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | | | | | | |
|  |  | **Location:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | | | | | | |
|  |  | **Contractor:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| **System** |  | **Fan No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | |  | **Leakage Class (CL):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | |  |
| **Data** |  | **Fan Design CFM:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | **Duct Pressure Class (PC):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | |  |
|  |  |  |  |  |  |  | **Test Pressure (PT):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | |  |
| **Test** |  |  |  |  |  |  |  |  |  |  |  |  |
| **Equipment** | | **Manufacturer:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | **Model No:\_\_\_\_\_\_\_\_\_\_\_** | | | **Serial No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | |
| For large systems, use the reverse side for a simple sketch of the entire duct system. Then use letter designations to | | | | | | | | | | | | |
| indicate the various duct sections being tested at one time. Also use the reverse side for test comments. | | | | | | | | | | | |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| Note that due to normal construction sequencing it is usually necessary to test risers separately prior to enclosing chases. | | | | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | **Design Data** | |  |  |  |  |  | **Field Test Data** | |  |  |
|  |  |  | **Allowable** | | **Diameter** | | **Pressure** | |  |  |  |  |
|  |  |  | **Leakage** | |  |  | **(in. wc.)** | |  |  |  |  |
|  |  | **Duct** | **Leakage** | **CFM** |  |  | **In** | **Across** |  |  |  |  |
| **Duct** | **Duct** | **Surface** | **Factor** | **for** | **Tube** | **Orifice** | **Duct** | **Orifice** |  | **Performed** | **Observed** | **Actual** |
| **Section** | **Shape** | **(Ft2)** | **(P.65CL)** | **Section** | **(D1)** | **(D2)** | **(P)** | **(Pdrop)** | **Date** | **By** | **By** | **CFM** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **TOTAL** |  |  |  |  |  |  |  |  |  |  |  |  |

## DUCT STRUCTURAL TEST REPORT

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **State of Wisconsin** | | | |  | |  |  |  |  |  | **DFD Project Number:\_\_\_\_\_\_\_\_\_** | | | | |  |
| **Department of Administration** | | | | | |  |  |  |  |  |  |  |  |  |  |  |
| **Division of Facilities Development** | | | | | | |  |  |  |  | **Date Submitted:\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | |  |
|  |  | |  |  | |  |  |  |  |  |  |  |  |  |  |  |
| **Project** |  | |  | **Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | | | | | | | | |
|  |  | |  | **Location:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | | | | | | | | |
|  |  | |  | **Contractor:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | | | | | | | | |
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| **System Data** | | |  | **Fan No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | |  |  |  |  |  |  |  |  |
| **Description of Test Method:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | | | | | | | | | | | | |
| **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | | | | | | | | | | | | |
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| **Test Equipment** | | | | **Manufacturer:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | | **Model No:\_\_\_\_\_\_\_\_\_\_\_** | | | **Serial No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | |
|  | |  | | |
| Indicate the various duct sections being tested at one time. Also use the reverse side for test comments. | | | | | | | | | | | | | | | |  |
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|  |  | |  | **Design Data** | | |  |  |  |  |  | **Field Test Data** | | |  |  |
|  |  | |  |  | | **Allowable** | | **Allowable** | |  | **Measured** | | **Measured** | |  |  |
|  |  | |  |  | | **Ductwork** | | **Joint/** |  | **Pressure** | **Ductwork** | | **Joint/** |  | **Per-** | **Wit-** |
| **Duct** | **Ductwork** | | | **Duct** | | **Wall** |  | **Reinforcement** | | **(in. wc.)** | **Wall** |  | **Reinforcement** | | **formed** | **nessed** |
| **Test** | **Shape** | | | **Pressure** | | **Deflection** | | **Deflection** | | **In** | **Deflection** | | **Deflection** | | **By/** | **By/** |
| **Location** | **H** | | **W** | **Class** | | **H** | **W** | **H** | **W** | **Duct** | **H** | **W** | **H** | **W** | **Date** | **Date** |
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END OF SECTION