

TechTips

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Codes and Standards

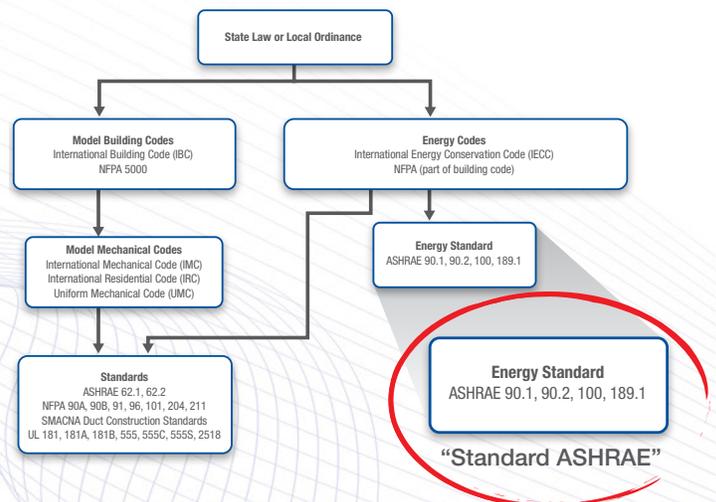
As we all know, the appropriate codes and standards must be followed when performing any work on an HVAC system and/or ductwork. In the previous Tech Tip, we expounded on the UL 181 Standard in detail when it comes to manufacturing a quality product. For this Tech Tip, we will be looking at the codes and standards that come into play when manufacturing and installing ductwork.



We will split this up into two categories: new construction and restoration. In new construction, we are focusing on new buildings and new HVAC systems being installed. In restoration, we are talking about buildings that are being retrofitted, updated, or restored utilizing the existing HVAC ductwork. As always, there are jobs that can be a combination, such as a tear-out and re-fit, that will fall across the two categories.

“In the U.S. private sector, each new construction or renovation project is normally governed by state laws or local ordinances that require compliance with specific health, safety, property protection, and energy conservation regulations,” (2016 ASHRAE Handbook Chapter 19 section 1.) These codes and standards are intended to protect the occupant as well as the contractor doing the work. The hierarchy of codes and standards is shown to the right (recreated from 2016 ASHRAE Handbook).

You will note that this hierarchy flows from the state law and local ordinances level down to the standards. When you’re working with the codes and standards and you determine that there is an issue in matching the state law or local ordinances, you should resolve this with your local building officials (AHJ – authority having jurisdiction). To cloudy up the waters, always remember to check the state and local ordinances in the specific area where you are working, as the local jurisdiction may not have adopted the most recent edition of the codes or standards. In addition, double-check which edition of the code or standard is being enforced. Many times, you will see a state adopt a high-level code, only to find an area in the state that has not adopted or does not enforce the same edition as the state. This difference in codes and standards adopted/enforced can be seen when comparing a large metropolitan area to a smaller city.



New Construction

For new construction, we are looking at the latest codes and standards for the construction, support, and sealing of the ductwork. We will break this down into several groups.

American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

- Handbook of Fundamentals; Duct Design
- Handbook of HVAC Systems and Equipment; Duct Construction

American Society for Testing and Materials (ASTM)

- E-84 – Test Method for Surface Burning Characteristics of Building Materials
- C-731 – Test Method for Extrudability, After Package Aging of Latex Sealants
- D-2202 – Test Method for Slump of Sealants

Sheet Metal and Air Conditioning Manufacturers National Association (SMACNA) HVAC Duct Construction Standards

- Rectangular Industrial Duct Construction Standards
- Round Industrial Duct Construction Standards
- HVAC Air Duct Leakage Test Manual
- Duct Cleanliness for New Construction Guidelines

Underwriters Laboratories, Inc. (UL)

- UL 181 Listed products or systems are used with spiral and rectangular galvanized, stainless, aluminum, and PVC-coated sheet metal duct and are not limited to rigid or flexible fiberglass air ducts and air connectors
- UL 181 B-M Mastic Closure for Use with Flexible Air Ducts
- UL 723 – Test Method for Surface Burning Characteristics of Building Materials

FDA approval based on criteria established by Food Safety and Inspection Services (FSIS) NSF/ANSI Standard 61 Pass

Michigan Department of Quality Criteria (Part 201/213) Acceptable Indoor Air Concentrations

U.S. Coast Guard

City of Los Angeles

SCAQMD

In addition, you have to look at the overarching energy and mechanical codes and how those are tied in to and interlaced with the local building codes.

When looking at the above list, it seems like a lot of reading and understanding is required to make sure your ductwork is done right. However, this list contains essential information about the standards

and codes which, when followed exactly, will make sure the ductwork is built, supported, and sealed correctly and the customer will receive a duct system that will perform its expected duties for years to come.

Restoration

For restoration, we are looking at additional codes and standards for restoring the existing HVAC duct system. The codes and standards listed above for new construction still come into play on restoration work. The duct system must be built and supported correctly. On restoration jobs, you must remember that you are working with an existing building. The duct system within that building should meet the codes and standards that were in place when it was originally built, but prior to ASHRAE 90.1-2010 there was no requirement to test for leakage in the duct system. The only requirement was a simple visual inspection of the duct system to make sure the joints and seams were sealed.

The additional specific codes and standards that are key are:

- a) National Air Duct Cleaners Association - NADCA ACR 2013 (or latest version) – “The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC Systems” defines the appropriate methods for assessment, cleaning, and restoration.
- b) Institute of Inspection Cleaning and Restoration Certification - BSR-IICRC S520 Mold Remediation – “Standard and Reference Guide for Professional Mold Remediation” defines the appropriate methods if mold exists in the HVAC system and/or ductwork.
- c) The Authority Having Jurisdiction (AHJ) must be consulted to verify the above standards are accepted, if not, then the AHJ must define the appropriate standard.

In any sealing job for restoration type work, the NADCA ACR is your first and key step. You must assess the duct system according to the ACR. The IICRC standard may also come into play based on the inspection. Reviewing these findings with the building owner/manager and the AHJ will determine the direction that the restoration work will take in order to continue. In sealing, the product used must adhere to the codes and standards required. Typically, this will mean a UL 181 Listed sealant. The appropriate codes and standards or AHJ will dictate the level of sealing required.

Sealing Verification

In both new construction and restoration, there is an allowable amount of air leakage for the duct system. There are two different ways that the allowable leakage will be defined for the job: per the SMACNA leakage class method or simply as a leakage percentage.

SMACNA and other codes have the following calculations to determine the allowable leakage of a duct system based on the leakage class.

For SMACNA this calculation is:

- Maximum leakage rate allowed = $S_{duct} \times CL \times (P_{design})^{0.65}$
- Where S_{duct} = duct surface area in square feet
- Where CL = leakage class
- And where P_{design} = the design pressure at which the system is to be running (inches of water column)

The leakage percentage calculation is more basic. The calculation is:

- Maximum leakage allowed = $Q_{system} \times F$
- Where Q_{system} = the flow rate of the system in CFM
- And where F = decimal fraction of system flow rate (typical range of 0.01 to 0.05 [1 to 5%])

The leakage percentage calculation is a simple method and the engineer determining the leakage percentage will define the goal. The industry can assist and direct the tightness of the duct systems in terms of allowable leakage per leakage class. SMACNA defines the leakage classes based on seal class, joint and seam type, maximum design pressure, construction, and size. Over time, SMACNA has been tightening the allowable leakage classes as energy efficiency has come more to the forefront.

Table 1-2 shows the seal class. Note that this shows seal classes A, B, and C. Over the last couple of years, engineers and codes have moved the focus to using only seal class A. This is key, as seal class A requires sealing all joints, seams, and duct penetrations. It is a more stringent class and makes sure the duct system is sealed as best as possible.

Table 4-1 (next column) shows the applicable leakage classes. This

Table 1-2 Standard Duct Sealing Requirements		
Seal Class	Sealing Requirements	Applicable Static Pressure Construction Class
A	Class A: All Transverse joints, longitudinal seams, and duct wall penetrations	4" w.g. and up (1000 Pa)
B	Class B: All Transverse joints and longitudinal seams only	3" w.g. (75-0 Pa)
C	Class C: Transverse joints only	2" w.g. (500 Pa)

In addition to the above, any variable air volume system duct 1" (250 Pa) and ½" w.g. (125 Pa) construction class that is upstream of the VAV boxes shall meet Seal Class C.

table was recreated from the SMACNA standard and shows the previous values that were allowed next to the current values. It is important to understand that the leakage class numbers shown in the table are values per 100 square feet of duct surface area. An example would be seal class A for rectangular duct, which allows for leakage

Table 4-1 Applicable Leakage Classes			
Duct Class	½", 1", 2" w.g.	3" w.g.	4", 6", 10" w.g.
Seal Class	C	B	A
Sealing Applicable	Transverse Joints Only	Transverse Joints & Seams	Joints, Seams & All Wall Penetrations
LEAKAGE CLASS			
Rectangular Metal	24- 16	12- 8	6- 4
Round Metal	12- 8	6- 4	3- 2

of 4 CFM per 100 square feet of duct surface area. SMACNA has even created an app that can be used to calculate your allowable leakage. You can find this app by searching for SMACNA or DALC (Duct Allowable Leakage Calculator) on your mobile device.

Summary

Whether you are working on new construction or restoration, building ductwork in a shop, or replacing/repairing ductwork on site, it is vital to know the codes and standards that impact your work, product selection, and ultimately how well the duct system is sealed. Make sure you are working with manufacturers that test and list their products to the latest standards so that your product selection is an easy one. For example, when Hardcast formulates and engineers a duct sealant, whether a mastic or a rolled mastic, we intend for it to perform for the expected life of the ductwork. In addition, Hardcast has now received UL's GREENGUARD Gold* certification on all its water-based liquid sealants. This rigorous testing compliments the proven performance characteristics of Hardcast sealants, provides LEED v4 compliance, and offers an assurance to specifiers, distributors, contractors, and facility managers of long-term safety for building occupants when using Hardcast water-based duct sealants.

**Hardcast water-based liquid sealant are GREENGUARD Gold certified and meet or exceed the requirements of LEED v4, being tested using the California Department of Public Health's CDPH/EHLB/Standard Method V1.2, "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2."*

It is also vital to know what level of codes and standards are adopted and being enforced where you are working. This allows you to strike that perfect balance in meeting the customer's needs and meeting the codes and standards. As always, only you can choose to set yourself apart and work at meeting the latest codes and standards at the highest level and help drive your market to best-in-class efficiency and higher-quality work. If you choose to do that, you will always have a pleased and satisfied end customer. Happy Sealing!



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