Duct Construction

Commonly Used Materials

Galvanized Steel

- APPLICATIONS
  - Widely used as duct material for most air handling systems.

- Advantages
  - High strength, rigidity, durability, rust resistant, availability, non-porous, workability and weldability
Carbon Steel

**APPLICATIONS**
- Breechings, flues, stacks, hoods, other high temperature duct systems, kitchen exhaust systems, ducts requiring paint or a special coating.

**ADVANTAGES**
- High strength, rigidity, durability, availability, paintability, weldability and non porous
Aluminum

**APPLICATIONS**
- Duct systems for moisture laden air, louvers, special exhaust systems and ornamental duct systems

**ADVANTAGES**
- Light weight, resistance to moisture, corrosion and availability

ALUMINUM DUCT
Stainless Steel

APPLICATIONS
- Duct systems for kitchen exhaust, moisture laden air and fume exhaust.

ADVANTAGES
- High resistance to corrosion from moisture and most chemicals and the ability to take a high polish.
**APPLICATIONS**

- Duct systems for exposure to outside elements and moisture laden air, certain chemical exhaust, ornamental ductwork, hoods and architectural sheet metal.

**ADVANTAGES**

- Accepts solder readily, durable, resists corrosion and non magnetic
Fiberglass Reinforced Plastic

- APPLICATIONS
  - Chemical fume exhaust, scrubbers, and underground duct systems
- ADVANTAGES
  - Resistance to corrosion and strength

Polyvinyl Chloride (PVC)

- APPLICATIONS
  - Exhaust systems for chemical fumes and hospitals, underground duct systems.
- ADVANTAGES
  - Resistance to corrosion, weight, weldability and ease of modification

Polyvinyl Steel

- APPLICATIONS
  - Underground duct systems, moisture laden air and corrosive air systems.
- ADVANTAGES
  - Resistance to corrosion and availability.
Concrete

- APPLICATIONS
  - Underground ducts and air shafts.

- ADVANTAGES
  - Compression strength and corrosion resistance

Asbestos Cement (Transite)

- APPLICATIONS (Former)
  - Underground duct systems, Kitchen exhaust, chemical exhaust, high temperature duct systems, flues and vents.

- ADVANTAGES
  - Resistance to most chemicals and can be used up to 2000 deg. F

Sheetrock

- APPLICATIONS
  - Ceiling plenums, corridor air passageways and air shafts.

- ADVANTAGES
  - Cost and availability
Sheet Metal Gage

Gage Definitions

Different types of sheet metal use different gaging methods. The gage of the sheet metal is determined by the size of the duct and the pressure class the duct system is designed to handle.

Carbon (Black Iron), Galvanized Steel & Stainless Steel

These metals are commonly measured by gage. In general, the thickness is halved about every 6 gages. 10 gage is approximately 1/8", 16 gage is approximately 1/16" and 22 gage is approximately 1/32".
Aluminum

Aluminum sheet metal is gaged or measured in decimals of an inch, such as .024, .032, .040 etc. The range of thickness for Aluminum sheet metal is commonly .020 to .120.

Copper

Copper is gaged by ounces per square foot, such as 16 oz. The normal range is from 10 oz. to 48 oz.
Duct Sealants & Duct Leakage Tests

Ducts should be sufficiently airtight, to ensure economical and quiet system performance. However, ducts are not, nor do they need to be absolutely airtight. Proper sealing can be verified by performing a Duct Leakage Test.

There are seven Pressure Test classes listed by inches of water gauge (in. wg), ½ in, 1 in, 2 in, 3 in, 4 in, 6 in and 10 in. If the designer doesn't designate the pressure class, the basis for compliance is 2 in. wg for all ducts between the supply fan and the VAV (variable air volume) boxes and 1 in. wg for all other ducts in the system.
It is generally not recommended to leakage test duct systems that are constructed to 3 in. wg or less, as it is normally not cost effective when adequate assembly and sealing methods are used.

Sealing Requirements Table 1-2

<table>
<thead>
<tr>
<th>SEAL CLASS</th>
<th>SEALING REQUIRED</th>
<th>STATIC PRESSURE CONSTRUCTION CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>All transverse joints, longitudinal seams and duct wall penetrations</td>
<td>4&quot; w.g. and up</td>
</tr>
<tr>
<td>B</td>
<td>All transverse joints and longitudinal seams</td>
<td>3&quot; w.g.</td>
</tr>
<tr>
<td>C</td>
<td>Transverse joints</td>
<td>2&quot; w.g.</td>
</tr>
</tbody>
</table>

In addition to the above any variable air volume system duct of 1" and 1/2" w.g. construction class that is upstream of the VAV boxes shall also meet Seal Class "C"
Cross Breaking or Beading

- Must be Cross Broken or Beaded if:
  - The duct is 19" wide and larger and has more than 10 square feet of unbraced panel.
  - Applicable to 20 gage or less and 3" w.g or less
  - It is unnecessary to break or bead all sides unless each duct dimension requires it

Cross Break

Beaded Duct

First bead 6" in from end

Typical Beads

Joints

Beads at 12" spacing
Transverse Joint Reinforcement

R is an allowed reinforcement interval

Intermediate Reinforcement

R

Tie ends of reinforcement at 4" W.G. and up

Tie

Unreinforced side

REINFORCEMENT

Accoustical Duct Lining
Duct Liner

Air flow

Detail "A"

When velocity exceeds 4000 FPM use metal nosing on every leading edge.

Pin Spotting
Good Fittings
Bad Fittings

Static Pressure
- The pressure exerted in all directions
- Restrictions in the duct system cause static pressure
- Static pressure (if not by design) is the number one enemy of the duct system

Increasing Static Pressure
- Reasons Static Pressure is Increased
  - Friction Loss
  - Dynamic Loss
RESISTANCE
FRICION LOSS
CAUSED BY THE AIR RUBBING THE WALLS OF THE DUCT
CAUSED WHEN AIR IS FORCED TO CHANGE DIRECTION OR FLOW AROUND OBSTRUCTIONS

ASPECT RATIO

SMACNA FRICTION LOSS IN FITTINGS
- The next slides are based on:
  - a typical low pressure system
  - Duct area = 650 Sq. In. or approximately 36” by 18”
  - CFM = 6580 at 1850 FPM
  - shown in equivalent feet of duct
Round Elbows

Radius elbows should use a minimum of 1 duct diameter for the throat radius.

Stamped Elbow
10’ of Duct

3 Gore Elbow
22’ of Duct

Stamped Elbow
10’ of Duct

4 Gore Elbow
18’ of Duct

Stamped Elbow
10’ of Duct

5 Gore Elbow
16’ of Duct
Mitered Elbow

2 Gore Mitered Elbow
Equivalent to
79' of Duct

Rectangular Elbows

Sq. Elbow no vanes
79' of Duct

Sq. Elbow with vanes
10' of Duct (Double Vanes)

Radius Elbow
10' of Duct
Rectangular Elbows

- Rectangular Elbow
  - No Vanes
  - 85' of Duct
- Rectangular Elbow
  - Radius Throat and Heel
  - 14' of Duct

Rectangular Elbows

- Radius Elbow
  - 10' of Duct
- Radius Heel Elbow
  - W/ Square Throat
  - 79' of Duct

Rectangular Elbows

- Double Elbow
  - No Vanes
  - 171' Duct
- Double Elbow
  - No Vanes
  - 276' Duct
Two manuals which you might find helpful.

HVAC Duct Systems Inspection Guide & HVAC Duct Construction Standards
Available from SMACNA

Thank You!!