Duct Construction

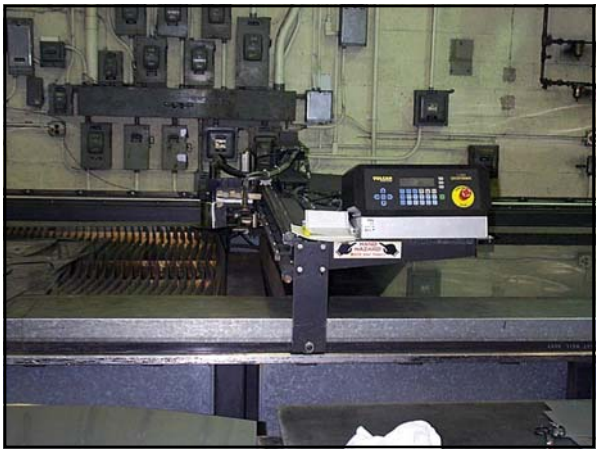
Commonly Used Materials

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

STAINLESS STEEL DUCTWORK

Welded Stainless Steel
with # 4 Finish

Stainless
Steel with
8 Finish

Copper

- 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)

- APPLICATONS
  - 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

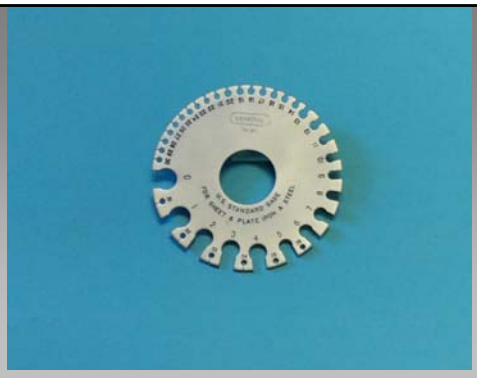
Sheet Metal Gage

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".



Typical Sheet Metal Gage

Aluminum

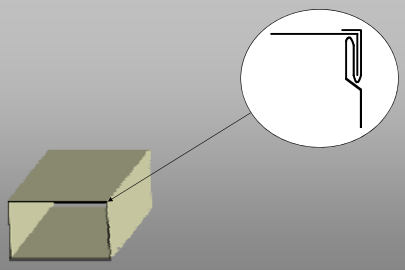
Aluminum sheet metal is gaged or measured in decimals of an inch, such as .024, .032, .040 etc. The range of thickness for Aluminum sheet metal is commonly .020 to .120.

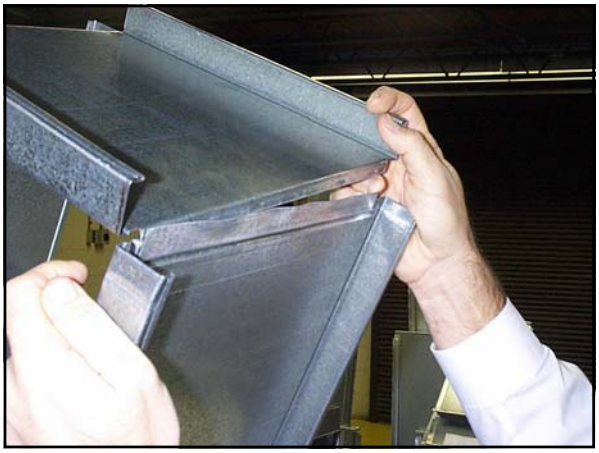
Copper

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

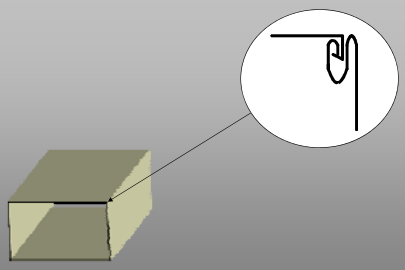
Seams, Locks and Connectors

PITTSBURGH LOCK

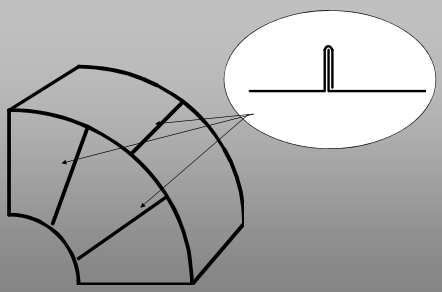


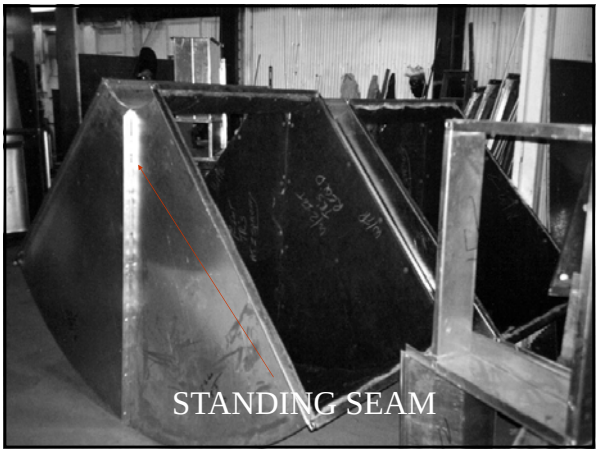


SNAP LOCK

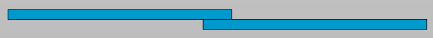


STANDING SEAM

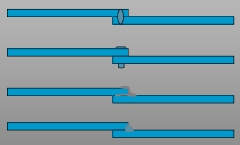




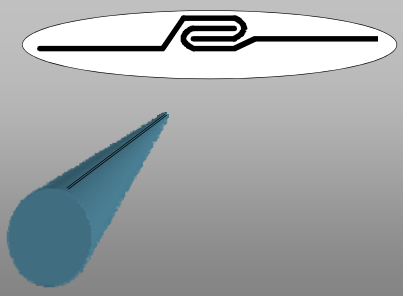
LAP SEAM



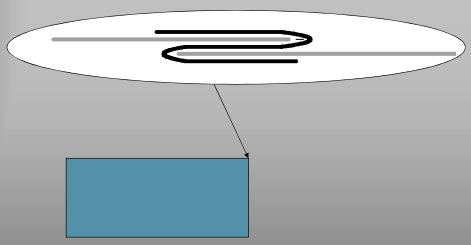
- Spot weld
- Pop Rivet
- Solder
- Weld



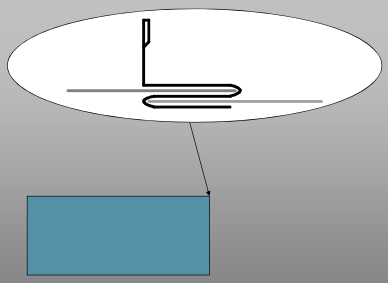
ACME LOCK/PIPE SEAM



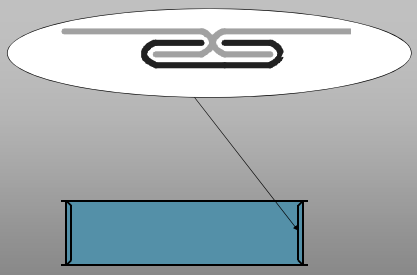
FLAT “S” CLEAT



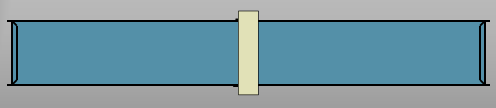
STANDING “S” CLEAT



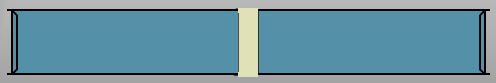
DRIVE CLEAT



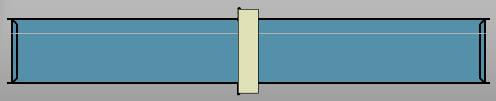
“S” & DRIVE CONSTRUCTION



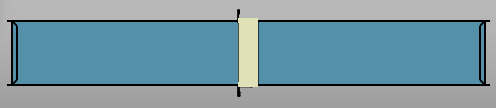
"S" & DRIVE CONSTRUCTION



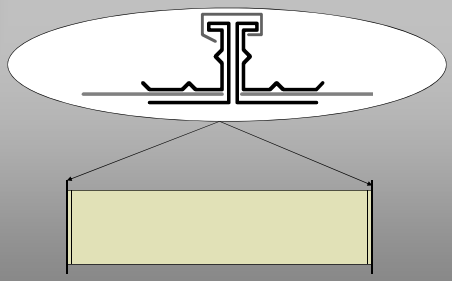
STANDING "S" & DRIVE CONSTUCTION



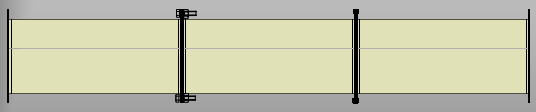
STANDING "S" & DRIVE CONSTUCTION



DUCT MATE

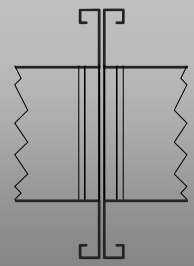


DUCTMATE CONSTRUCTION

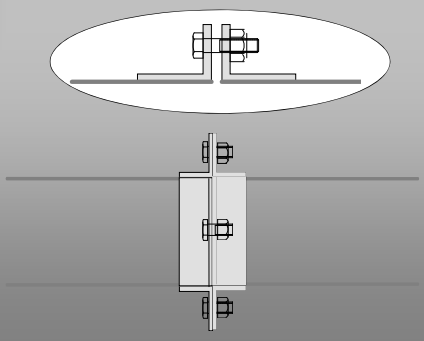


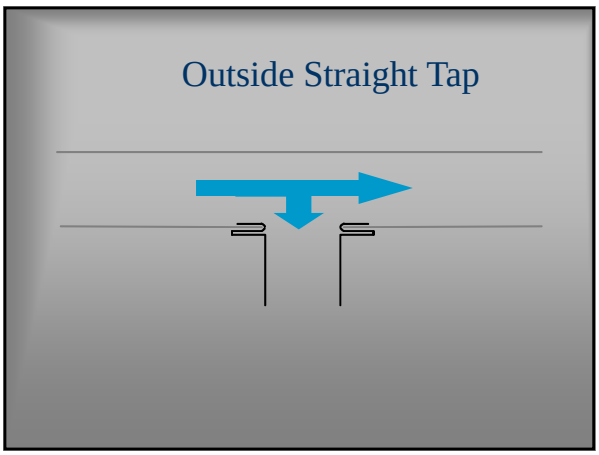
TDC

Transverse Duct Connector

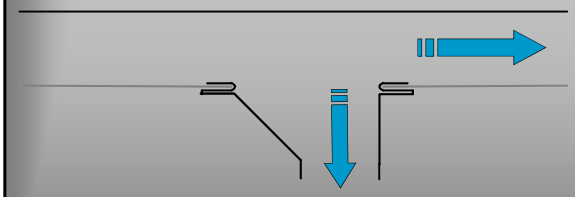


COMPANION FLANGE

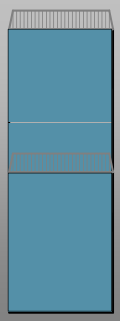



Outside Straight Tap

45 Degree Tap



Crimp & Bead



BEADED COLLAR

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 1-2
DUCT SEALING REQUIREMENTS

SEAL CLASS	SEALING REQUIRED	STATIC PRESSURE CONSTRUCTION CLASS
A	All transverse joints, longitudinal seams and duct wall penetrations	4" w.g. and up
B	All transverse joints and longitudinal seams	3" w.g.
C	Transverse joints	2" w.g.

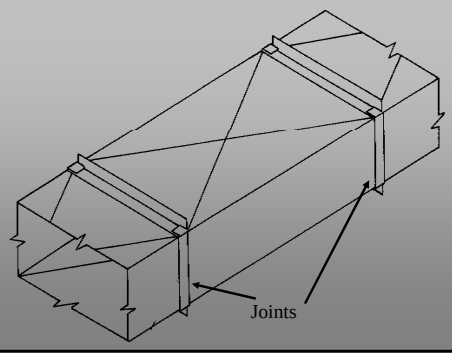
In addition to the above any variable air volume system duct of 1" and 1/2" w.g. construction class that is upstream of the VAV boxes shall also meet Seal Class "C"

Rectangular Duct Reinforcement

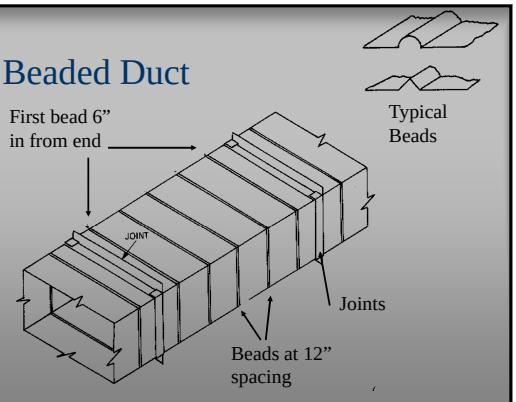
Cross Breaking or Beading

- 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



BEADED DUCT

DUCT DIMENSION (in.)	PRESSURE CLASS (in. wg) Positive or Negative						
	½	1	2	3	4	6	10
8	26	26	26	24	24	24	22
9–10	26	26	26	24	22	20	18
11–12	26	26	24	22	20	18	16
13–14	26	24	22	20	18	18	
15–16	26	22	20	18	18	16	
17–18	26	22	20	18	16		
19–20	24	20	18	16			
21–22	22	18	16	16			
23–24	22	18	16	16			
25–26	20	18	REINFORCEMENT IS REQUIRED				
27–28	18	16					
29–30	18	16					
31–36	16						

This table gives minimum duct wall thickness (gage) for use of flat type joint systems. Plain S and hemmed S connectors are limited to 2 in. wg maximum. Slips and drives must not be less than two gages lighter than the duct wall nor below 24 gage. Double S slips must be 24 gage for ducts 30 in. (762 mm) wide or less and 22 gage for greater width.

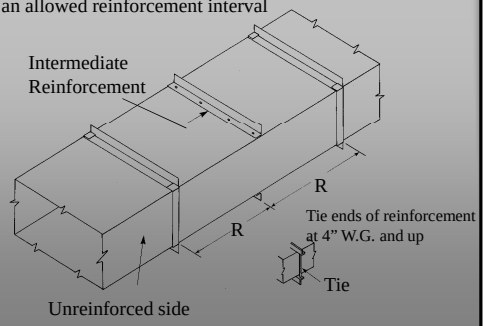
Duct Gage	26 to 22	20	18	16
Minimum Flat Slip and Drive Gage	24	22	20	18

See Figure C-3 for joint types.

Table C–3 Unreinforced Duct (Wall Thickness)

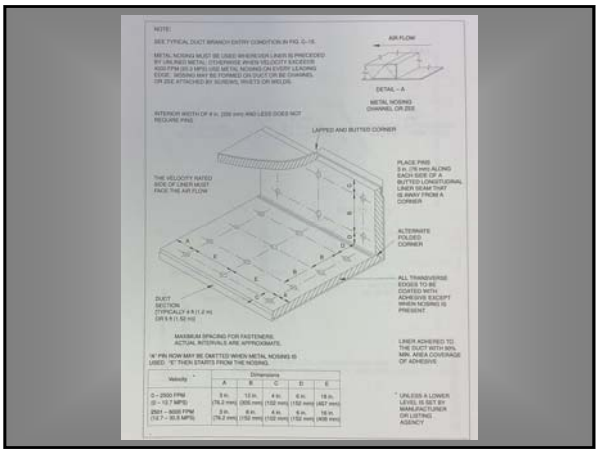
Transverse Joint Reinforcement

R is an allowed reinforcement interval

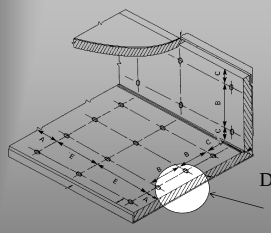


REINFORCEMENT

Accoustical Duct Lining

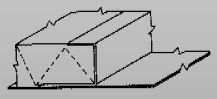


Duct Liner



Detail "A"

Air flow



Detail "A"

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

Air flow

Pin Spotting

Good Fittings
Bad Fittings

Static Pressure

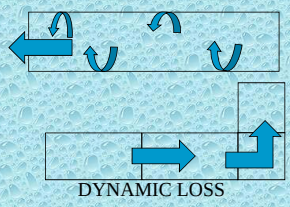
- The pressure exerted in all directions
- Restrictions in the duct system cause static pressure
- Static pressure (if not by design) is the number one enemy of the duct system

Increasing Static Pressure

- Reasons Static Pressure is Increased
  - Friction Loss
  - Dynamic Loss

RESISTANCE

FRICTION LOSS



CAUSED BY THE AIR RUBBING THE WALLS OF THE DUCT

CAUSED WHEN AIR IS FORCED TO CHANGE DIRECTION OR FLOW AROUND OBSTRUCTIONS

DYNAMIC LOSS

ASPECT RATIO

PERIMETER = 62.83"
AREA = 324 sq.. in

PERIMETER = 72"
AREA = 324 sq.. in
RATIO = 1 - 1

PERIMETER = 78"
AREA = 324 sq.. in
RATIO 2.25 - 1

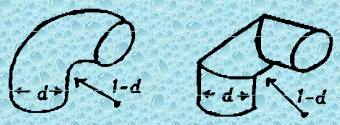
PERIMETER = 90"
AREA = 324 sq.. in
RATIO 4 - 1

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

Round Elbows

Stamped Elbow
10' of Duct

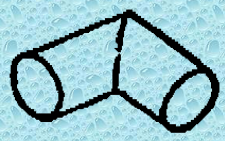
4 Gore Elbow
18' of Duct

Round Elbows

Stamped Elbow
10' of Duct

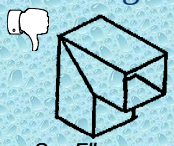
5 Gore Elbow
16' of Duct

Mitered Elbow

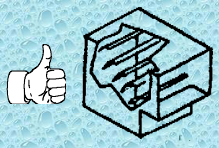


2 Gore Mitered Elbow
Equivalent to
79' of Duct

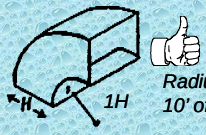
Rectangular Elbows



Sq.. Elbow no vanes
79' of Duct

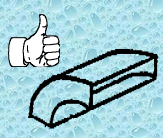


Sq.. Elbow with vanes
10' of Duct (Double Vanes)

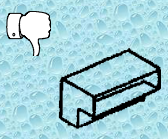


Radius Elbow
10' of Duct

Rectangular Elbows

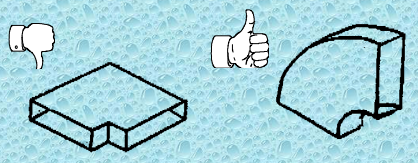


Rectangular Radius Elbow 10' of Duct



Rectangular Elbow No Vanes 79' of Duct

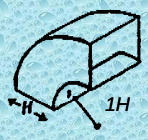
Rectangular Elbows



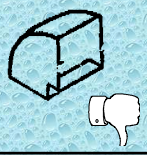
Rectangular Elbow
No Vanes
85' of Duct

Rectangular Elbow
Radius Throat and Heel
14' of Duct

Rectangular Elbows

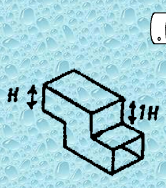


Radius Elbow
10' of Duct

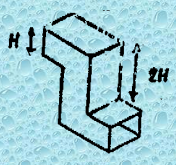


Radius Heel Elbow
W/ Square Throat
79' of Duct

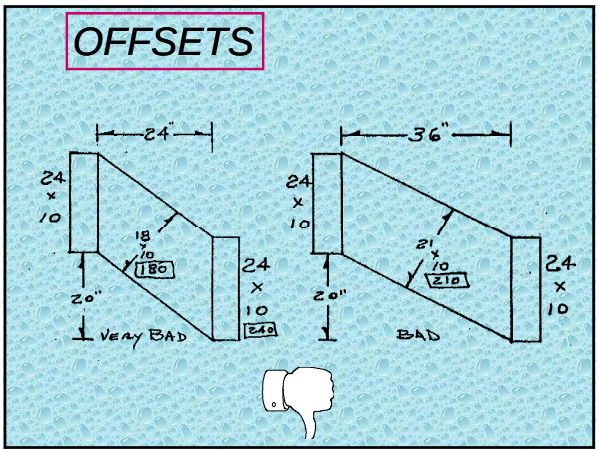
Rectangular Elbows

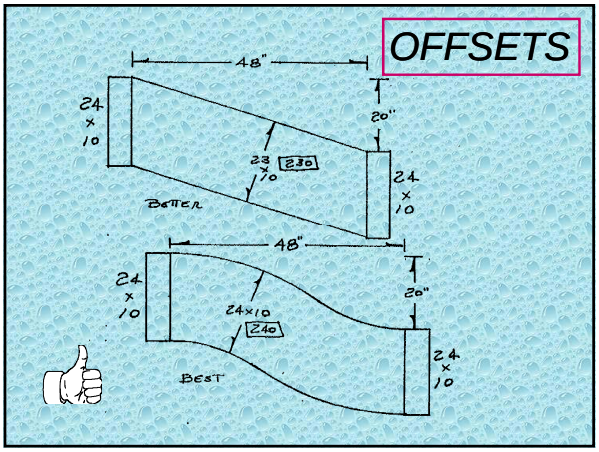


Double Elbow
No Vanes
171' Duct



Double Elbow
No Vanes
276' Duct


OFFSETS
24"
36"
24 x 10
18 x 10
180
20"
VERY BAD
21 x 10
210
BAD


OFFSETS
48"
20"
23 x 10
230
BETTER
24 x 10
24x10
240
BEST

Two manuals which you might find helpful.

HVAC Duct Systems Inspection Guide
&
HVAC Duct Construction Standards

Available from SMACNA

Thank You !!