SHEET METAL & AIR CONDITIONING
CONTRACTORS' NATIONAL ASSOCIATION

Connecticut Chapter of ASHRAE

Duct Systems Inspection

December 12, 2024

Learning Objectives

Overview of the following Standards:

1. HVAC Duct Construction
2. HVAC Accessories
   - (Fire & Fire/Smoke Dampers)
3. Duct Inspection Guide

SHEET METAL & AIR CONDITIONING
CONTRACTORS' NATIONAL ASSOCIATION

Section-01

HVAC DUCT CONSTRUCTION

Information Required for Duct Construction

ENGINEER

- Design Conditions:
  - CFM
  - Static Pressure
  - Duct Size
  - Fitting Types
  - Duct Pressure Class

CONTRACTOR

- Construction Considerations:
  - Duct Pressure Class
    - As Specified by the E.O.R.
  - Duct Dimensions
    - Panel Width and Height
  - Panel Thickness (Gage)
  - Joint Type and Spacing
  - Intermediate Reinforcement
    - Type and Spacing
  - Sealing Requirements

Information Required for Duct Construction

- Table 1-3: Static Pressure

Duct Pressure Class		Operating Pressure
in. wg	Pa	
½	125	Up to ½ in. wg
1	250	Over ½ in. up to 1 in. wg
2	500	Over 1 in. up to 2 in. wg
3	750	Over 2 in. up to 3 in. wg
4	1000	Over 3 in. up to 4 in. wg
6	1500	Over 4 in. up to 6 in. wg
10	2500	Over 6 in. up to 10 in. wg

Table 1–3 Static Pressure

Snapshot: Page 1.18

Information Required for Duct Construction

Table 1-1: Standard Duct Sealing Requirements

- Seal Class A = Most Stringent
  - 4in. wg. and above
  - All Joints / Seams / App. Penetrations
- Seal Class B
  - 3in. wg. and above
  - All Joints & Seams
- Seal Class C
  - 2in. wg. and above
  - Transverse Joints Only

Seal Class	Sealing Requirements	Applicable Static Pressure Construction Class
A	Class A: All Transverse joints, longitudinal seams, and duct wall penetrations	4 in. wg and up (1000 Pa)
B	Class B: All Transverse joints and longitudinal seams only	3 in. wg (750 Pa)
C	Class C: Transverse joints only	2 in. wg (500 Pa)
In addition to the above, any variable air volume systems duct of 1 in. (250 Pa) and ½ in. wg (125 PA) construction class that is upstream of the VAV boxes shall meet Seal Class C.		

Table 1–1 Standard Duct Sealing Requirements

Terms and Definitions

- **Seams**
  - The joining of two longitudinally oriented edges (in the direction of airflow) of the duct surface material occurring between two joints.
    - Figure 2-2: Rectangular Duct / Longitudinal Seams
      - Typical Seam styles
      - Seams are designated with an “L-x”
        - Ex: “L-1” = Pittsburgh Lock
    - Includes “helical” seams (Spiral)

Terms and Definitions

- Longitudinal Seams
  - Figure 2-2
  - Page 2.10

Let's take a Closer Look at these Details…

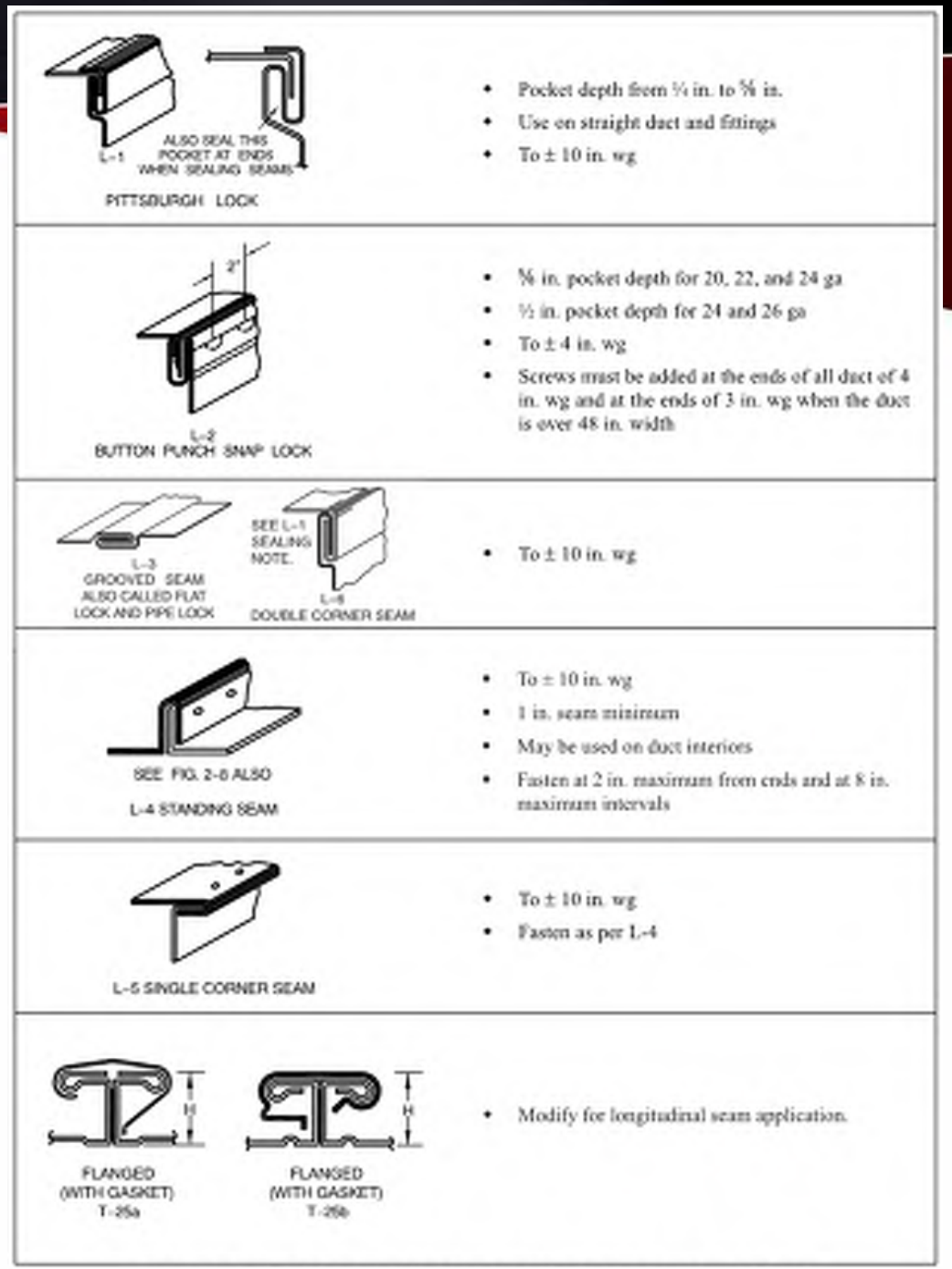
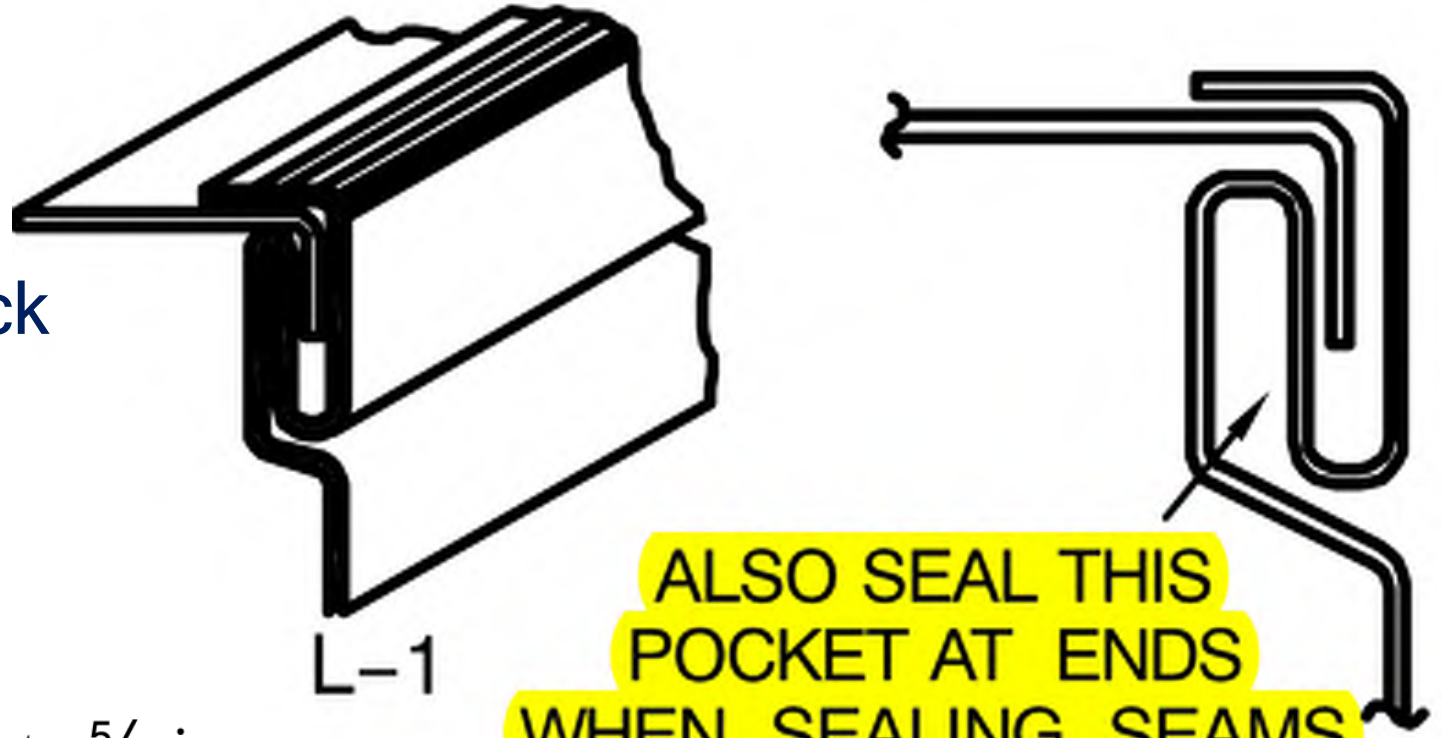


FIGURE 2–2 RECTANGULAR DUCT/LONGITUDINAL SEAMS

Terms and Definitions

- **Longitudinal Seams**
  - L-1 Pittsburgh Lock

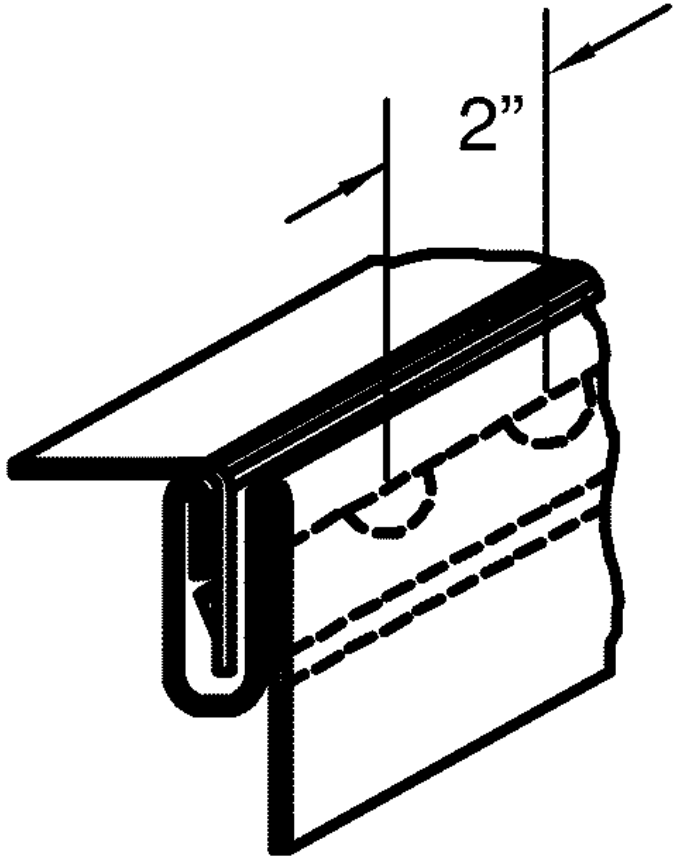


PITTSBURGH LOCK

- Pocket depth from ¼ in. to ⅝ in.
- Use on straight duct and fittings
- To ± 10 in. wg

Terms and Definitions

- Longitudinal Seams
  - L-2 Button Punch Snap Lock
    - ⅝ in. pocket depth for 20, 22, and 24 ga
    - ½ in. pocket depth for 24 and 26 ga
    - To ± 4 in. wg
    - Screws must be added at the ends of all duct of 4 in. wg and at the ends of 3 in. wg when the duct is over 48 in. width



L–2
BUTTON PUNCH SNAP LOCK

Terms and Definitions

- **Longitudinal Seams**

  - T-25a / T-25b
  - (TDC/TDF)

FLANGED
(WITH GASKET)
T–25a

FLANGED
(WITH GASKET)
T–25b

- Modify for longitudinal seam application.

Terms and Definitions

- **Transverse Joints**
  - All other duct wall connections are deemed to be Joints
    - Girth Joints:
      - Joining two sections of ducts
    - Branch and Sub-branch intersections
    - Duct Collar Tap-ins, Fitting sub-sections
    - Louver and Air Terminal connections to ducts
    - Access Door and Access Panel FRAMES
    - Abutments to building structures
      - Plenums / Fresh Air Intakes

Terms and Definitions

- **Transverse Joint Connections**

- Figure 2-1: Rectangular Duct / Transverse Joints
  - Pages 2.6 through 2.9
  - Illustrations of Common Connection Methods (Joints)
    - Each Connection is given a “T-x” Designation
- Each Connection (T-x) has a list of “Rules” for use
- Each Connection may Qualify as Reinforcement

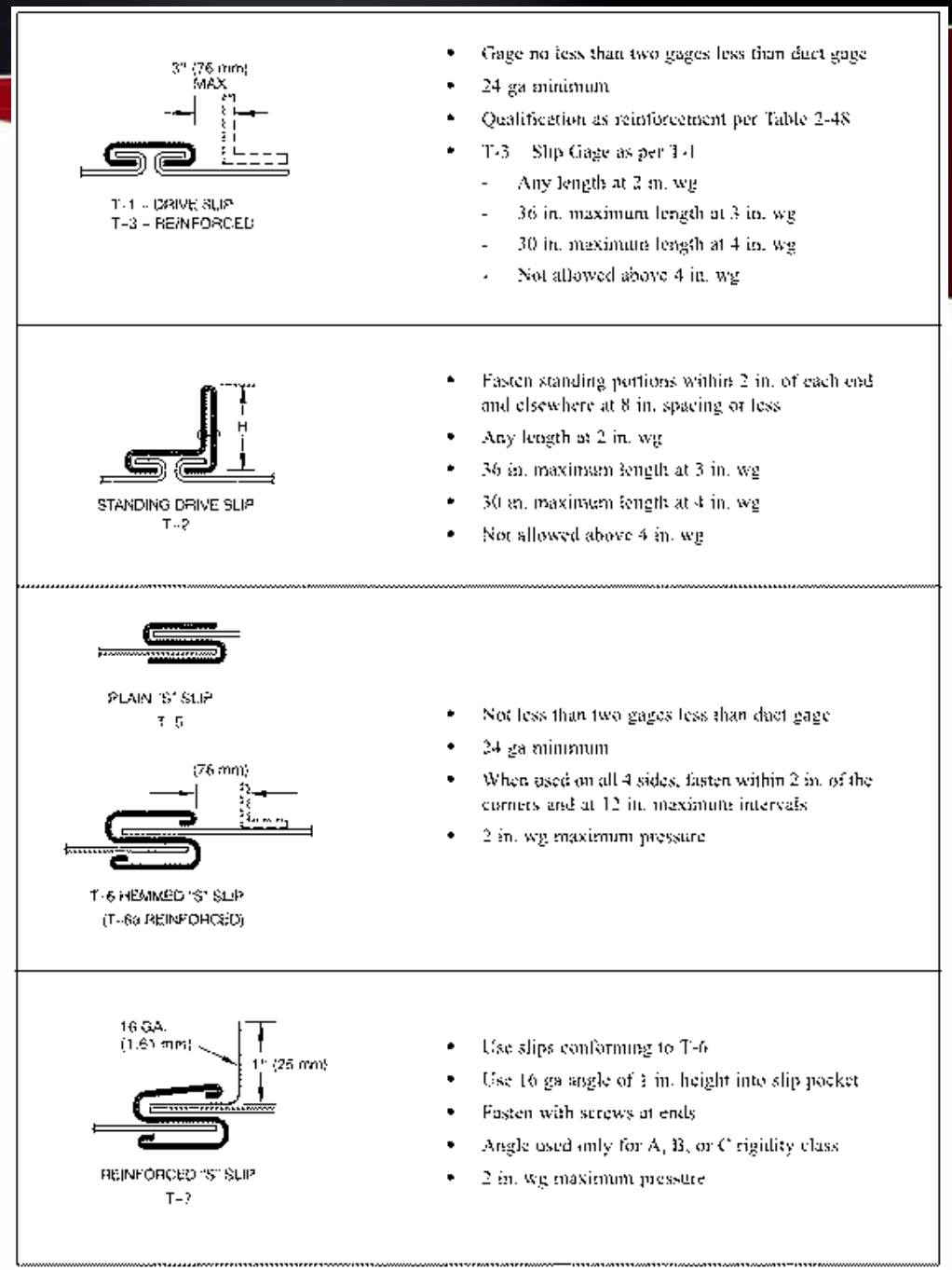
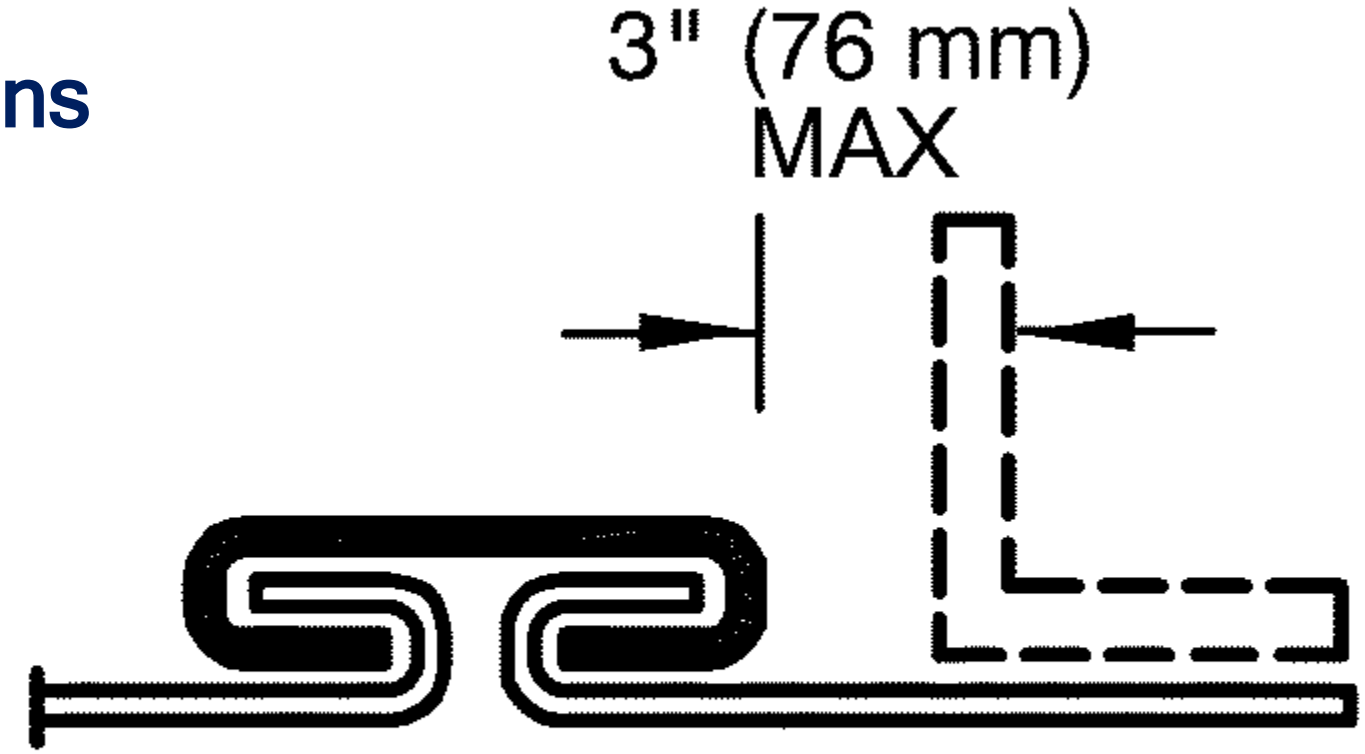


FIGURE 2-1 RECTANGULAR DUCT/TRANSVERSE JOINTS

Terms and Definitions

- **Transverse Joint Connections**
  - T-1 Drive Slip
  - T-3 Reinforced Drive Slip

- Gage no less than two gages less than duct gage
- 24 ga minimum
- Qualification as reinforcement per Table 2-48
- T-3 Slip Gage as per T-1
  - Any length at 2 in. wg
  - 36 in. maximum length at 3 in. wg
  - 30 in. maximum length at 4 in. wg
  - Not allowed above 4 in. wg



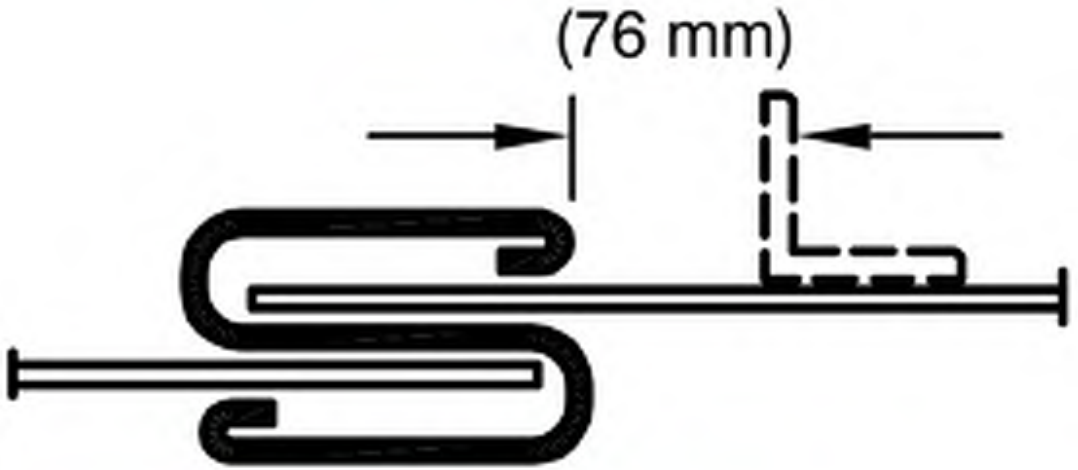
T–1 – DRIVE SLIP
T–3 – REINFORCED

Terms and Definitions

- **Transverse Joint Connections**
  - T-5 Plain “S” Slip
  - T-6 is a T-5 with Hemmed Edges

PLAIN “S” SLIP

T–5



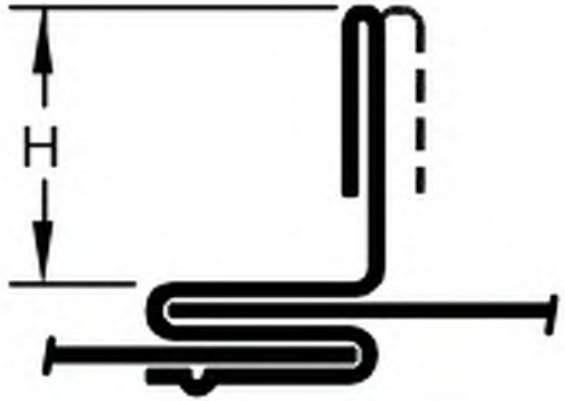
T–6 HEMMED “S” SLIP

(T–6a REINFORCED)

- Not less than two gages less than duct gage
- 24 ga minimum
- When used on all 4 sides, fasten within 2 in. of the corners and at 12 in. maximum intervals
- 2 in. wg maximum pressure

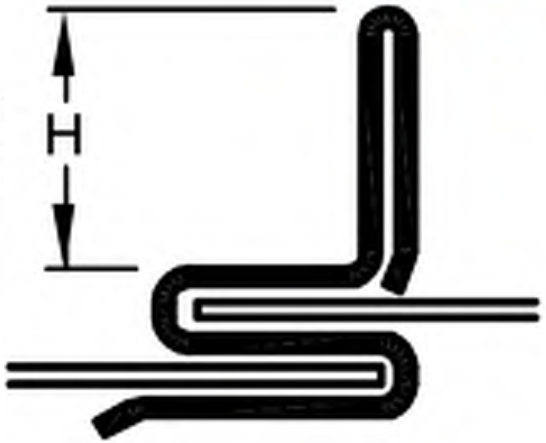
Terms and Definitions

- **Transverse Joint Connections**
  - T-10 Standing “S”
  - T-11 & T-12
    - Alternates to a T-10 with higher reinforcement values

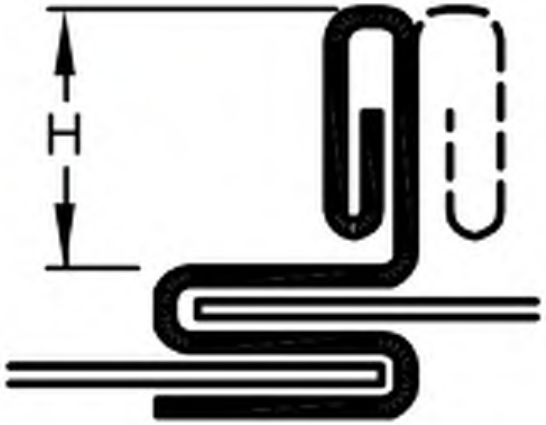


STANDING S
T–10

- When using S on all four sides, fasten slip to duct within 2 in. of the corner and at 12 in. maximum intervals
- Any length at 2 in. wg
- 36 in. maximum length at 3 in. wg
- 30 in. maximum length at 4 in. wg
- Not allowed above 4 in. wg



STANDING S (ALT.)
T–11

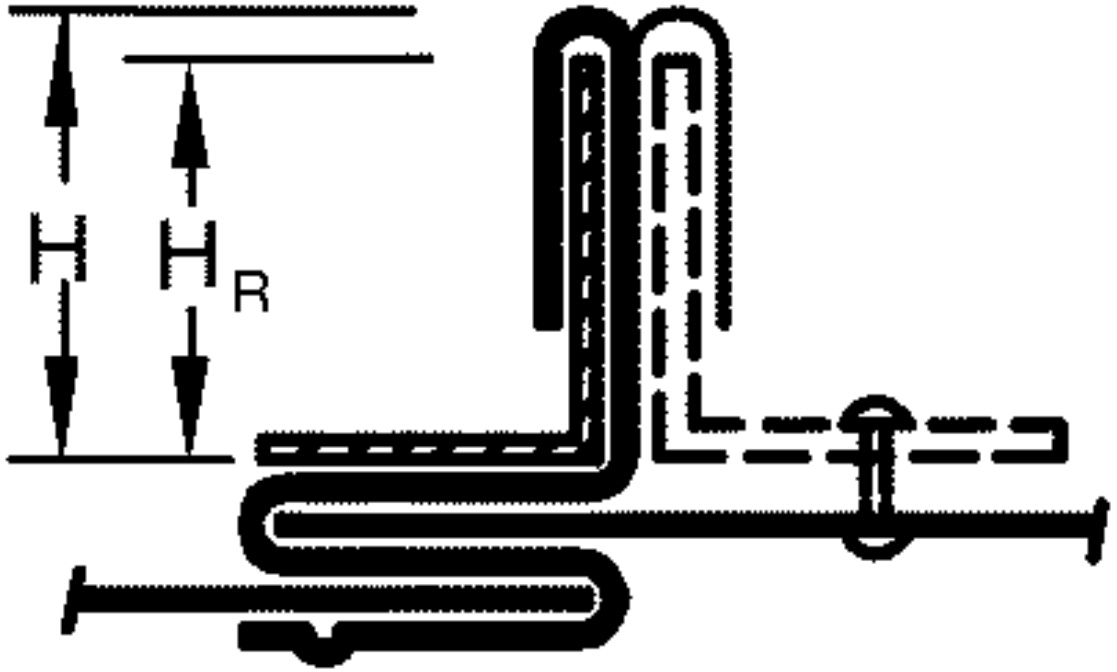


STANDING S (ALT.)
T–12

Terms and Definitions

- **Transverse Joint Connections**
  - T-14 Standing “S” (Angle Reinforced)

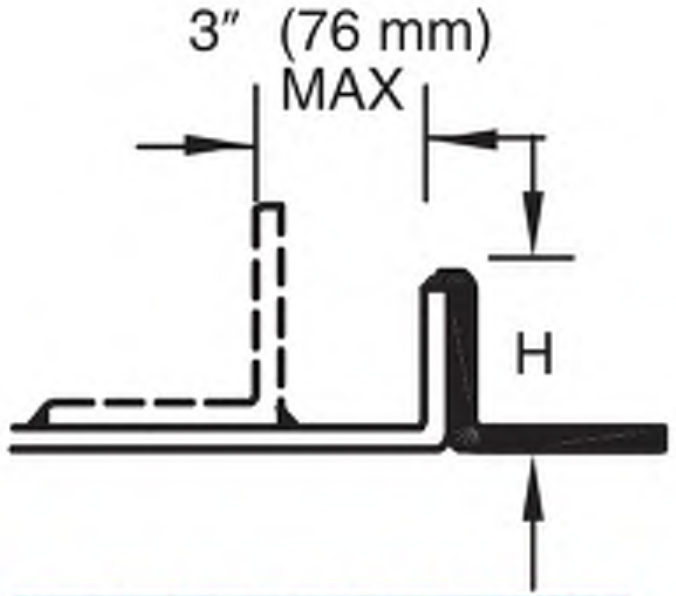
    - Fasten as per Joint T-10
    - Standing portion as per T-10 or T-11 to hold Flat Bar
    - Fasten bar stock to the connector within 2 in. of the corner and at 12 in. maximum intervals
    - Any length at 2 in. wg
    - 36 in. maximum length at 3 in. wg
    - 30 in. maximum length at 4 in. wg
    - Not allowed above 4 in. wg



STANDING S
(ANGLE REINFORCED)
T–14

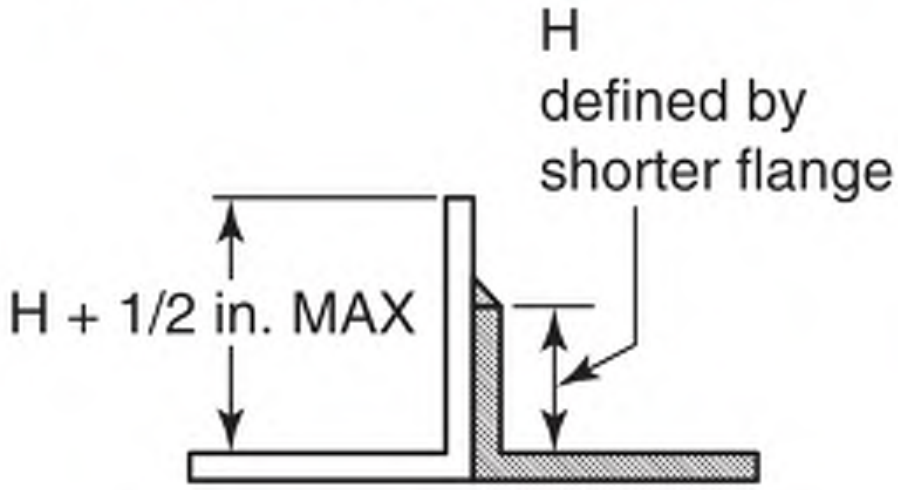
Terms and Definitions

- **Transverse Joint Connections**
  - T-21 Welded Flange
  - T-21a Reinforced Welded Flange



T–21 WELDED FLANGE
(T–21a REINFORCED W.F.)

- Use ½ in. minimum flange and continuous end weld
- Flanges larger than ¾ in. must be spot welded, bolted, riveted or screwed to prevent separation (2 in. from ends and at 8 in. maximum intervals)

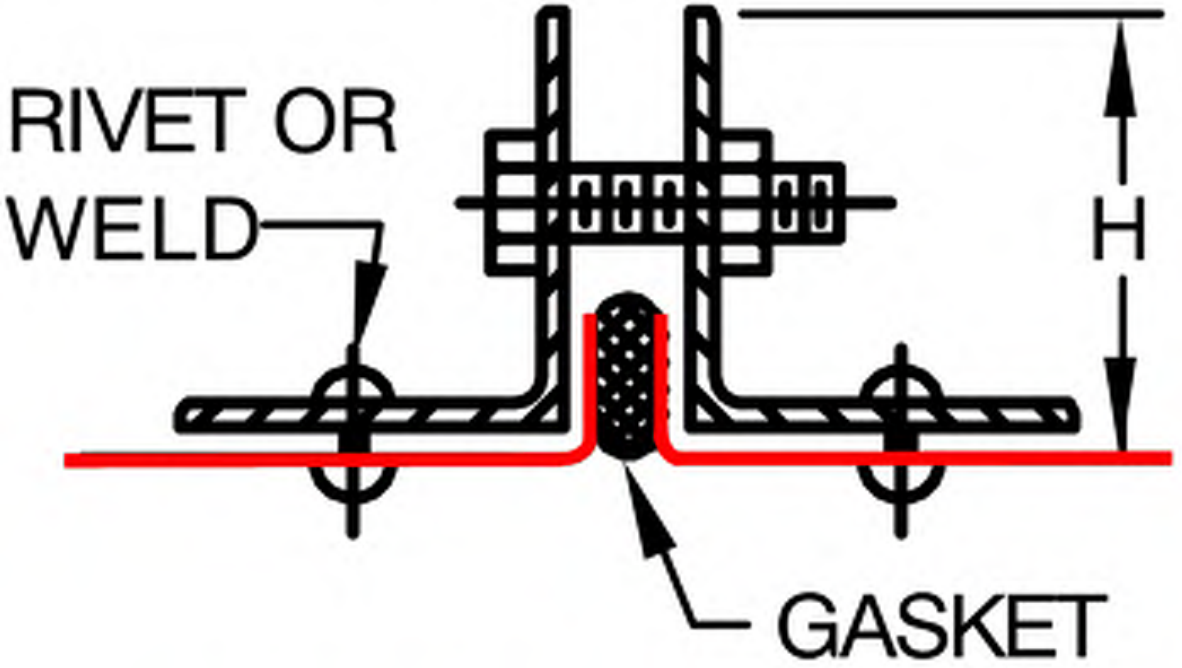


Uneven Flange

Terms and Definitions

- **Transverse Joint Connections**
  - T-22 Companion Angles

    - ⅜ in. minimum flange on duct
    - Angles must have welded corners
    - Angles must be tack welded, bolted or screwed to the duct wall at 2 in. maximum from the ends and at 12 in. maximum intervals
    - Bolt Schedule:
      - 5/16 minimum diameter at 6 in. maximum spacing at 4 in. wg or lower
      - ⅛ in. angle requires 4 in. maximum spacing at 4 in. wg
      - 4 in. maximum spacing at higher pressures

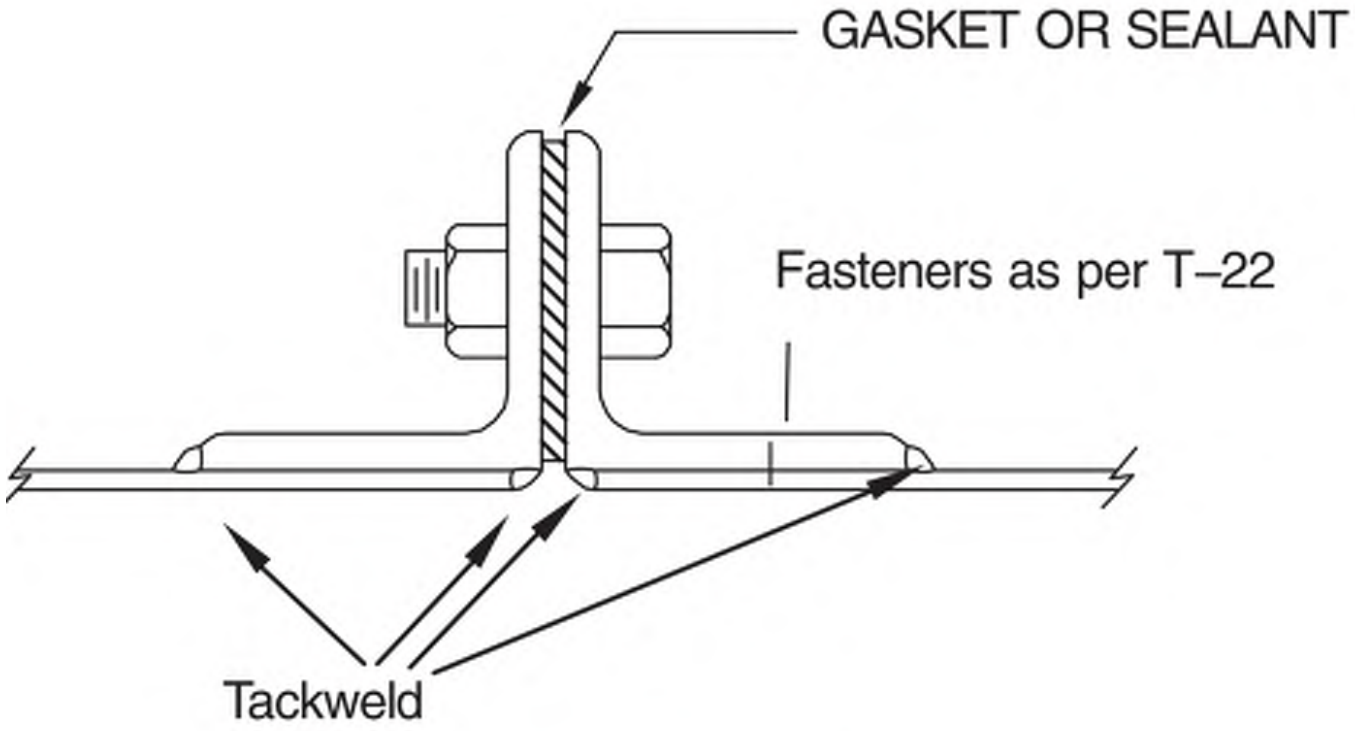


COMPANION ANGLES
(CAULK OR GASKET)
T–22

Terms and Definitions

- **Transverse Joint Connections**
  - T-22 Alternate Companion Angles

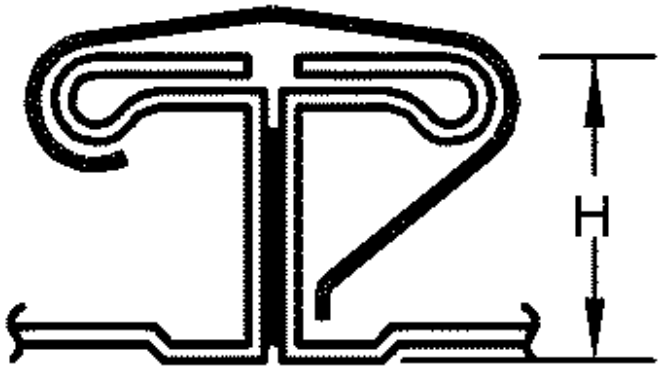
- Hold duct back ⅛ in. from vertical face of the angle and tack weld to the flange along the edge of the duct
- Fasten angle to duct as per T-22
- For additional tightness place sealant between the angle and duct or seal the weld
- If the faces of the angles are flush, thick consistency sealant may be used in lieu of gasket
- Use gasket suitable for the specific service and fit it uniformly to avoid protruding into the duct



COMPANION ANGLES
T–22 ALT.

Terms and Definitions

- **Transverse Joint Connections**
  - T-25a/b TDC / TDF



FLANGED
(WITH GASKET)
T–25a

FLANGED
(WITH GASKET)
T–25b

- Assemble per Figure 2-18
- Ratings may be adjusted with EI-rated bar stock or members from Tables 2-29 and 2-30
- Supplemental members may be attached to the duct wall on both sides of the joint
- Single members may be used if they are fastened through both mating flanges
- Gasket to be located to form an effective seal

Terms and Definitions

- **Transverse Joints / Connections**
  - Section 1.3.4: Transverse Joints for Rectangular Duct
    - Paragraph S1.40

S1.40

Fasteners used on steel duct shall be steel. They may be zinc or cadmium coated. Standard or self-drilling sheet metal screws may be used as appropriate. Blind rivets using pull-through mandrels are not permitted unless the holes are sealed to reduce air leakage. Fastenings shall not project into duct interiors more than ¾ in. (20 mm). Where only bolts or welds are specified, other types of fastening are not allowed. Clinching or similar techniques are permitted on sheet metal to sheet metal applications. Consult equipment manufacturer for adjustments to type and quantity of clinches required.

Modified in 4th Edition

ADDED in 4th Edition

Terms and Definitions

- **Rectangular Intermediate Reinforcement**
  - Intermediate Reinforcement:
    - Reinforcement added between qualifying Joints or Reinforcements
  - Four (4) Basic Shapes
    - Angle
    - Hat Section (Channel)
    - Channel or “Zee”
    - Framing Channel (Uni-Strut)

Terms and Definitions

- **Rectangular Intermediate Reinforcement**
- Figure 2-3 (Page 2.12)
  - Four (4) Common Shapes
  - Table 2-29 provides RC Ratings
    - Angle
    - Hat Section
    - Channel
  - Table 2-30 provides RC Ratings
    - Framing Channel (Uni-Strut)

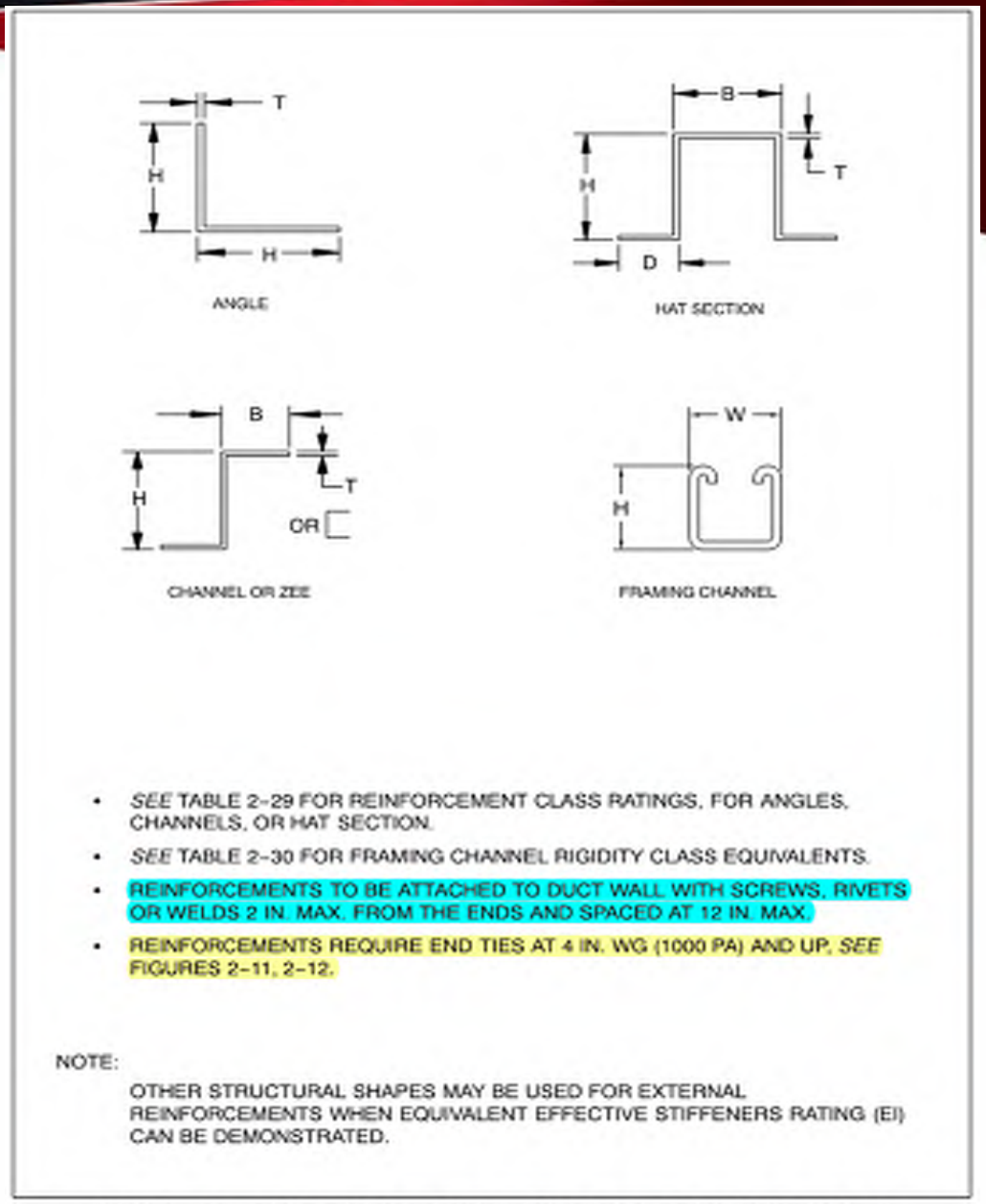
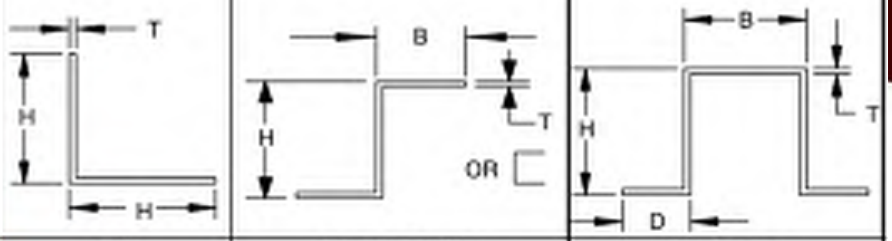


FIGURE 2–3 RECTANGULAR DUCT EXTERNAL REINFORCEMENTS

Terms and Definitions

- **Rectangular Intermediate Reinforcement**
- Table 2-29 Intermediate Reinforcement
  - (Page 2.70)
  - Three (3) of the Four (4) Common Shapes
  - **Reinforcement Class Column**
    - **Alphabetical Designation**
      - **RC-A through RC-L**

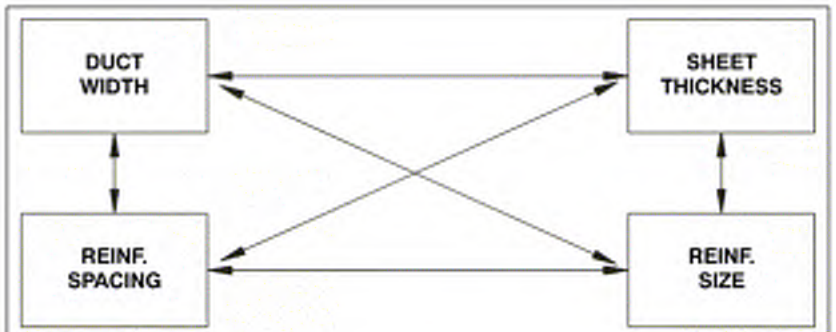


Reinf. Class		Angle		Channel or Zee		Hat Section	
	EI*	H × T (MIN)	WT LF	H × B × T (MIN)	WT LF	H × B × D × T (MIN)	WT LF
A	0.43	Use C		Use B		Use F	
B	1.0	Use C		¾ × ½ × 20 ga	0.24	Use F	
C	1.9	C 1 × 16 ga C ¾ × ⅝	0.40 0.57	¾ × ½ × 18 ga 1 × ⅜ × 20 ga	0.31	Use F	
D	2.7	H ⅝ × ⅝ C 1 × ⅜	0.57 0.80	1 × ⅜ × 18 ga	0.45	Use F	
E	6.5	C 1 ⅜ × 12 ga H 1 × ⅝	0.90	2 × 1 ⅜ × 20 ga	0.60	Use F	
F	12.8	H 1 ¾ × ⅜	1.02	1 ½ × ¾ × 18 ga	0.54	1 ½ × ¾ × ⅝ × 18 ga 1 ½ × 1 ½ × ¾ × 20 ga	0.90 0.83
G	15.8	1 ½ × ⅜	1.23	1 ½ × ¾ × 16 ga	0.66	1 ½ × ¾ × ⅝ × 18 ga	0.80
H	26.4	1 ½ × 3/16 2 × ⅜	1.78 1.65	1 ½ × ¾ × ⅜	1.31	1 ½ × 1 ½ × ¾ × 18 ga 2 × 1 × ¾ × 20 ga	1.08 0.90
I	69	C 2 × 3/16 2 ½ × ⅜	2.44 2.10	2 × 1 ⅜ × 12 ga 3 × 1 ⅜ × 16 ga	1.60 1.05	2 × 1 × ¾ × 16 ga	1.44
J	80	H 2 × 3/16 C 2 × ¼ 2 ½ × ⅜ (+)	2.44 3.20 2.10	2 × 1 ⅜ × ⅜	1.85	2 × 1 × ¾ × 12 ga 2 ½ × 2 × ¾ × 18 ga	2.45 1.53
K	103	2 ½ × 3/16	3.10	3 × 1 ⅜ × 12 ga	2.00	2 ½ × 2 × ¾ × 16 ga 3 × 1 ½ × ¾ × 16 ga	1.88 2.00
L	207	H 2 ½ × ¼	4.10	3 × 1 ⅜ × ⅜	2.29	2 ½ × 2 × ¾ × ⅜ 3 × 1 ½ × ¾ × 12 ga	3.70 3.40

Table 2–29 Intermediate Reinforcement

Duct Construction: Dependent Variables

- **Figure 1-2: Dependent Variables**
  - Known interrelationship between the elements of any duct construction.
    - Duct Width
    - Sheet Thickness
    - Reinforcement Size
    - Reinforcement Spacing



RELATIONSHIPS:

a. For each pressure level and a constant duct size, the thicker the sheet the more distant the reinforcement spacing; the thinner the sheet the closer the reinforcement spacing.

b. For a given sheet thickness and constant duct size, reinforcement size, and reinforcement spacing, reduce with pressure reduction and increase with pressure increase.

c. The larger a duct at a given pressure, the larger the reinforcement and the closer the reinforcement spacing on a selected gage.

d. For each combination of sheet thickness, pressure, and duct width, a maximum reinforcement spacing occurs beyond which sheet deflection is not controlled by reinforcement size nor reinforcement position.

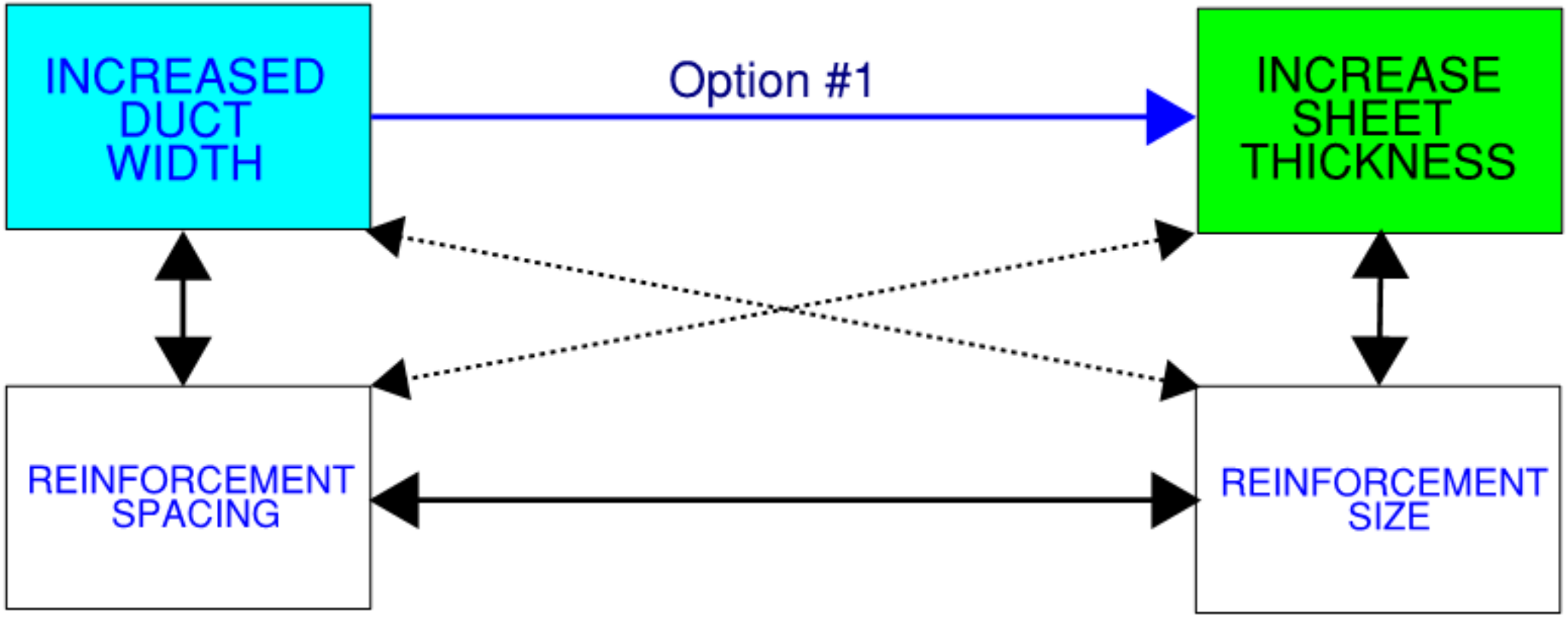
Maximum Deflection		Maximum Test Pressure
Joint and Reinf. 1/4 in. on 48 in.W. on W/200 on 49 – 120 in.	Sheet: 3/8 in. on 12 in. Dn. 1/2 in. on 13 – 18 in. 5/8 in. on 19 – 24 in. 3/4 in. on 25 – 84 in. 1 in. on 85 – 120 in.	Lab: Class Rating + 50% Field: Class Rating + 25%
Tolerance: +7.75%	Tolerance: +10%	

Maximum Deflection		Maximum Test Pressure
Joint and Reinf. 6.4 mm on 1200 mm W. on W/200 on 1201 – 3000 mm	Sheet: 9.53 mm on 300 mm Dn. 12.7 mm on 301 – 450 mm 15.9 mm on 451 – 600 mm 19.0 mm on 601 – 2100 mm 25 mm on 2101 – 3000 mm	Lab: Class Rating + 50% Field: Class Rating + 25%
Tolerance: +7.75%	Tolerance: +10%	

FIGURE 1–2 DEPENDENT VARIABLES

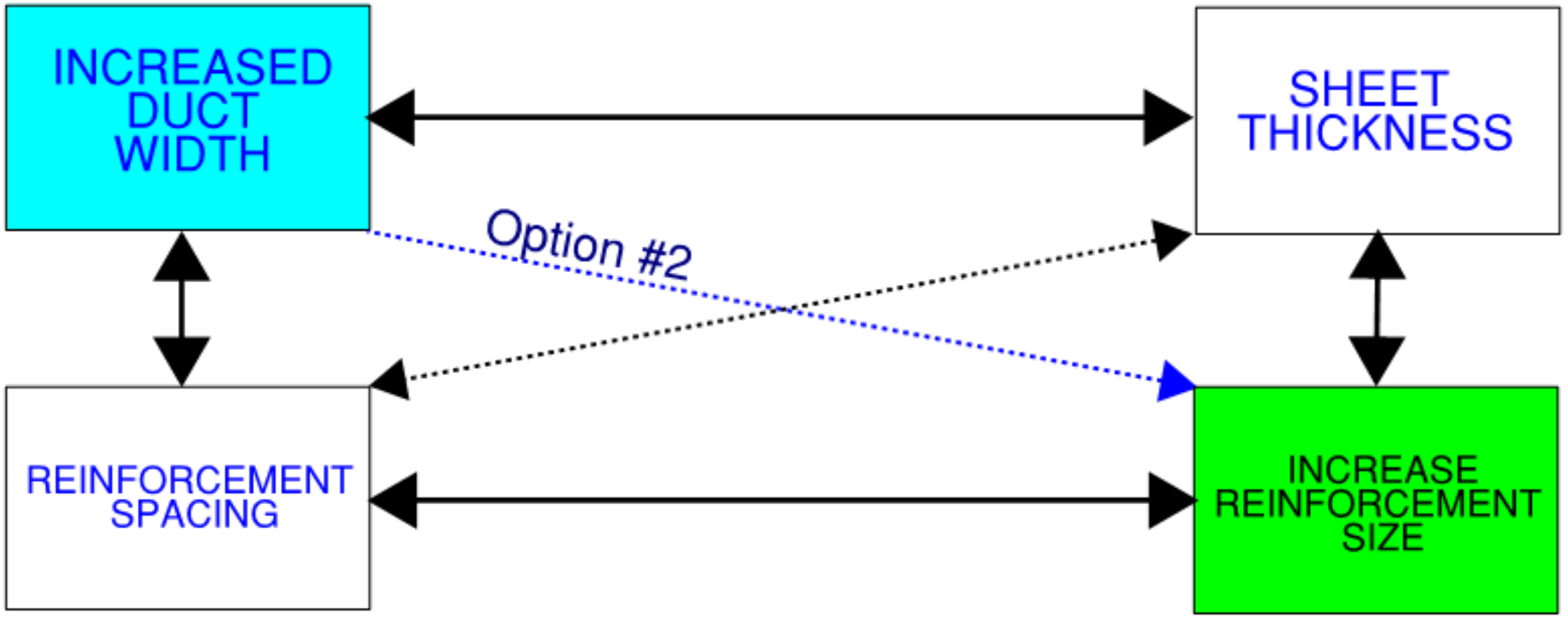
Duct Construction Dependent Variables

- Figure 1-2: Dependent Variables



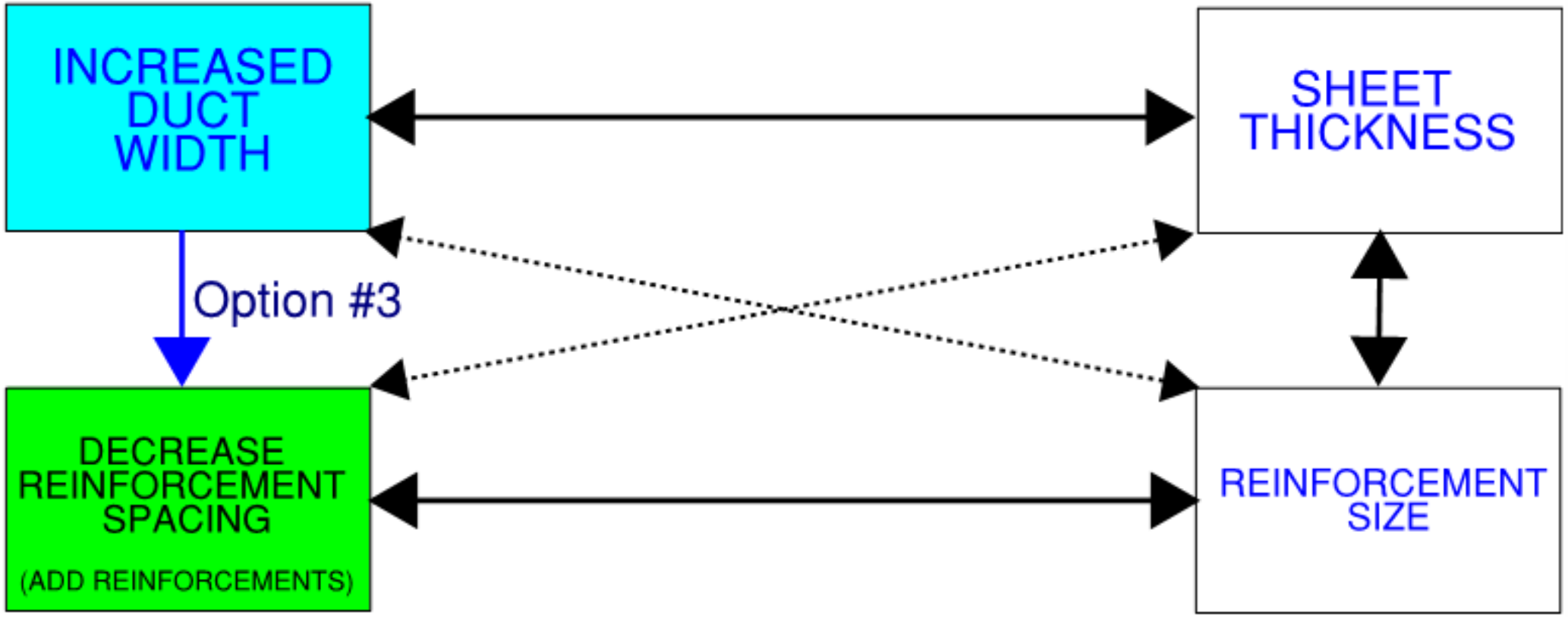
Duct Construction Dependent Variables

- Figure 1-2: Dependent Variables



Duct Construction Dependent Variables

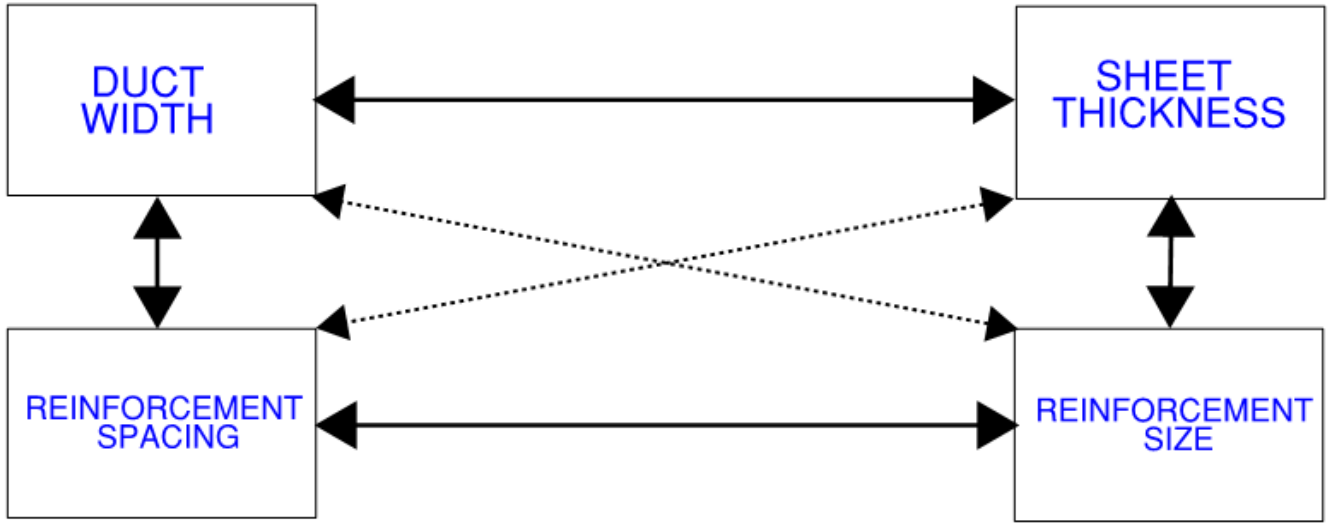
- Figure 1-2: Dependent Variables



Duct Construction Dependent Variables

- **Figure 1-2: Dependent Variables**
  - Choose Combinations for System Specific Requirements

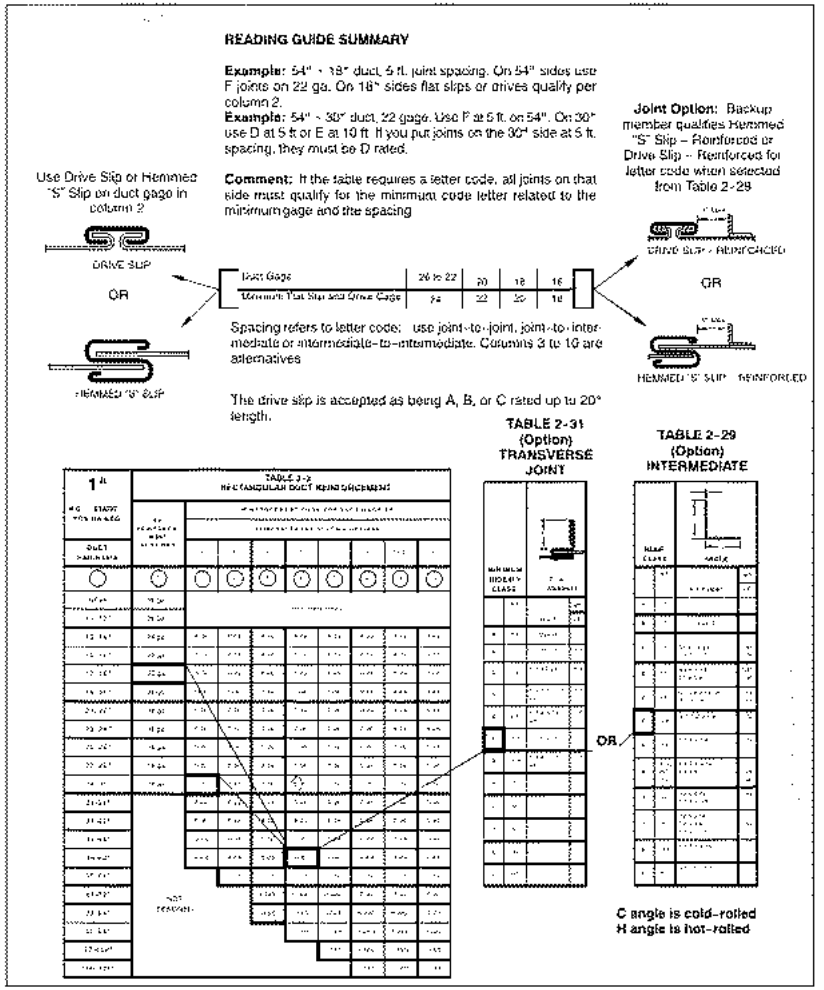
- **Thicker Panel Gage**
  - Smaller Reinforcement Size
  - Less Reinforcements Needed
- **Heavier Reinforcement**
  - Thinner Panel Gage
  - Less Reinforcements Needed
- **Less Reinforcement Spacing**
  - More Reinforcements
  - Thinner Panel Gage
  - Smaller Reinforcement Size



Basic Duct Construction Process

- **Rectangular Duct Tables**
  - Reading Guide Summary
    - Page 2.5
  - “Cheat Sheet” for using the Tables

Let’s dig deeper into the Tables…



Tie Rods

Internal Reinforcement typically used in Rectangular or Flat Oval Duct

- Used at Joints & Midpanels
- Can be Used:
  - With External Reinforcement
  - Standalone
- Benefits:
  - Smaller External Reinforcements
  - Locks opposing panels together

- Common Types of Tie-Rods
  - Conduit
    - RC (rigid)
    - EMT (most common type)
  - Steel Rod
    - Threaded (all thread)
    - Partially Threaded

Tie-Rod Attachments

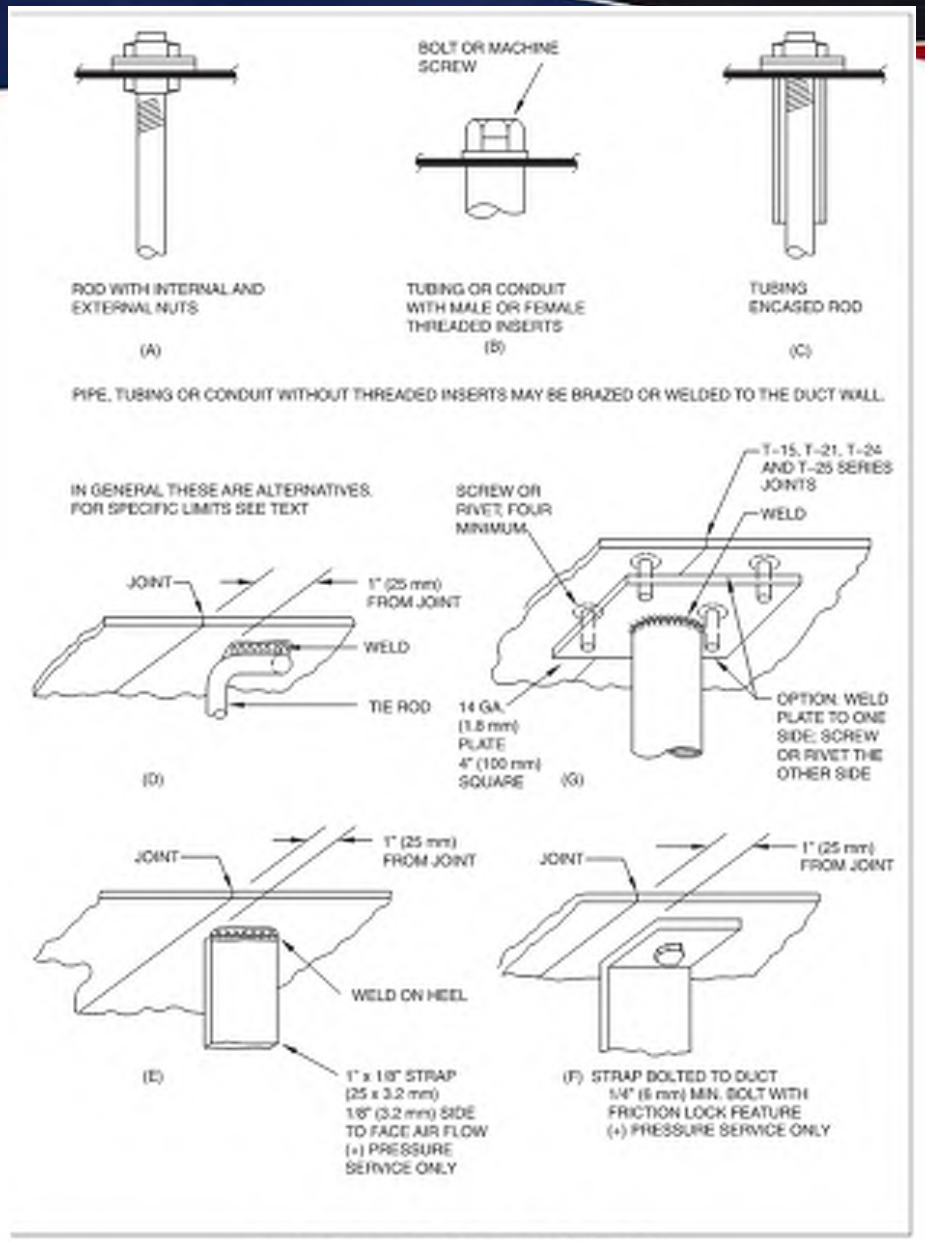


FIGURE 2–5 TIE ROD ATTACHMENTS

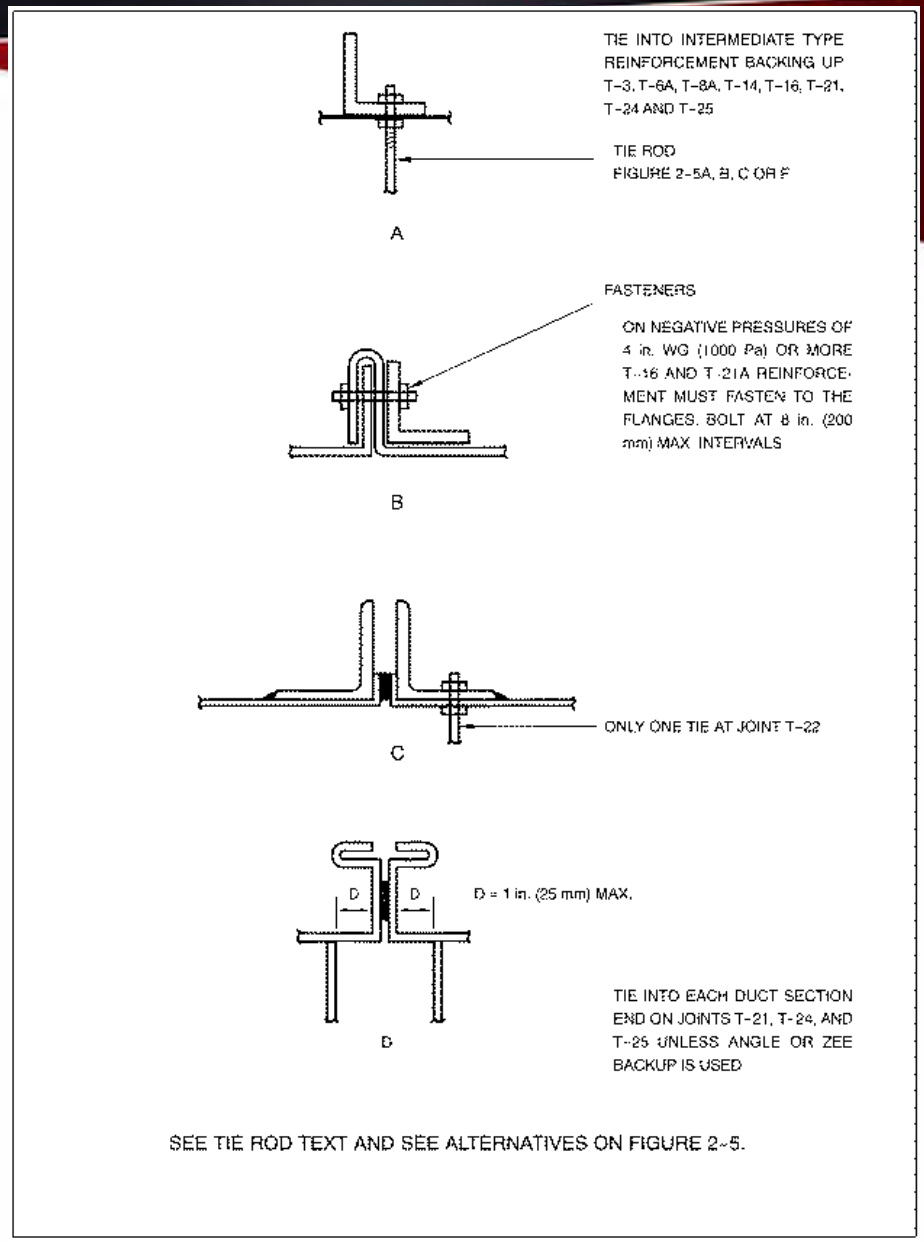


FIGURE 2–6 TIE ROD ATTACHMENTS

Tie Rods

Safety Stop!!

Tie Rods are Sized Differently for **Positive** & **Negative** Pressures

- Positive Pressure:
- Tie-Rods are sized by *LOAD*
- Tie-Rods are in *Tension*

- Negative Pressure:
- Tie-Rods are sized by *LOAD & LENGTH*
- Tie-Rods are in *Compression*

Tie Rod Layout

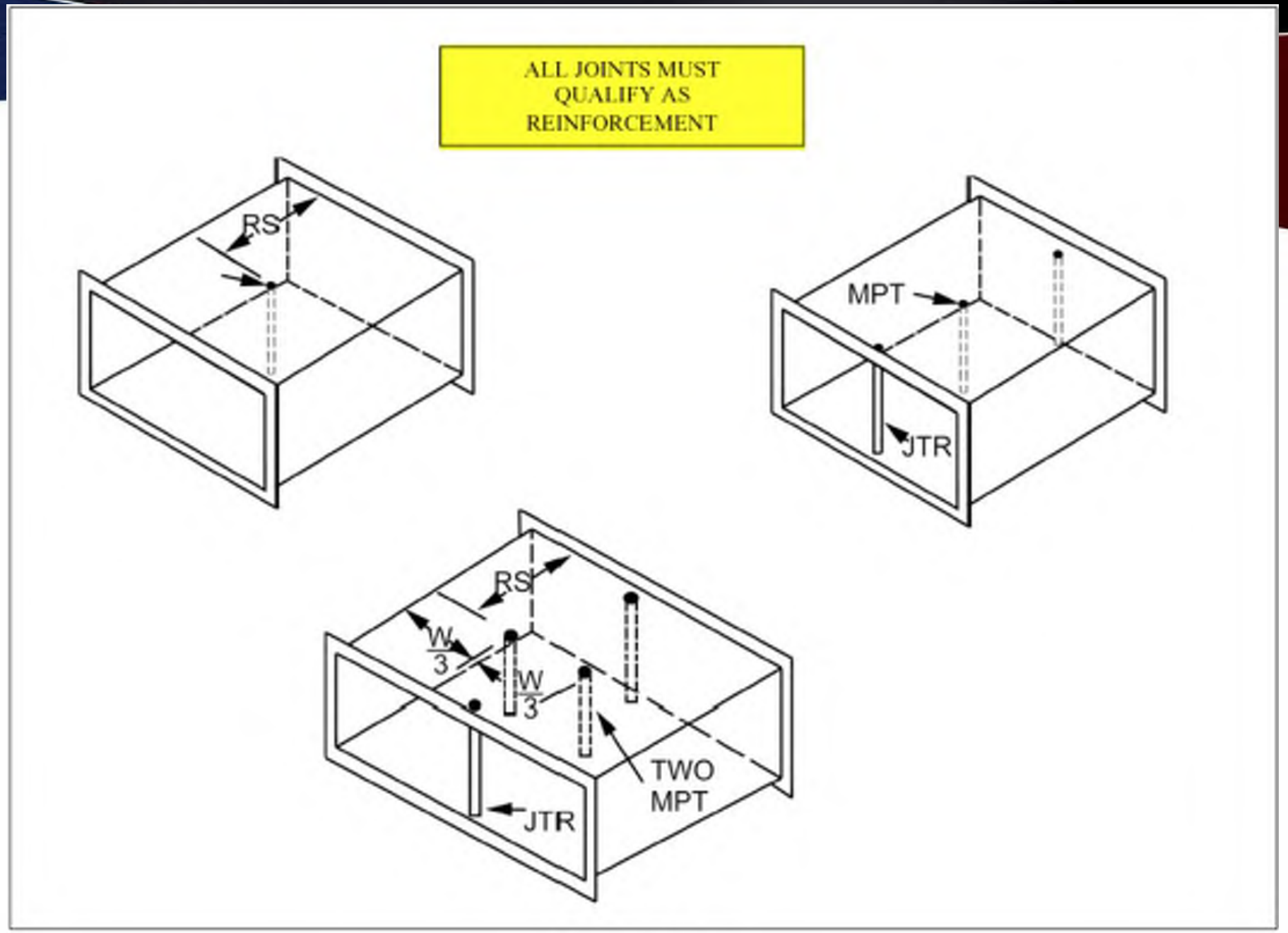


FIGURE 2-7

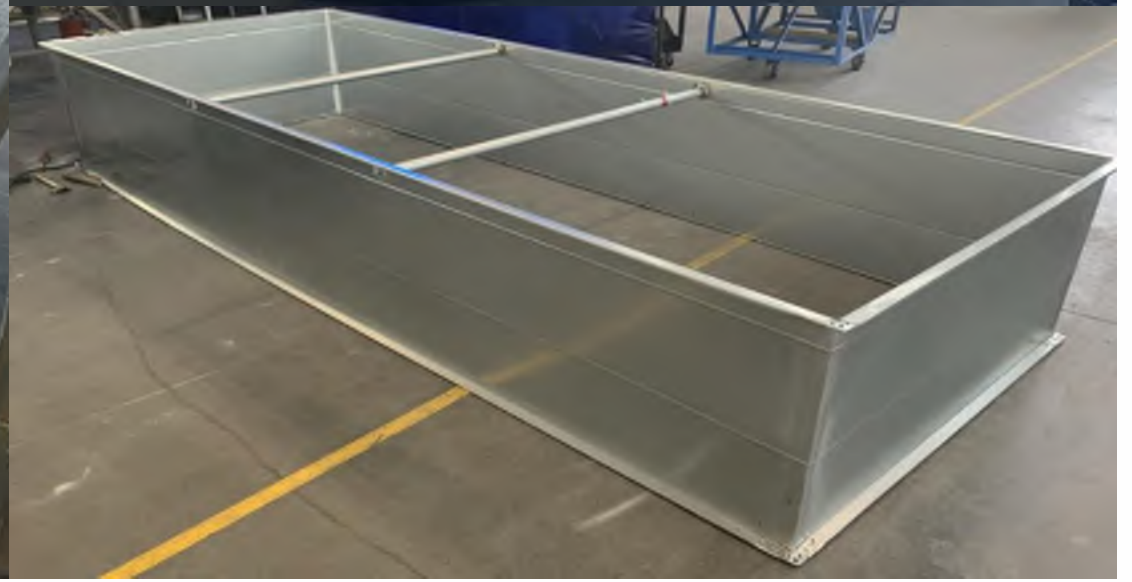
Mid-Panel Tie Rods

- Acceptable alternative to external intermediate reinforcement through 96 in.
- Applicable up to 6 ft joint spacing
- Transverse joints must already qualify as reinforcements
- If tie rods occur in 2 directions in the same vicinity, they must: (applies to JTR and MPT)
  - Be prevented from touching
  - Or be permanently attached

Mid-Panel Tie Rods

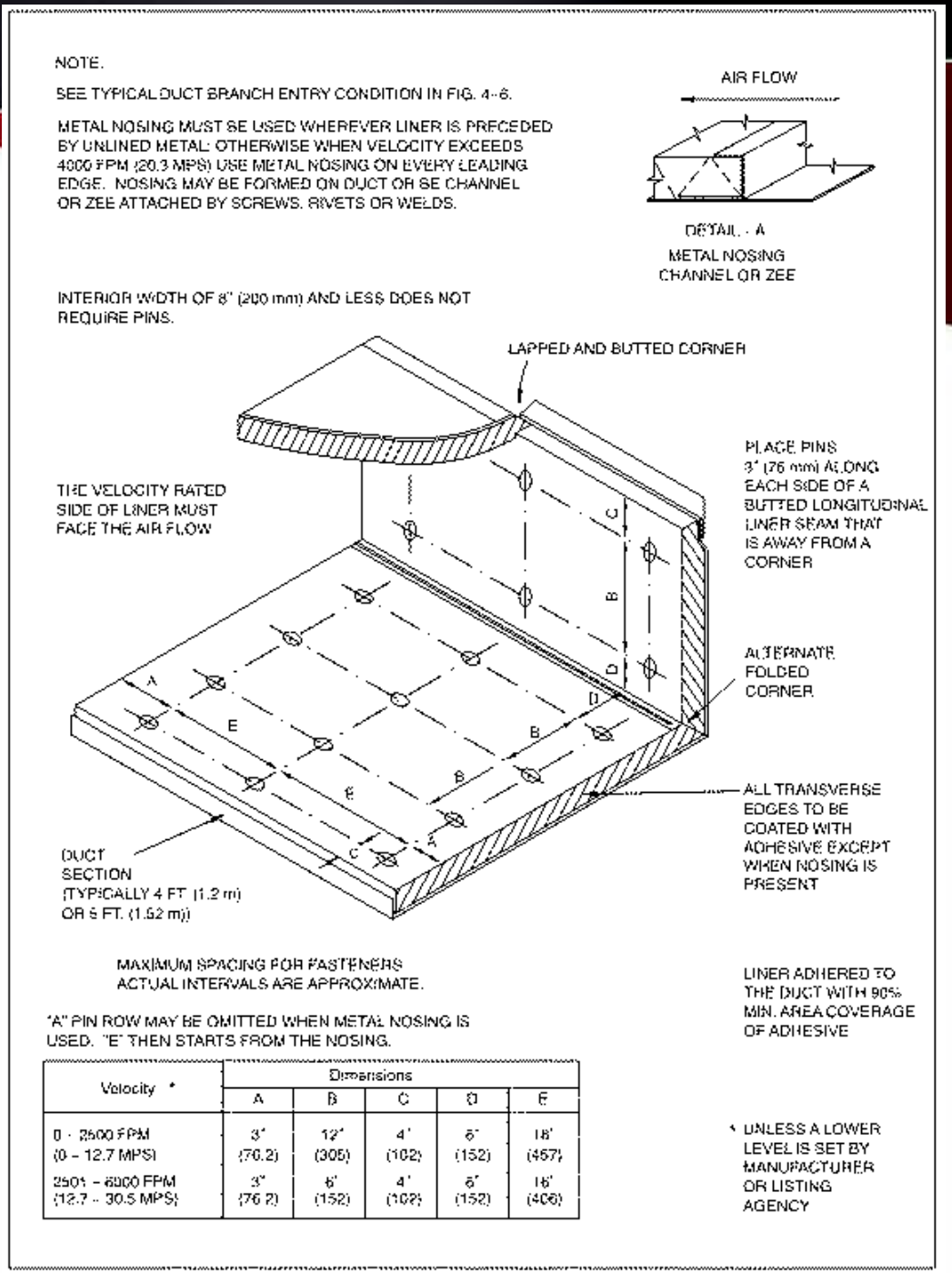
- Do not use for outside if not waterproofed
- Do not use where grease or condensation can collect
  - Unless no penetration is made
  - Or penetration is sealed watertight
- Do not use in underground/slab apps
- Do not use if air velocity > 2500 fpm
- Do not use near centrifugal or axial fans that can create System Effects

Any Questions?



Lined Duct

- Figure 7-11: Flexible Duct Liner Installation
  - Liner Adhesion (90% Coverage Minimum)
  - Mechanical Fasters
  - Transverse Edges
    - Metal Nosing
    - Adhesive Coating



Velocity *	Dimensions				
	A	B	C	D	E
0 - 2500 FPM (0 - 12.7 MPS)	3" (76.2)	12" (305)	4" (102)	6" (152)	18" (457)
2501 - 6000 FPM (12.7 - 30.5 MPS)	3" (76.2)	6" (152)	4" (102)	6" (152)	16" (406)

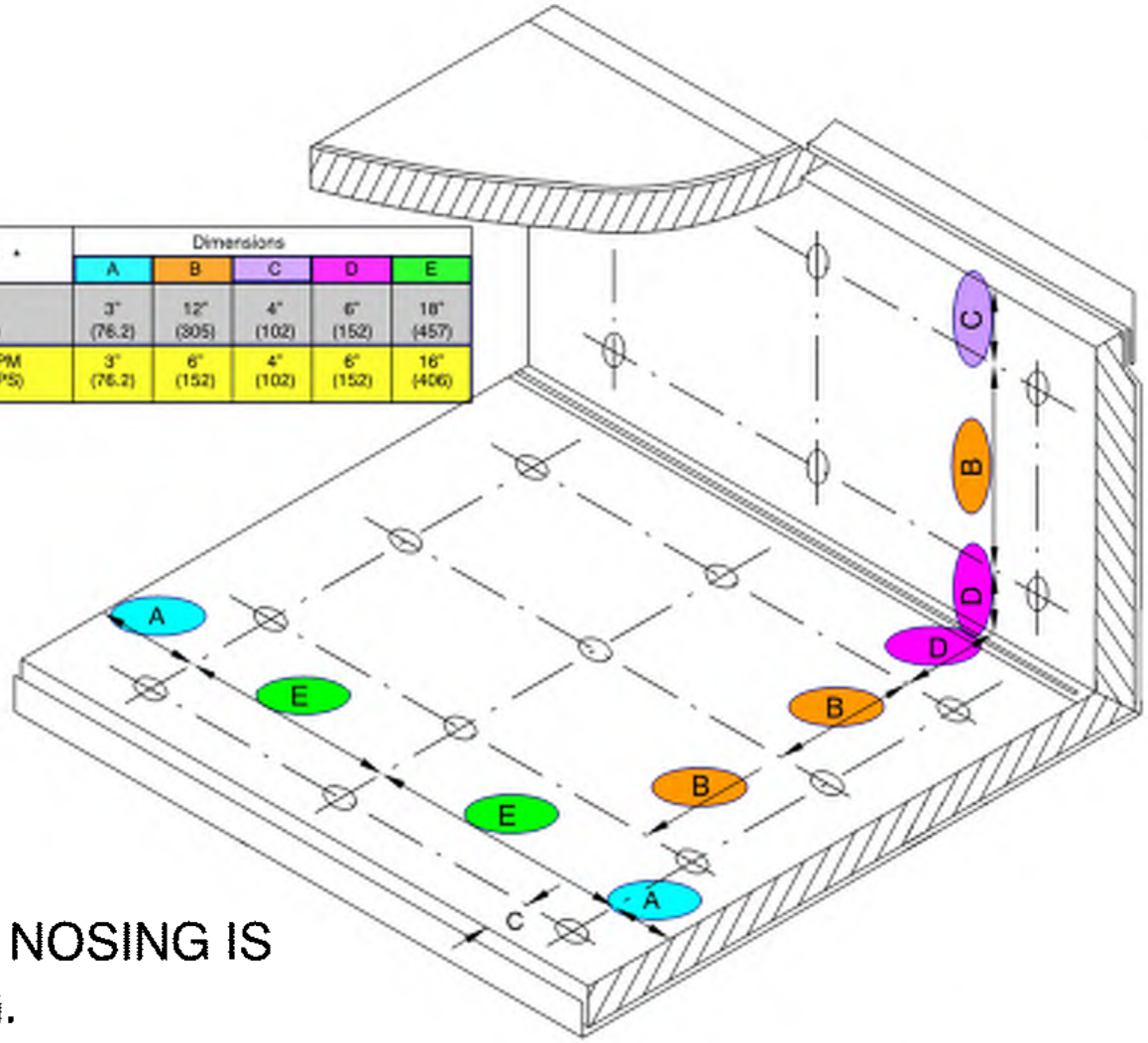
FIGURE 7-11 FLEXIBLE DUCT LINER INSTALLATION

Lined Duct

- Figure 7-11:

  - Mechanical Fasters
  - 2 Velocity Ranges
    - 0-2500 FPM
    - 2501-6000 FPM

Velocity *	Dimensions				
	A	B	C	D	E
0 – 2500 FPM (0 – 12.7 MPS)	3" (76.2)	12" (305)	4" (102)	6" (152)	18" (457)
2501 – 6000 FPM (12.7 – 30.5 MPS)	3" (76.2)	6" (152)	4" (102)	6" (152)	16" (406)

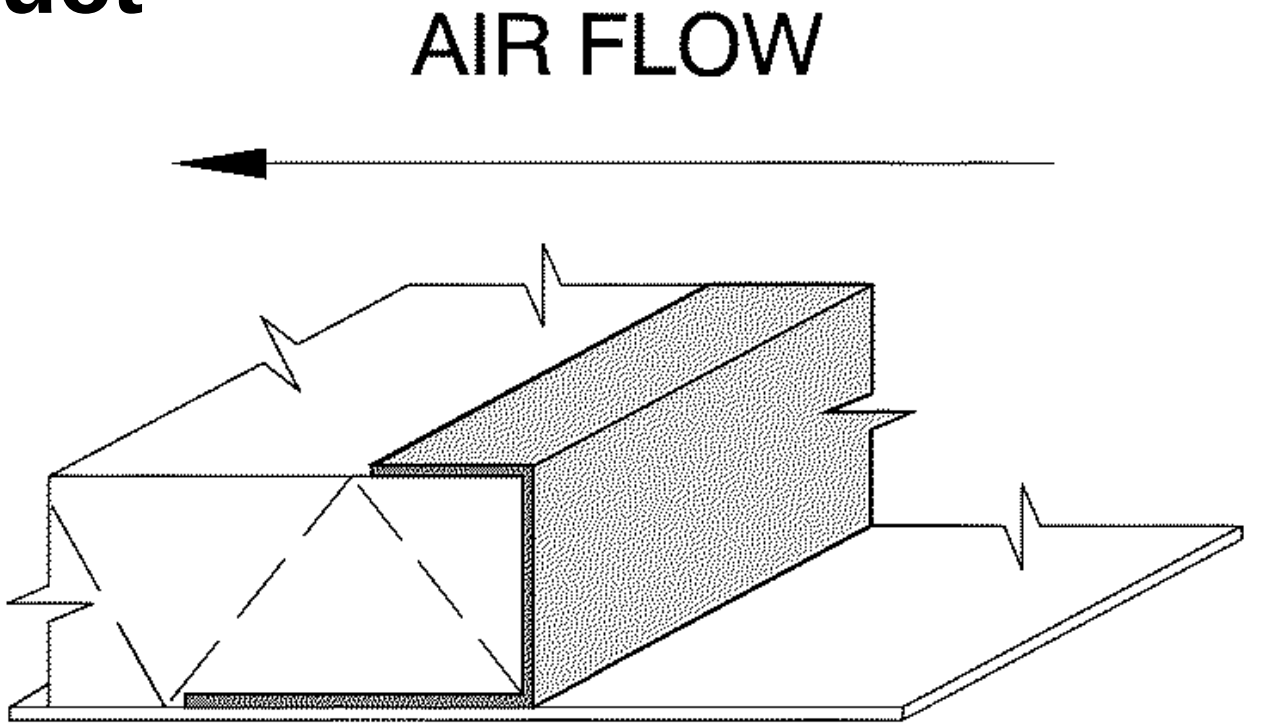


"A" PIN ROW MAY BE OMITTED WHEN METAL NOSING IS USED. "E" THEN STARTS FROM THE NOSING.

Lined Duct

- Figure 7-11: Metal Nosing

- Metal Nosing MUST be used when:
  - Liner is *preceded* by unlined metal
  - On *ALL* leading edges when the velocity is over 4000 fpm



DETAIL – A

METAL NOSING
CHANNEL OR ZEE

Page 7.13
Figure 7-11

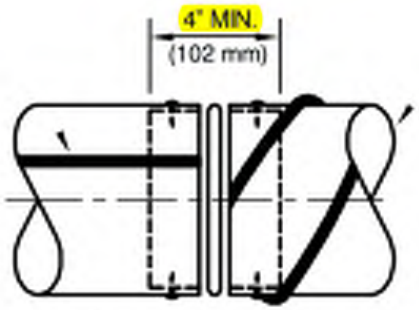
Round and Flat Oval Duct

- Round Duct
  - Terms and construction options
  - Spiral & longitudinal Seam
- Flat Oval Duct
- Hanger Selection

Transverse Joints

RT-1: Beaded Sleeve

- Same Gage as Duct
- 3 Screws
  - 14” and Below

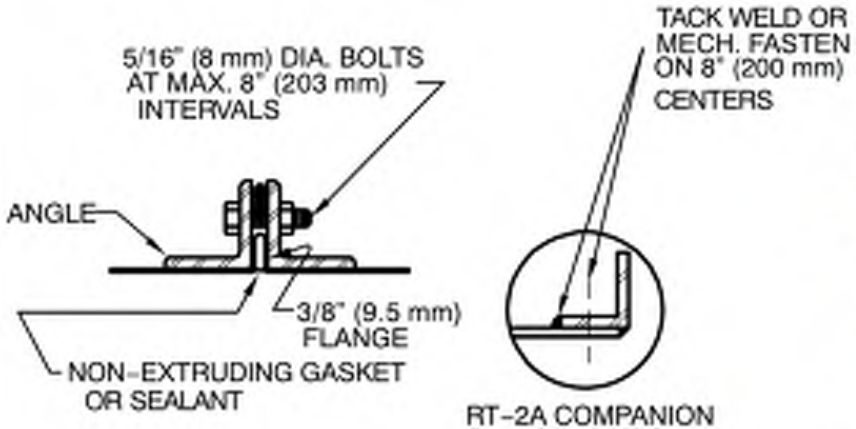


BEADED SLEEVE JOINT
RT–1

- Longitudinal or Spiral Seam
- Sleeve to be at least the same gage as duct
- Screws must be used at uniform intervals of at most 15 in. along the circumference
- Three screws minimum on 14 in. or less diameter

RT-2: Companion Flange

- Min. Flange Sizes
- Reinforcement:
  - See Table 3-4
- Male Rings



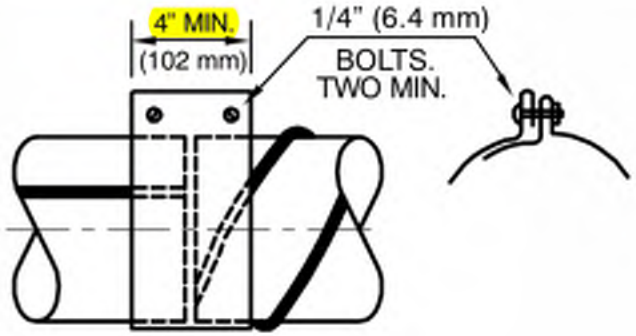
RT–2A COMPANION
FLANGE (OPTIONAL)

- Longitudinal or spiral seam
- Minimum Flange Sizes:
- 1 in. × 1 in. × 10 ga up to 14 in. Dia.
- 1 ½ in. × 1 ½ in. × ⅜ in. over 14 in. Dia.
  If flanges are used as reinforcement *see* Table 3-4
- Male (internal) rings are permitted

Transverse Joints

RT-3: Drawband

- Same Gage as Duct

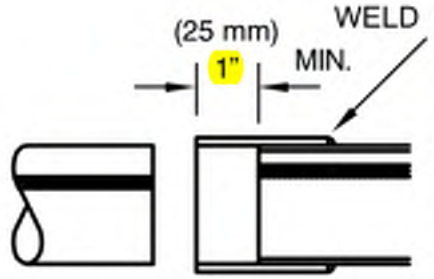


RT3 DRAWBAND JOINT

- Longitudinal or spiral seam
- Drawband to be at least same gage as duct

RT-4: Outside Sleeve

- 1” Min. Hub



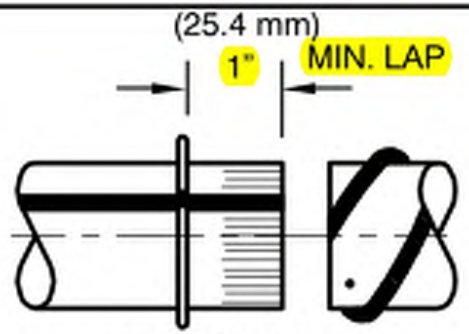
RT4 OUTSIDE SLEEVE

- Longitudinal seam only
- See RT-1 for screw requirements

Transverse Joints

RT-5: Crimp Joint

- 1” Min. Lap

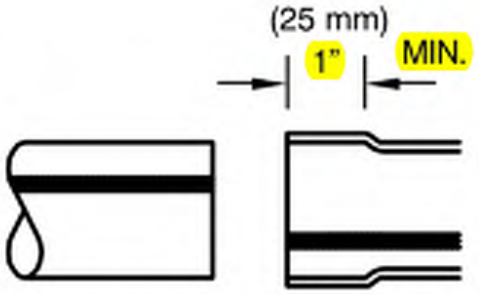


CRIMP JOINT
BEAD OPTIONAL
RT–5

- Longitudinal or spiral seam
- See RT-1 for screw requirements

RT-6: Swedge (Bell)

- 1” Min. Hub

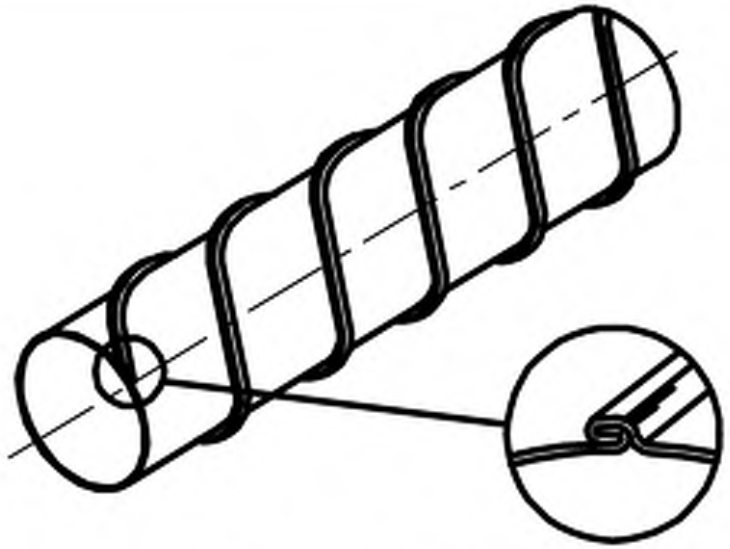


SWEDGE (BELL)
RT–6

- Longitudinal seam only
- See RT-1 for screw requirements

Spiral Seams

RL-1: SPIRAL



SPIRAL SEAM
RL–1

- To ± 10 in. wg

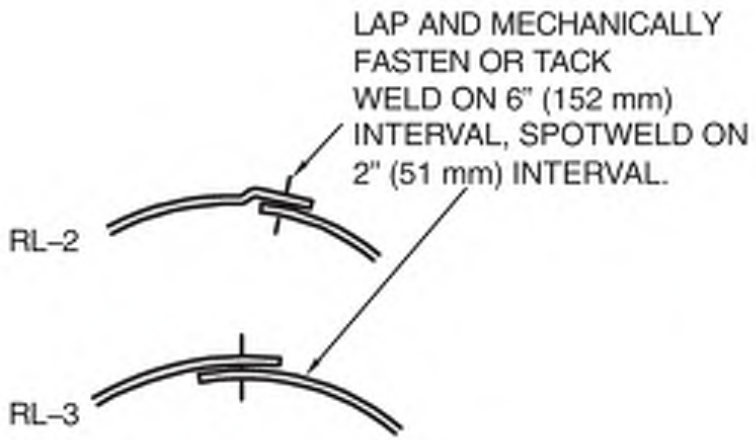
Refer to Round Industrial DCS for higher pressures

Longitudinal Seams

RL-2: LAP JOINT

RL-3: LAP JOINT

RL-4: BUTT WELD



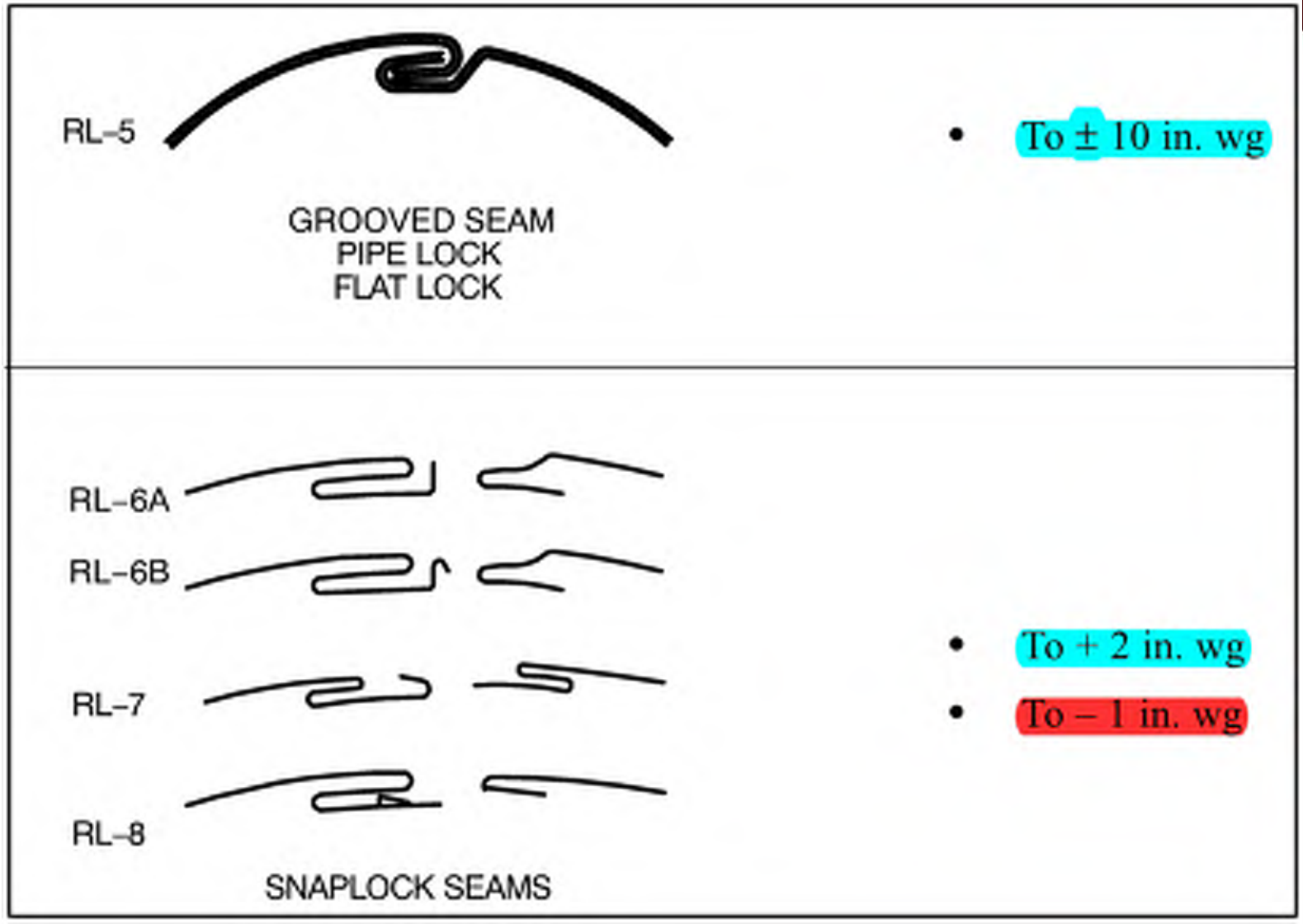
- To ± 4 in. wg
- Acceptable to 10 in. wg if spot welded on 1 in. intervals or tack welded on 3 in. intervals

- To ± 10 in. wg
- See RL 2 for weld options or continuously weld

Longitudinal Seams

RL-5: GROOVED SEAM

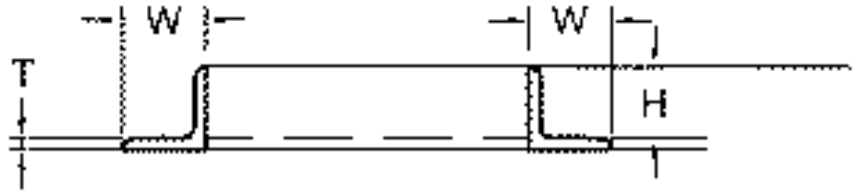
RL-6A: SNAPLOCK
RL-6B: SNAPLOCK
RL-7: SNAPLOCK
RL-8: SNAPLOCK



Round Reinforcement

Reinforcement Rings

- 3-2 Reinforcement
- 3-3 Attachment Schedule



Angle Rings

FIGURE 3–3 ROUND DUCT REINFORCEMENT

Reinforcement Class	Size W × H × T
A	1 × 1 × ⅛
B	1 ¼ × 1 ¼ × ⅛
C	1 ½ × 1 ½ × ⅛
D	1 ½ × 1 ½ × ¼
E	2 × 2 × ⅛
F	2 × 2 × ¼
G	3 × 3 × ¼

Table 3–2 Angle Ring Size

Duct Dia, in.	Number of Attachments
6 and under	4
12 and under	6
18 and under	8
30 and under	12
54 and under	16
78 and under	20
96 and under	24

Table 3–3 Ring Attachment Schedule

Round Reinforcement

Companion Flange

- Reinforcement

AND

- Connection

Duct Dia. in.	Flange Selection
up to 9	1 × 1 × ⅛*
10 – 12	1 ¼ × 1 ¼ × ⅛*
13 – 25	1 ½ × 1 ½ × 3/16
26 – 48	2 × 2 × 3/16
49 – 60	2 ½ × 2 ½ × 3/16
61 – 96	3 × 3 × ¼

Table 3–4 Companion Flange Joints Used As Reinforcement

*Standard rings in 10 ga are an acceptable slightly heavier alternative to the specified ⅛ in. thickness rings.

Round Duct Construction Tables

- Positive Pressure Systems
  - Longitudinal and Spiral Seam
    - Unreinforced Panel Gages up to 10in.wg.
    - Unreinforced Panel Gages up to 96 in. diameter

- Negative Pressure Systems
  - Longitudinal and Spiral Seam
    - Specific Tables per Pressure Class
    - Reinforcement Options based on Spacing

Table 3-5

(Page 3.8)

Table 3-5, pg. 3.8

Note: +10” wg,
24” Round
Long. or Spiral Seam

MAX. Diameter, in.	Longitudinal Seam	Spiral Seam
4	28	28
6	28	28
8	28	28
10	28	28
12	28	28
14	28	28
16	26	26
18	26	26
20	24	26
22	24	26
24	24	26
30	22	24
36	22	24
42	22	24
48	20	22
54	20	22
60	20	22
66	18	22
72	18	20
78	18	20
84	18	20
90	18	20
96	18	20

Table 3–5 Round Duct Gage Unreinforced Positive Pressure To 10 in. wg

Notes:

- Positive Pressure Only
- 10 in. WG *MAX*
- Longitudinal Seam
- Spiral Seam

Table 3-5, pg. 3.8

Note: +10” wg,
24” Round
Long. or Spiral Seam

Round Const. Tables – Positive Pressure

Table 3-5

(Page 3.8)

Notes:

- Diameter = 24”
- Longitudinal Seam = 24ga

MAX. Diameter, in.	Longitudinal Seam	Spiral Seam
4	28	28
6	28	28
8	28	28
10	28	28
12	28	28
14	28	28
16	26	26
18	26	26
20	24	26
22	24	26
24	24	26
30	22	24

Table 3–5 Round Duct Gage Unreinforced Positive Pressure To 10 in. wg

Table 3-5, pg. 3.8

Note: +10” wg,
24” Round
Long. or Spiral Seam

Round Const. Tables – Positive Pressure

Table 3-5

(Page 3.8)

Notes:

- Diameter = 24”
- Spiral Seam = 26ga

MAX. Diameter, in.	Longitudinal Seam	Spiral Seam
4	28	28
6	28	28
8	28	28
10	28	28
12	28	28
14	28	28
16	26	26
18	26	26
20	24	26
22	24	26
24	24	26
30	22	24

Table 3–5 Round Duct Gage Unreinforced Positive Pressure To 10 in. wg

Table 3-9, pg. 3.16

Note: -10” wg, 24” Rd, Long Seam

Long. Seam Const. Tables – Negative Pressure

Table 3-9

(Page 3.16)

Notes:

- -10in. W.G.
- Long. Seam
- Diameter = 24”

Neg. Pressure 10 in. wg	Stiffener Spacing											
	Unstiff.		20 ft		12 ft		10 ft		6 ft		5 ft	
MAX. Diameter, in.	GA	R	GA	R	GA	R	GA	R	GA	R	GA	R
4	28	NR	Use Unstiffened Solution									
6	28	NR										
8	24	NR	24	A	26	A	26	A	28	A	28	A
10	24	NR	24	A	24	A	26	A	28	A	28	A
12	22	NR	22	A	24	A	24	A	26	A	28	A
14	20	NR	22	A	24	A	24	A	26	A	26	A
16	18	NR	20	A	22	A	24	A	24	A	26	A
18	18	NR	20	A	22	A	22	A	24	A	24	A
20	18	NR	20	A	22	A	22	A	24	A	24	A
22	16	NR	18	A	20	A	22	A	24	A	24	A
24	16	NR	18	A	20	A	20	A	22	A	24	A
30			18	B	18	A	20	A	22	A	22	A
36			16	C	18	B	18	B	20	A	22	A

Table 3–9 Min. Required Gage for Longitudinal Seam Duct Under Neg. Pressure

Table 3-9, pg. 3.16

Note: -10” wg, 24” Rd, Long Seam, 5’ segments, 24 ga, Class-A reinf.

Long. Seam Construction - Negative Pressure

One solution is:

- 5 ft. sections (roll size, coil width)
- 24 Gage
  - Join pieces of duct with any method approved for -10 in. w.g
  - Install a Class “A” reinforcement at center of each piece, resulting in a stiffener spacing of 5 ft.

Neg. Pressure 10 in. wg	Stiffener Spacing											
	Unstiff.		20 ft		12 ft		10 ft		6 ft		5 ft	
MAX. Diameter, in.	GA	R	GA	R	GA	R	GA	R	GA	R	GA	R
24	16	NR	18	A	20	A	20	A	22	A	24	A
30			18	B	18	A	20	A	22	A	22	A
36			16	C	18	B	18	B	20	A	22	A

Table 3-9, pg. 3.16

Note: -10” wg, 24” Rd, Long Seam, 5’ segments, 24 ga, A reinf.

Round Reinforcement

Reinforcement Class	Size W × H × T
A	1 × 1 × 1/8
B	1 1/4 × 1 1/4 × 3/16
C	1 1/2 × 1 1/2 × 3/16
D	1 1/2 × 1 1/2 × 1/4
E	2 × 2 × 3/16
F	2 × 2 × 1/4
G	3 × 3 × 1/4

Table 3–2 Angle Ring Size

Duct Dia, in.	Number of Attachments
6 and under	4
12 and under	6
18 and under	8
30 and under	12
54 and under	16
78 and under	20
96 and under	24

Table 3–3 Ring Attachment Schedule

NOTES:

a. Rings may be attached to the duct wall using screws, rivets, or tack welds.

Note: -10” wg, 24” Rd, Long Seam, 5’ segments, 24 ga, A reinf

Long. Seam Construction - Negative Pressure

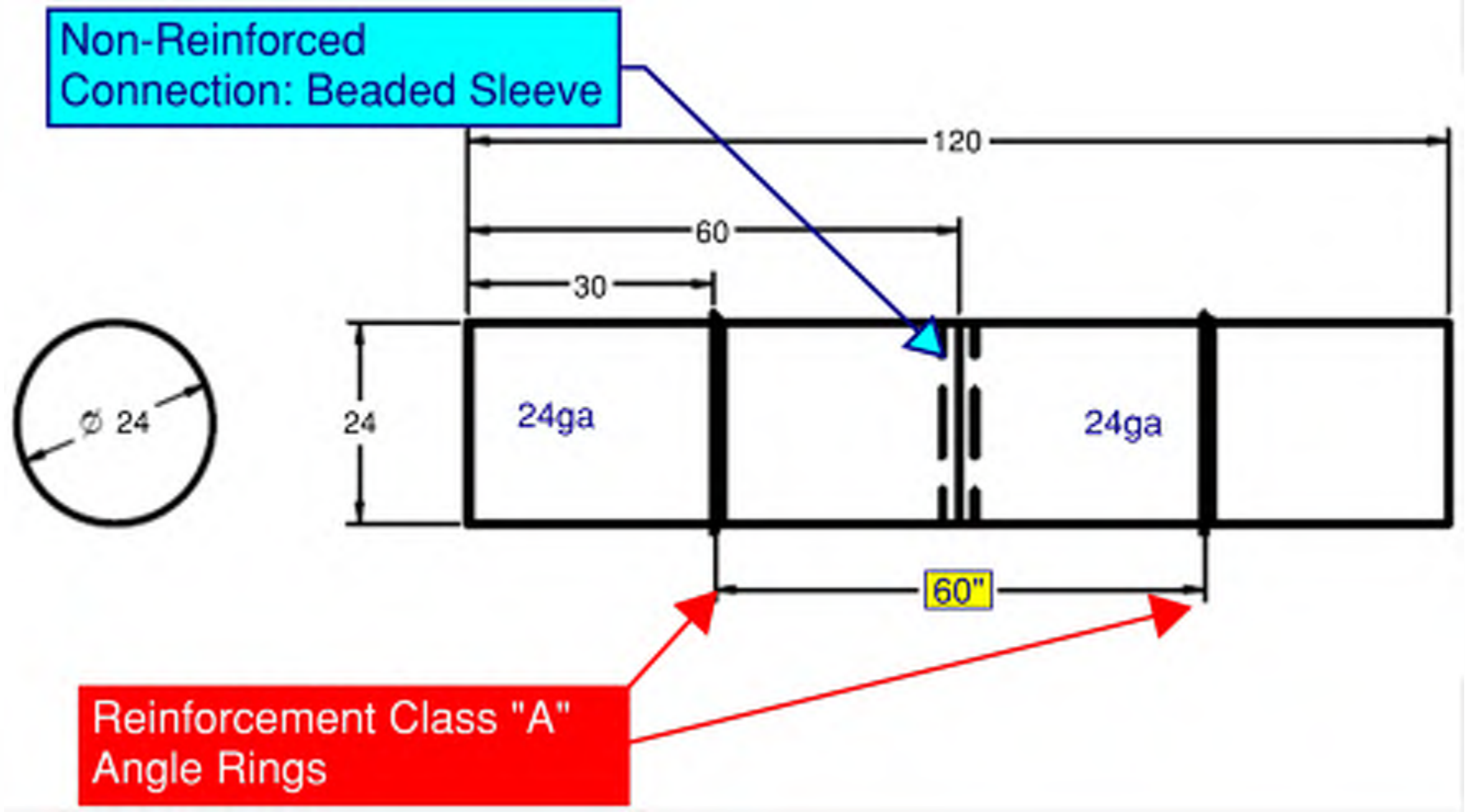


Table 3-9, pg. 3.16

Note: -10” wg, 24” Rd, Long Seam, 12’ RS, 12’ duct, 20 ga, Rienf Joint

Long. Seam Construction - Negative Pressure

Another solution could be:

- 12 ft. Stiffener Spacing
  - Duct to be 12 ft. made from (2) 6 ft. sections
- 20 gage = Minimum Panel Gage
- Companion flanges will be used and also act as stiffeners i.e., reinforcement
  - ➢ Use Table 3-4 when companion flanges are used for reinforcement

Neg. Pressure 10 in. wg	Stiffener Spacing											
	Unstiff.		20 ft		12 ft		10 ft		6 ft		5 ft	
MAX. Diameter, in.	GA	R	GA	R	GA	R	GA	R	GA	R	GA	R
24	16	NR	18	A	20	A	20	A	22	A	24	A
30			18	B	18	A	20	A	22	A	22	A
36			16	C	18	B	18	B	20	A	22	A

Table 3-4, pg. 3.6

Note: -10” wg, 24” Rd, Long Seam, 12’ RS, 12’ duct, 20 ga, Rienf Joint

Round Reinforcement

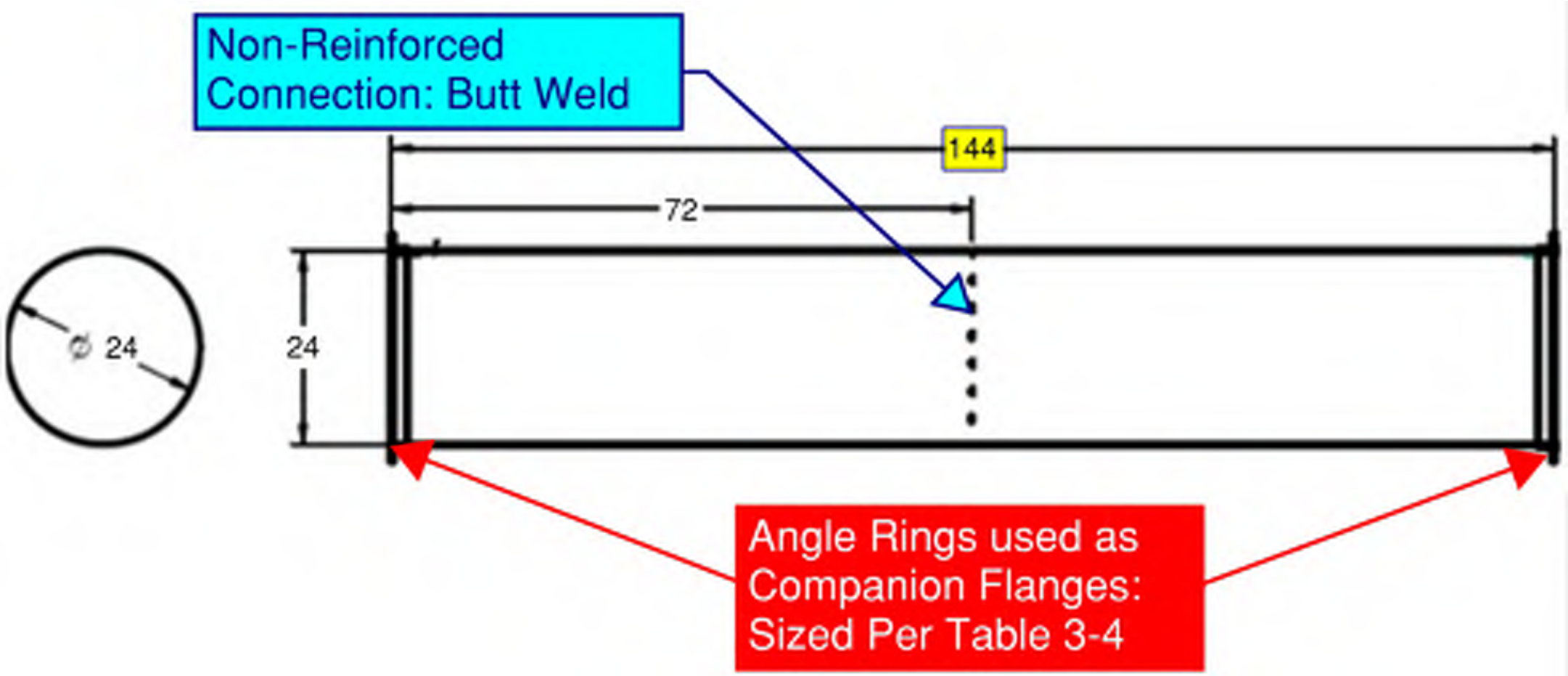
b. Companion Flanges used for reinforcement shall be:

Duct Dia. in.	Flange Selection
up to 9	1 × 1 × 1/8*
10 – 12	1 1/4 × 1 1/4 × 1/8*
13 – 25	1 1/2 × 1 1/2 × 3/16
26 – 48	2 × 2 × 3/16
49 – 60	2 1/2 × 2 1/2 × 3/16
61 – 96	3 × 3 × 1/4

Table 3–4 Companion Flange Joints Used As Reinforcement

Note: -10” wg, 24” Rd, Long Seam, 12’ RS, 12’ duct (2 6’ segments), 20 ga, Rienf Joint

Long. Seam Construction - Negative Pressure

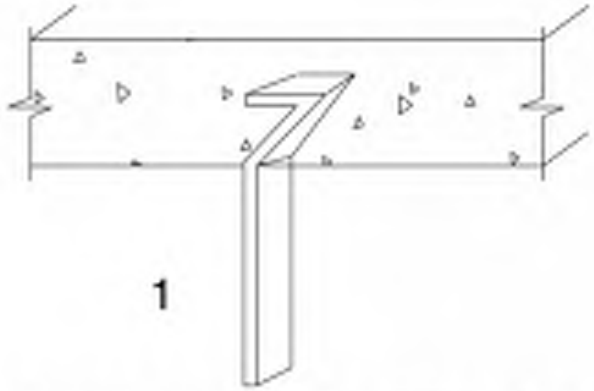


Hanging and Support Systems

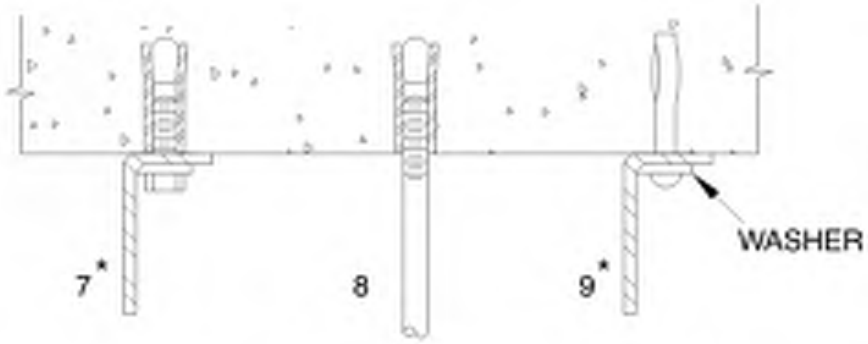
Basic Definitions of Hanger Components

- Upper attachment
- Lower attachment
- Hanger (vertical)
- Trapeze (horizontal)

Hanger Upper Attachments

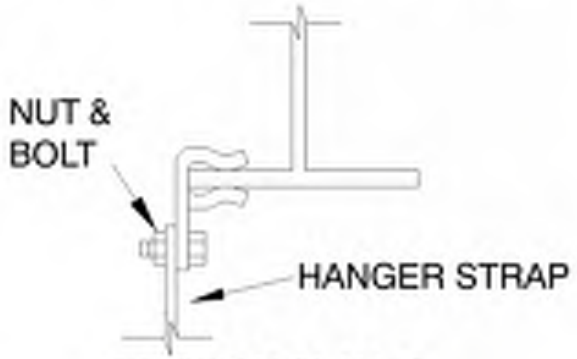


FLAT BAR CONCRETE INSERT



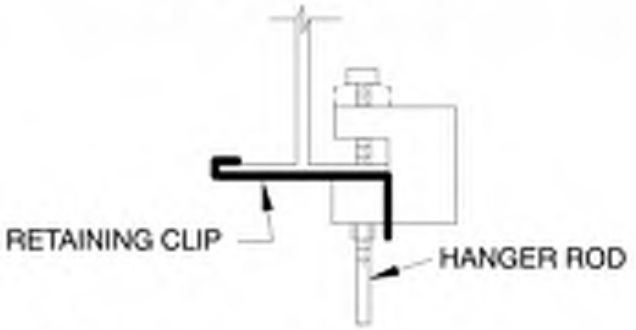
EXPANSION SHIELDS EXPANSION NAIL

CONCRETE ANCHORS



FRICTION CLAMPS

FRICTION CLAMPS

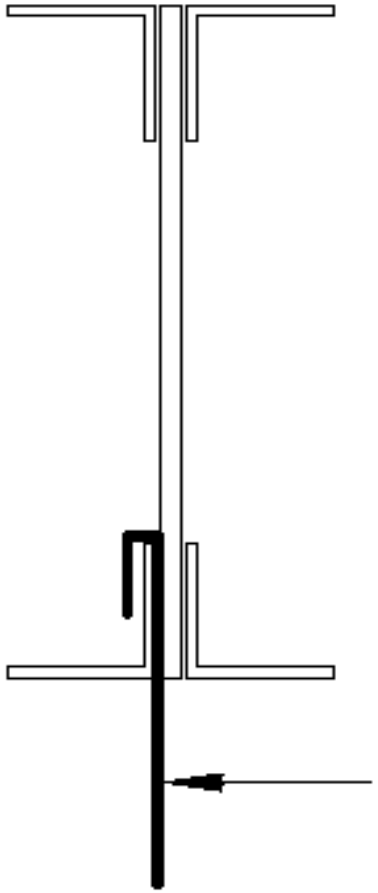


6a C-CLAMP W/ RETAINING CLIP OR
6b C-CLAMP W/ LOCK NUT (OPTIONAL)

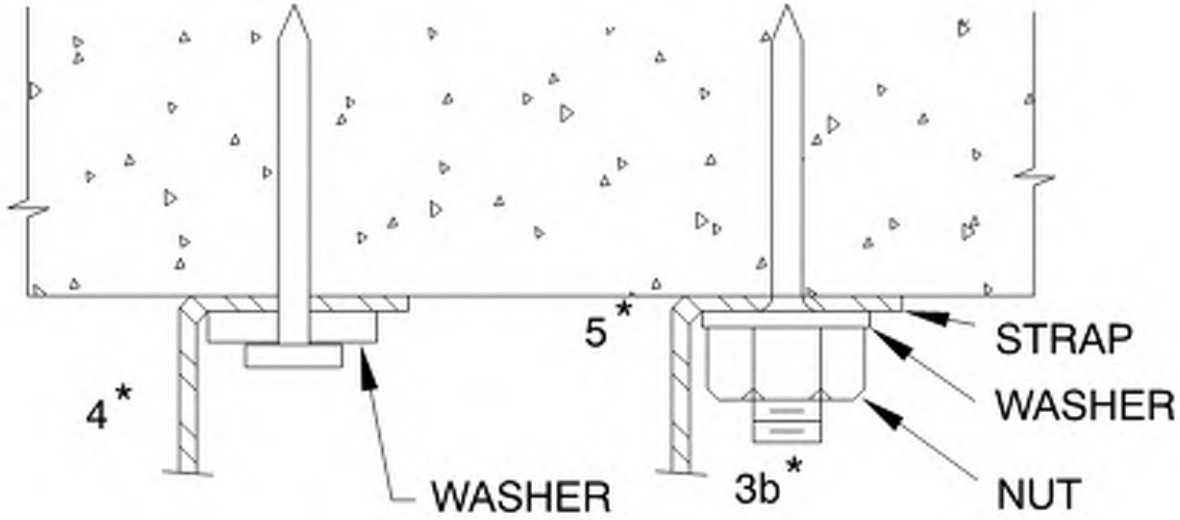
A HANGER STRAP MAY ALSO BE C
CLAMPED TO THE STRUCTURAL FLANGE

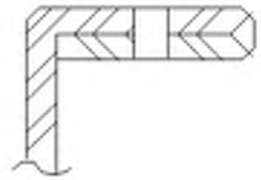
UNLESS OTHERWISE APPROVED ALLOWABLE LOAD ON UPPER ATTACHMENT IS 1/4 OF FAILURE LOAD.
UPPER ATTACHMENTS MAY BE TO WOOD STRUCTURES ALSO.

Hanger Upper Attachments



16 GA (1.61 MM)
BAND IRON
HANGERS





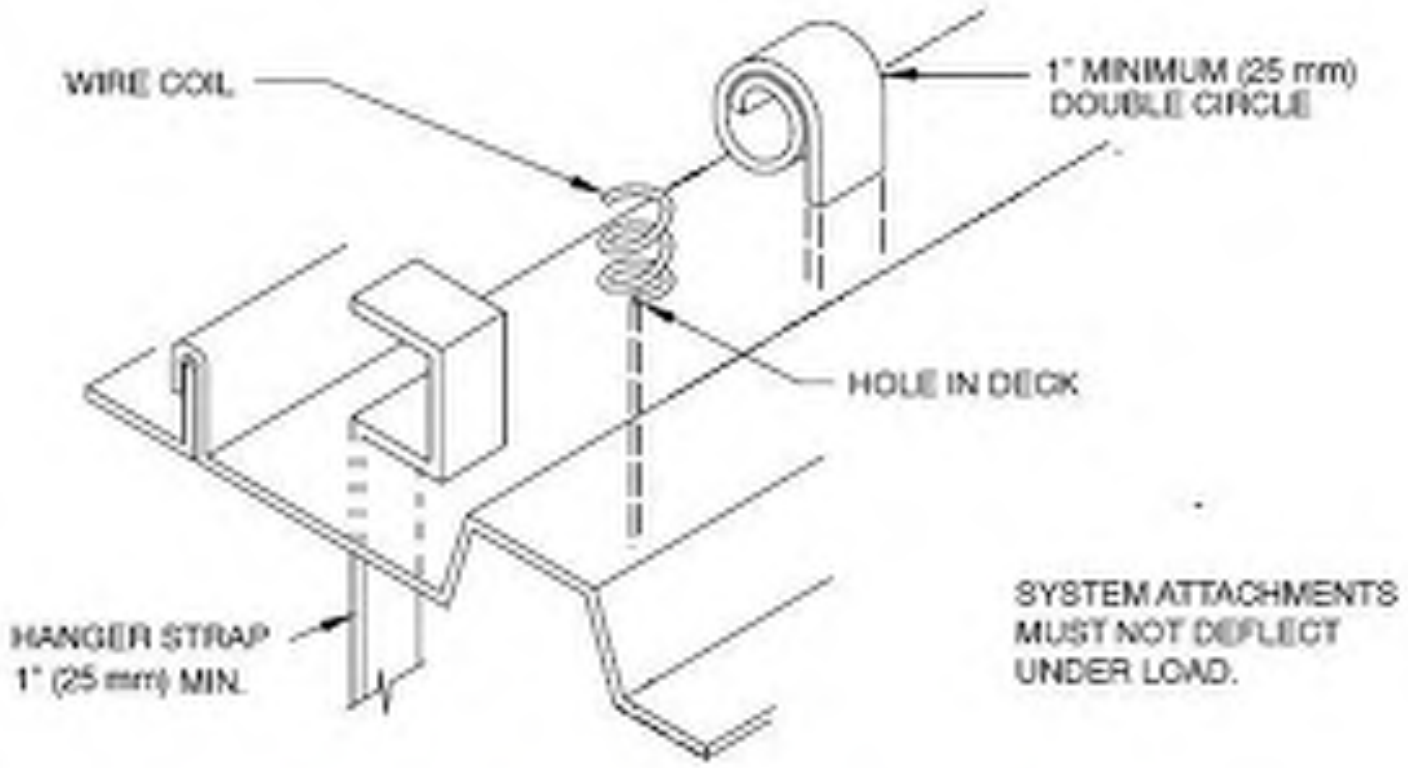
WASHER MAY BE OMITTED WITH
100 LB (45 KG) MAX LOAD ON
22 GA (0.85 mm) STRAP WHEN
FOLDED

Concrete Anchors

UNLESS OTHERWISE APPROVED ALLOWABLE LOAD ON UPPER ATTACHMENT IS 1/4 OF FAILURE LOAD.
UPPER ATTACHMENTS MAY BE TO WOOD STRUCTURES ALSO.

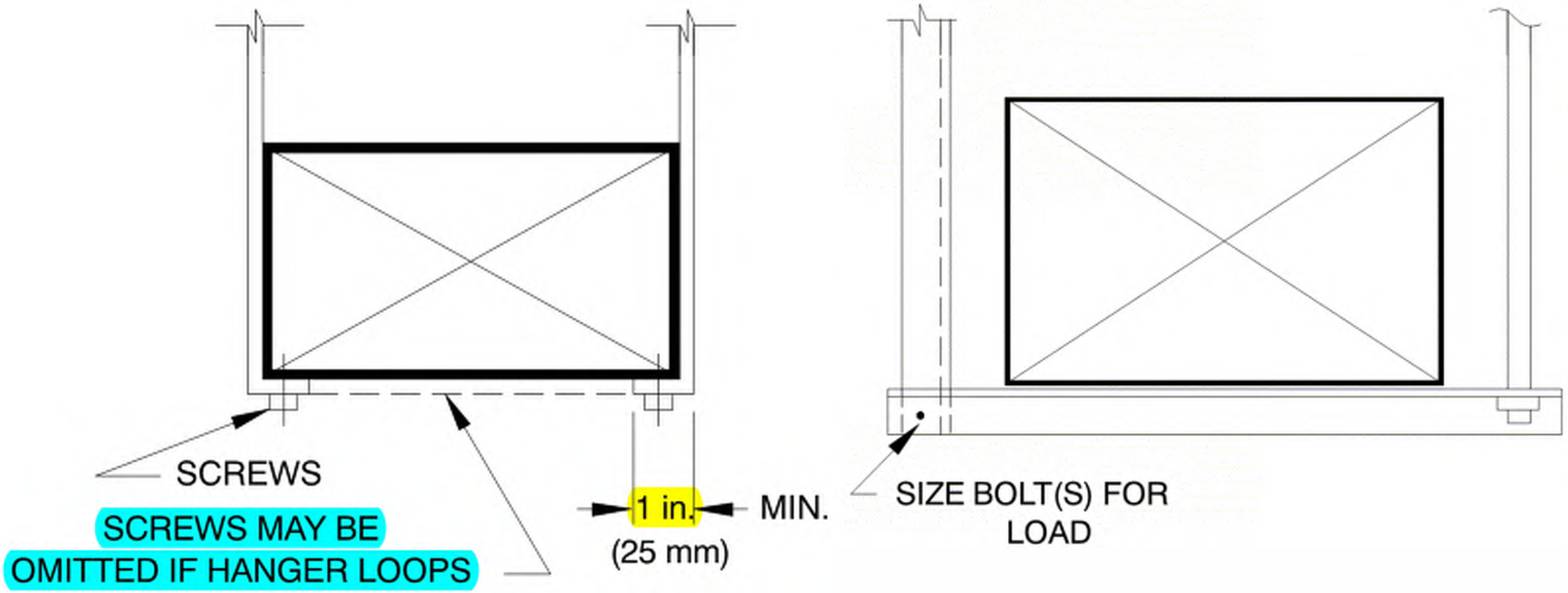
Hanger Upper Attachments

UNLESS OTHERWISE APPROVED ALLOWABLE LOAD ON UPPER ATTACHMENT IS 1/4 OF FAILURE LOAD.

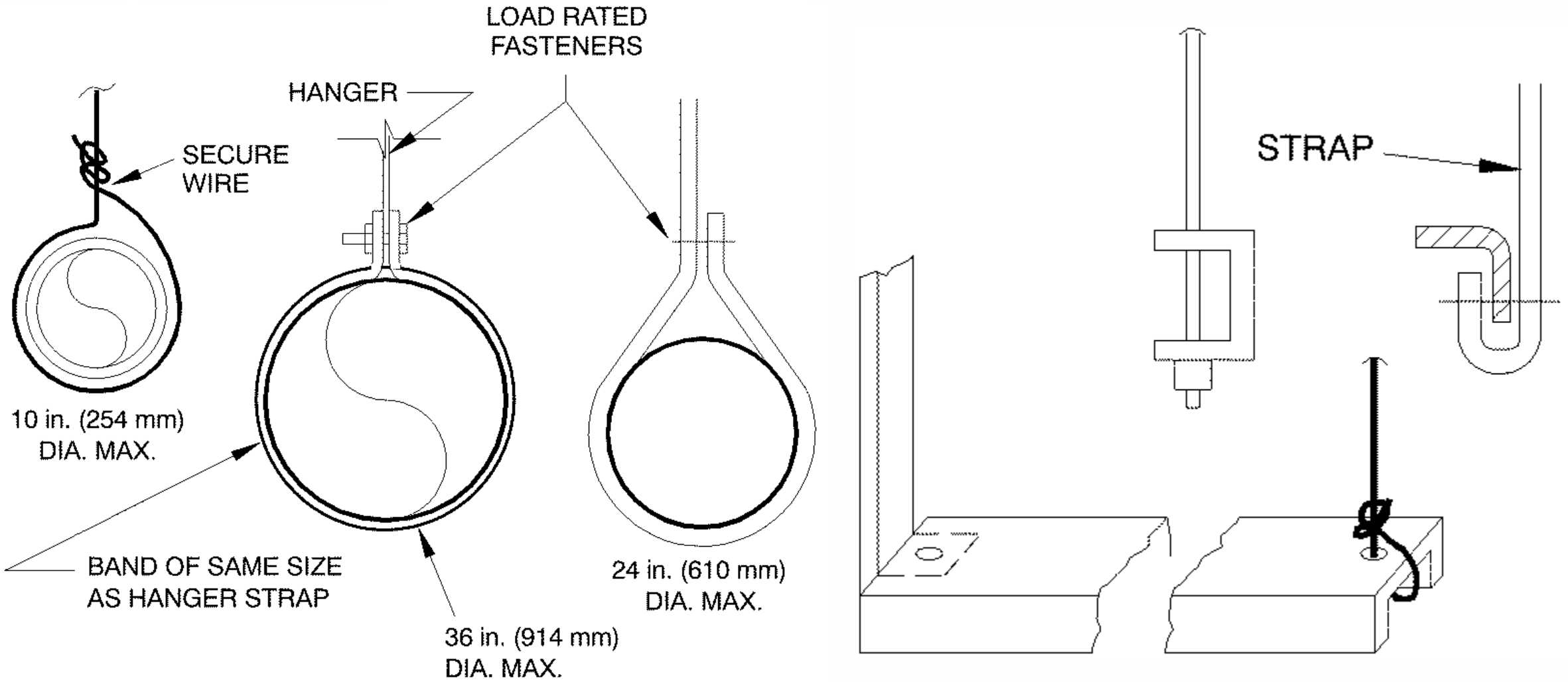


Pour In Place "Drop-In"

Hanger Lower Attachments

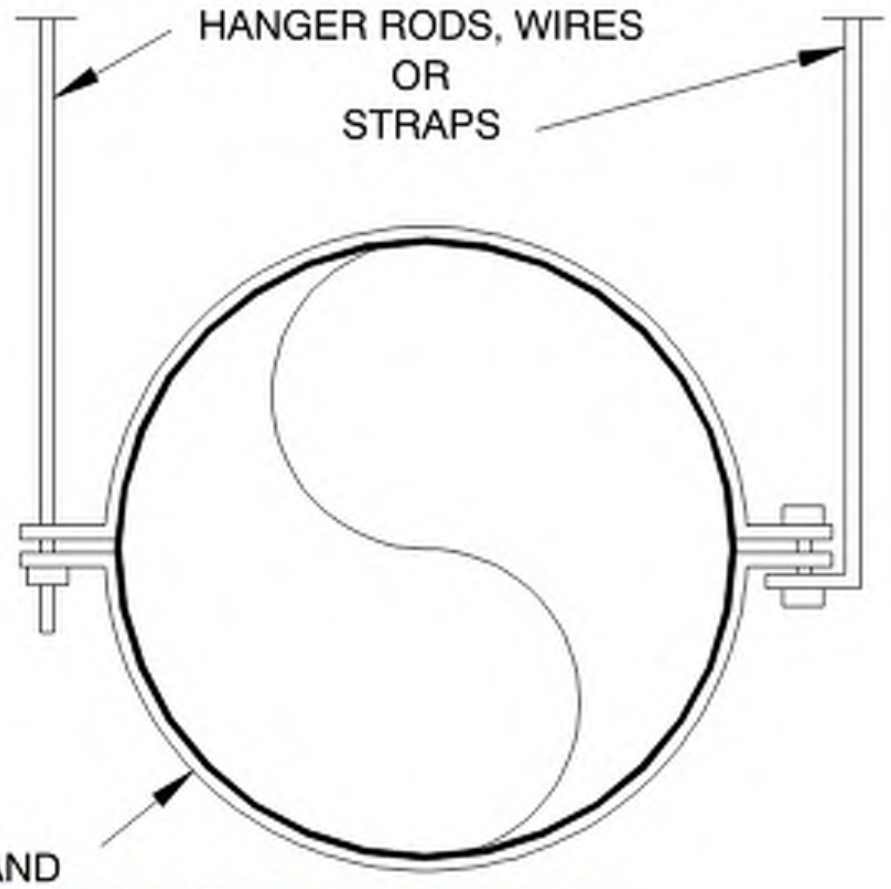


Hanger Lower Attachments

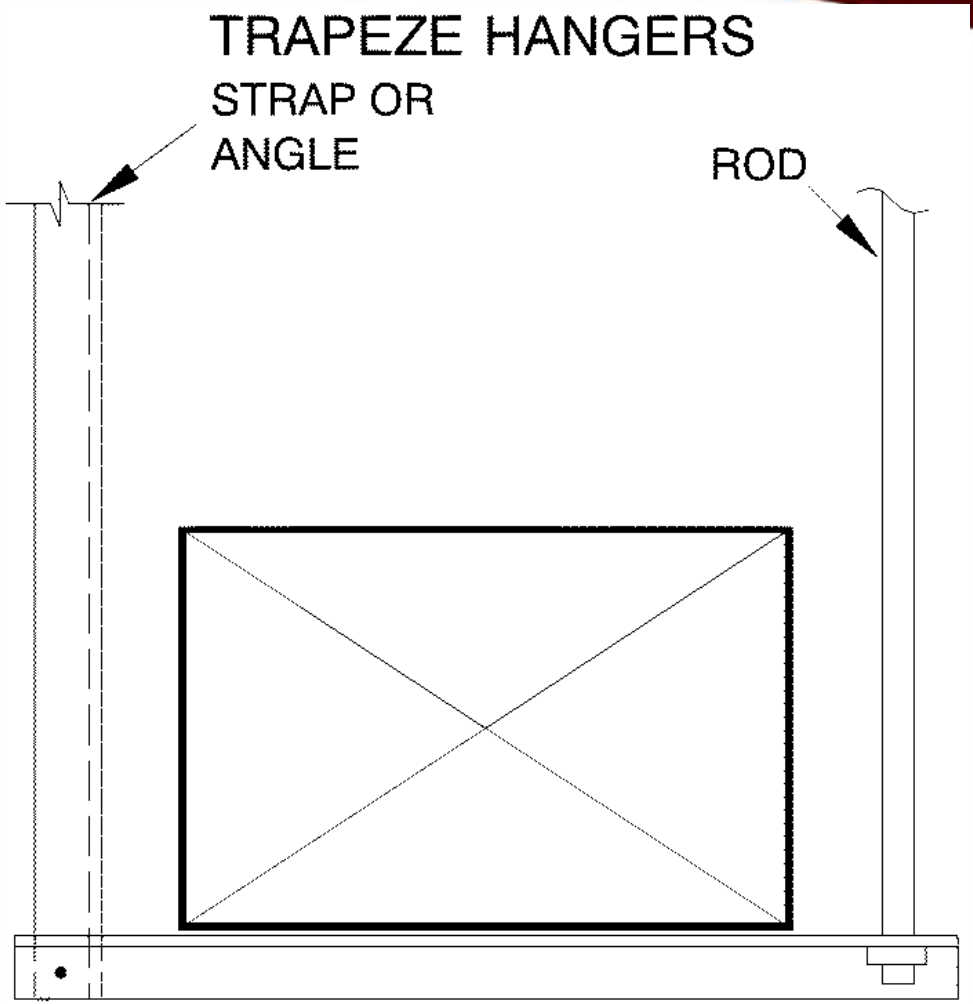


Hangers (Vertical)

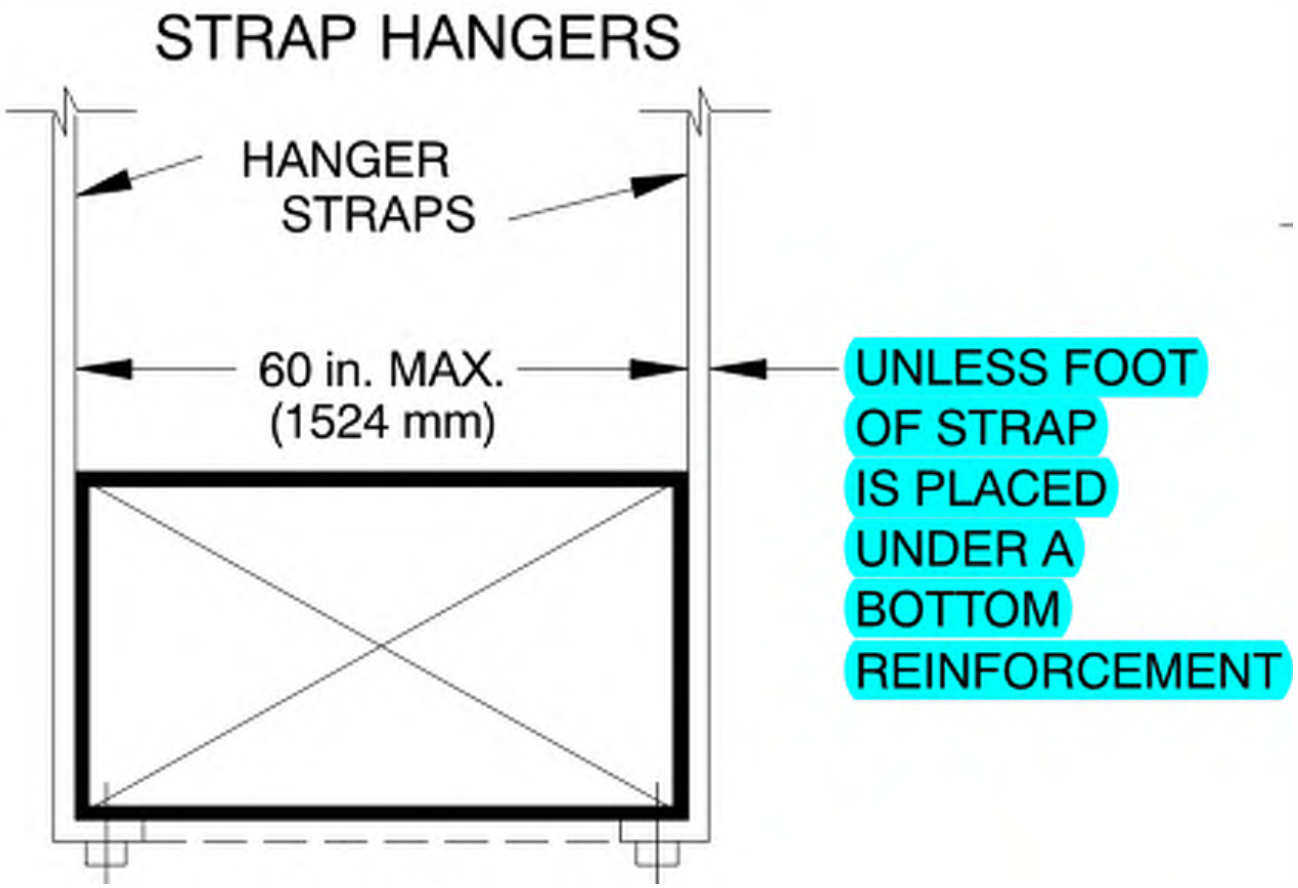
HANGERS MUST NOT DEFORM DUCT SHAPE

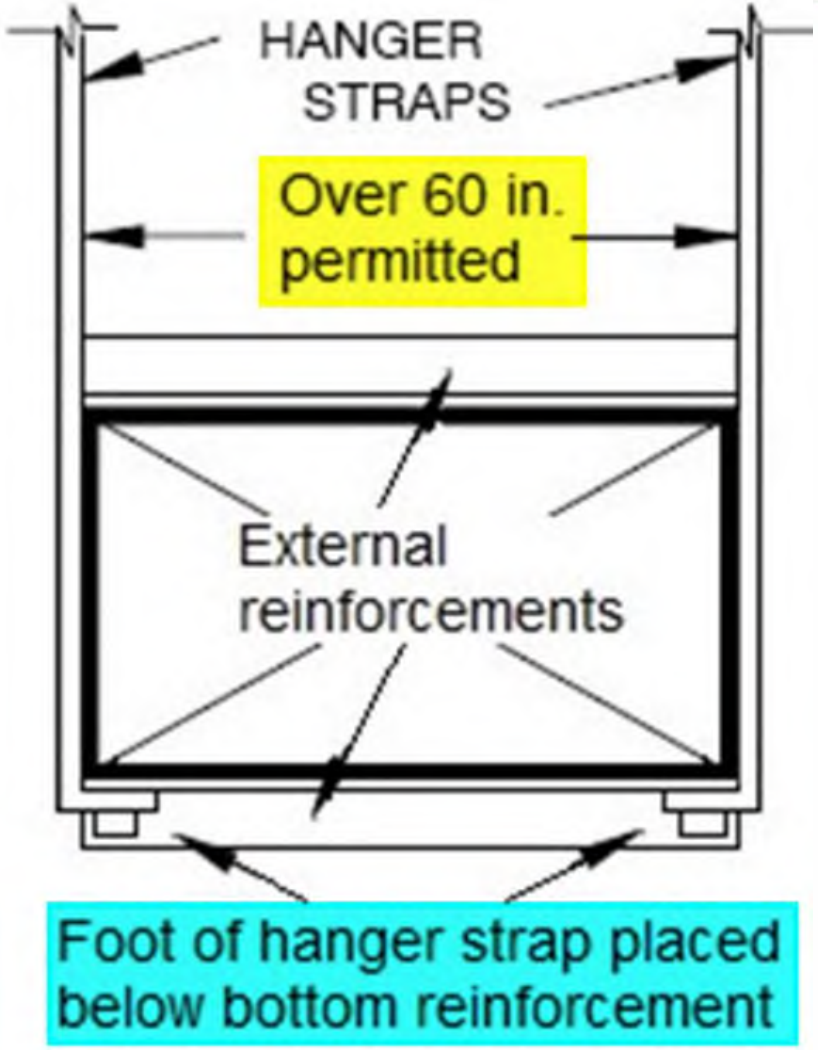


ONE HALF-ROUND MAY BE USED
IF DUCT SHAPE IS MAINTAINED.



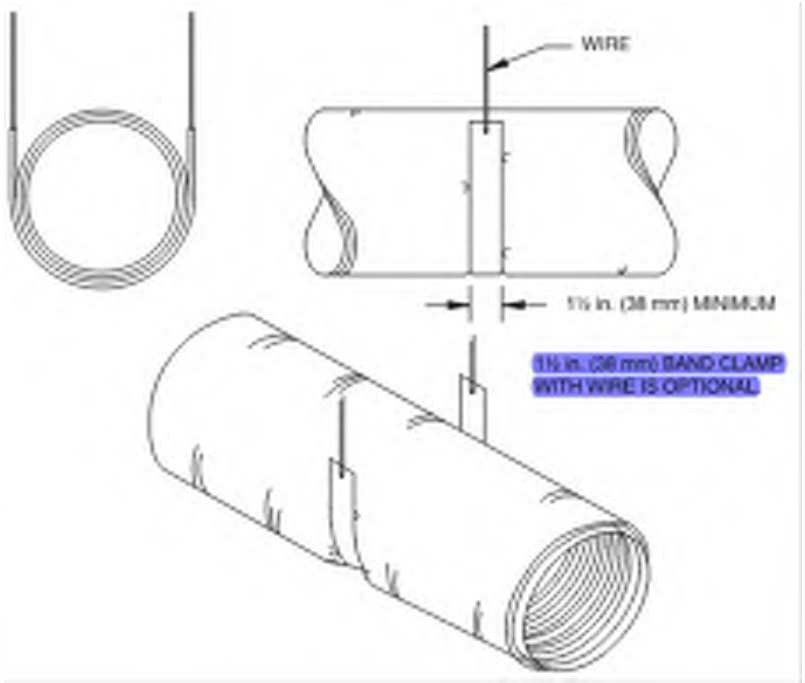
Hangers (Vertical)

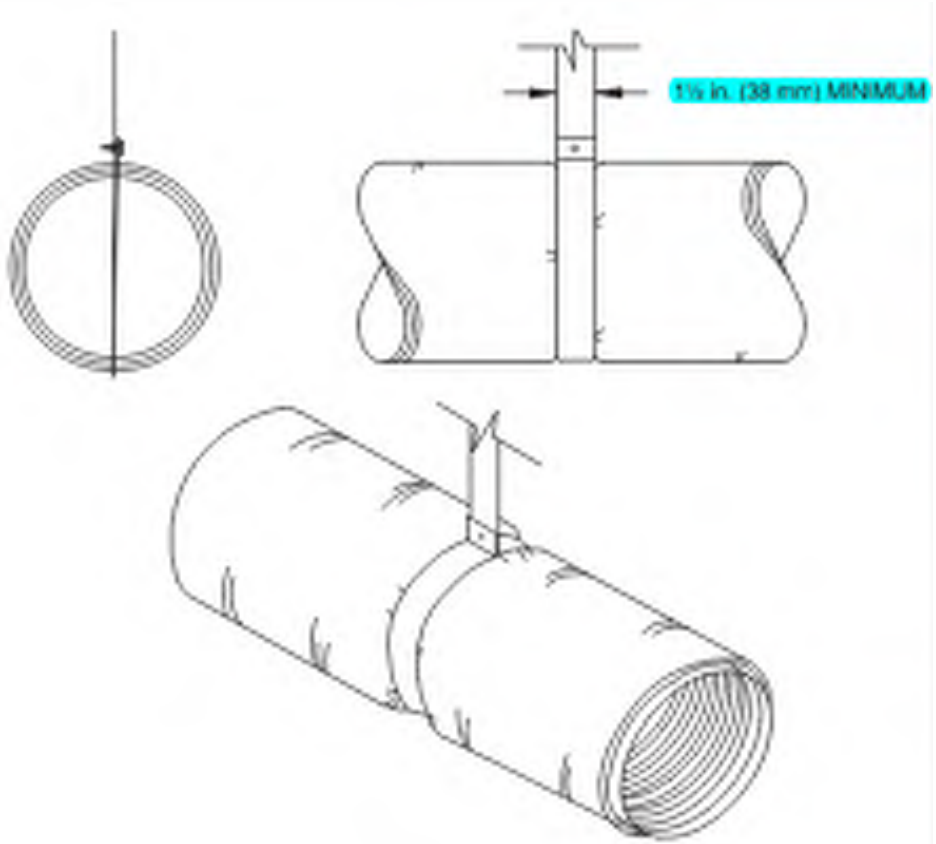




Flexible Duct Systems

- *Follow manufacturers installation instructions*
- *1-1/2” Wide Hanger Minimum*

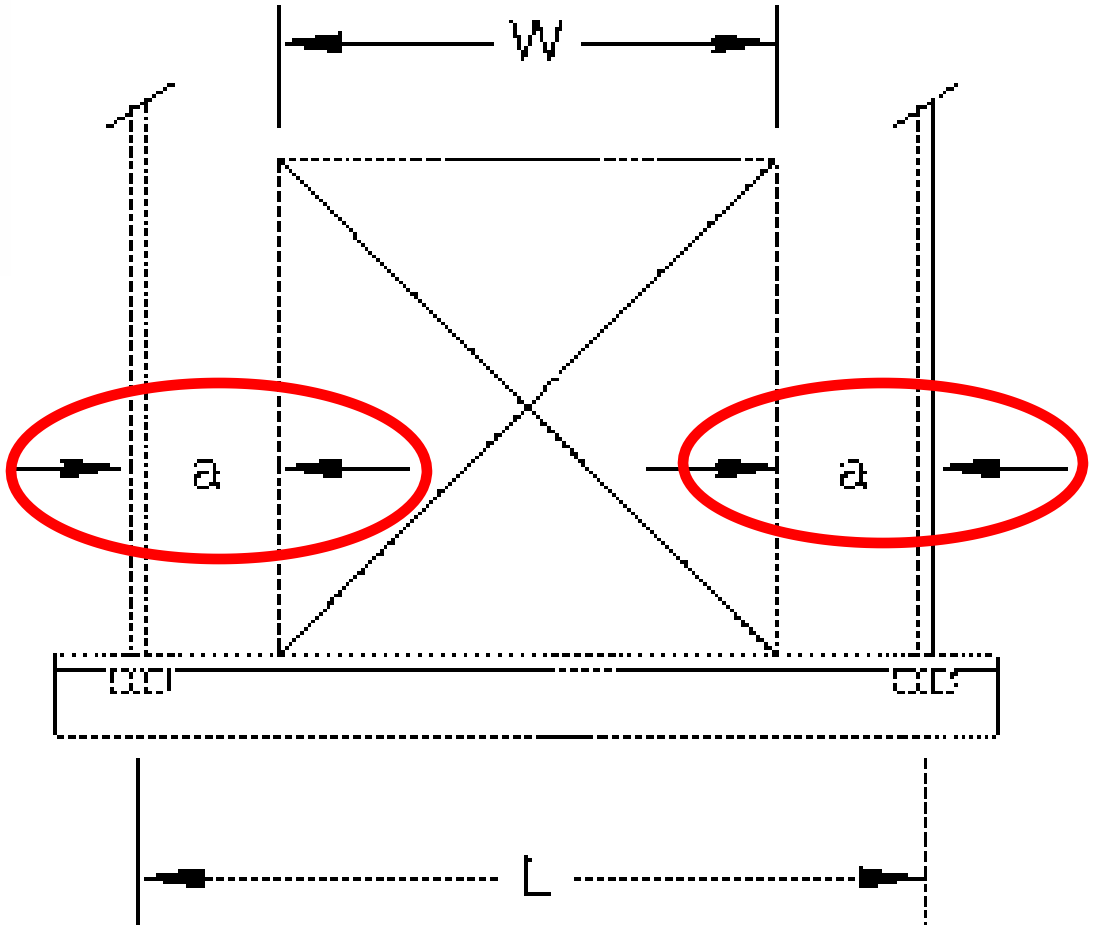




Cable Hanging Systems

- *Follow manufacturers installation instructions*
- *Dyna-Tite (Dura Dyne), Clutcher (Ductmate), Hang-Fast (Gripple), nVent CADDY Speed Link (Erico)*
- *Proprietary product. SMACNA Testing & Research Institute for SMACNA verification as an "acceptable alternative"*

Trapeze (Horizontal)



When using Table 5-3:

- Ducts to 96” W: a = 6” max
- Ducts > 96” W: a = 3” max

“Rules” for Duct Support

- Round Duct supported every 12 ft. or less
- Rectangular Duct supported every 10 ft. or less
- Upper attachment has an allowable load of ¼ of the failure load
- Horizontal ducts will be supported within 2 ft. of each elbow and within 4 ft. of each branch…

Figure 5-12
pg. 5.22

“Rules” for Duct Support

Elbow Supports:

- At Least One Support in Shaded Area
- Optional Heel Support
- Spacing Per Table 5-1

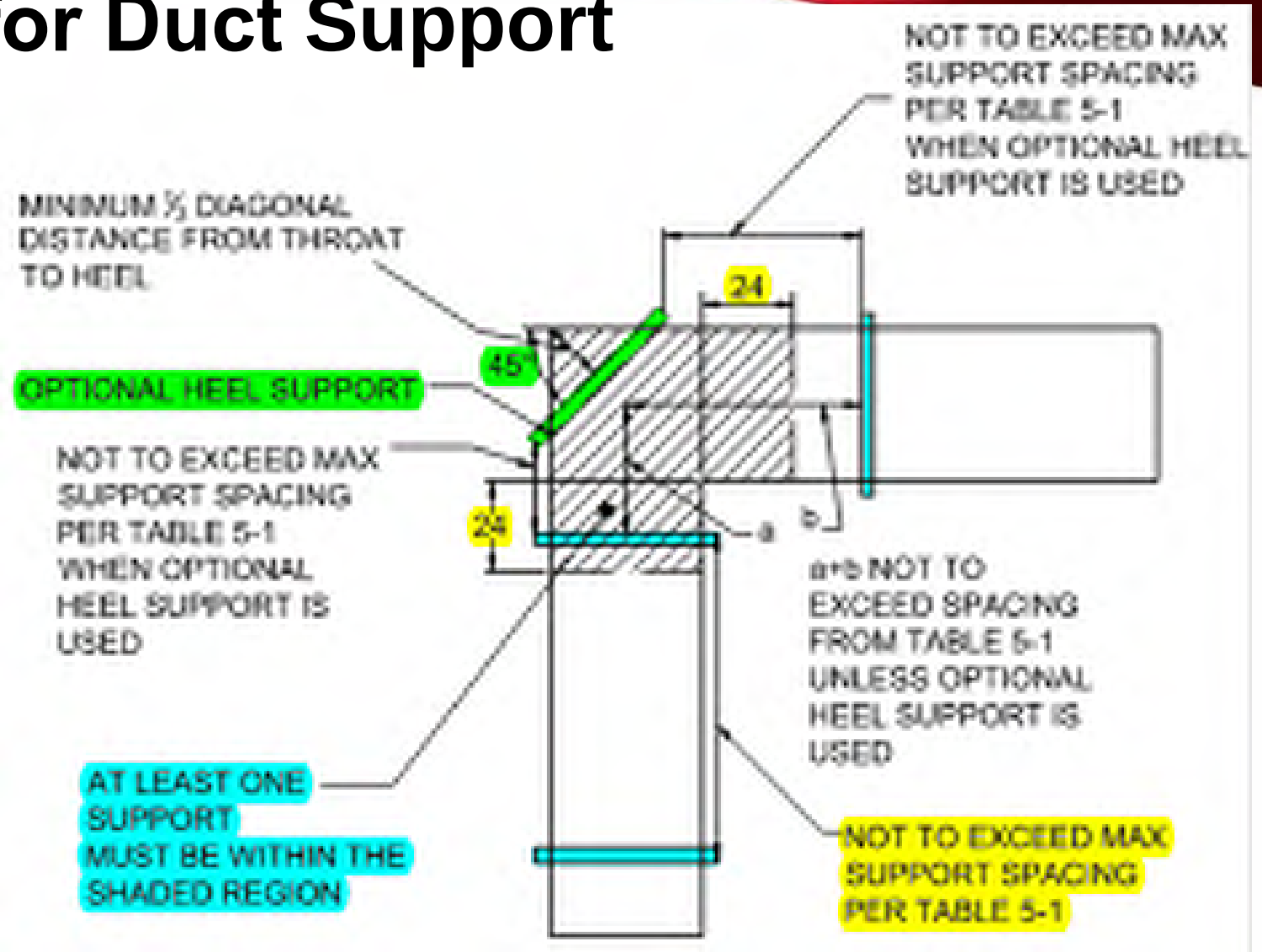


Figure 5-13, pg. 5.23

“Rules” for Duct Support

Branch Supports:

- At Least One Support in Shaded Area
- Spacing Per Table 5-1

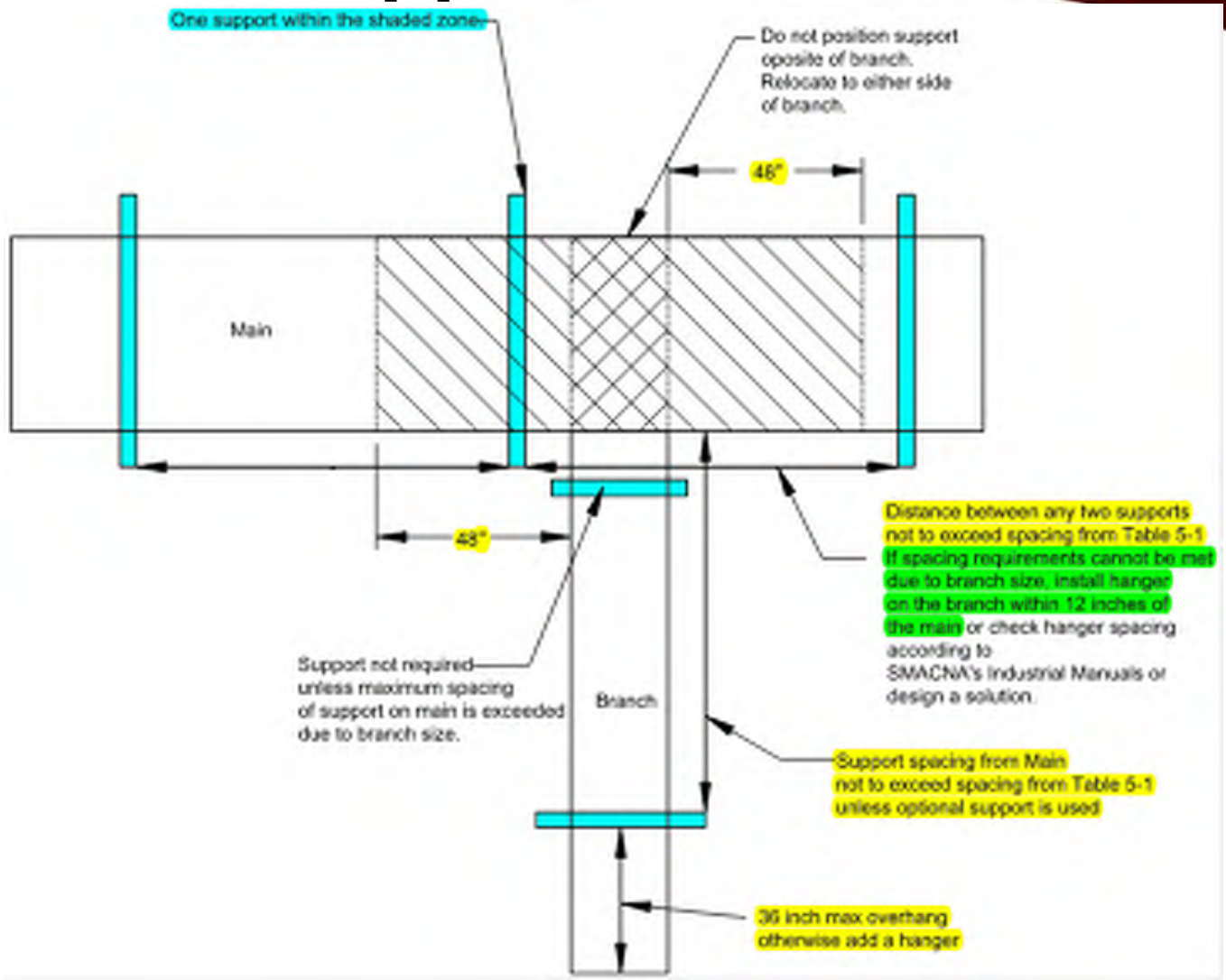


Table 5-1, pg. 5.7

Hangers

Maximum Half of Duct Perimeter	Pair at 10 ft Spacing		Pair at 8 ft Spacing		Pair at 5 ft Spacing		Pair at 4 ft Spacing	
	Strap	Wire/ Rod	Strap	Wire/ Rod	Strap	Wire/ Rod	Strap	Wire/ Rod
P/2 = 30"	1" × 22 ga	10 ga (.135")	1" × 22 ga	10 ga (.135")	1" × 22 ga	12 ga (.106")	1" × 22 ga	12 ga (.106")
P/2 = 72"	1" × 18 ga	⅜"	1" × 20 ga	¼"	1" × 22 ga	¼"	1" × 22 ga	¼"
P/2 = 96"	1" × 16 ga	⅜"	1" × 18 ga	⅜"	1" × 20 ga	⅜"	1" × 22 ga	¼"
P/2 = 120"	1½" × 16 ga	½"	1" × 16 ga	⅜"	1" × 18 ga	⅜"	1" × 20 ga	¼"
P/2 = 168"	1½" × 16 ga	½"	1½" × 16 ga	½"	1" × 16 ga	⅜"	1" × 18 ga	⅜"
P/2 = 192"	Not Given	½"	1 ½ " × 16 ga	½"	1" × 16 ga	⅜"	1" × 16 ga	⅜"
P/2 = 193" up	Special Analysis Required							

When Straps are Lap Joined Use These Minimum Fasteners:	Single Hanger Maximum Allowable Load	
	Strap	Wire or Rod (Dia.)
1" × 18, 20, 22 ga -two #10 or one ¼" bolt 1" × 16 ga -two ¼" dia. 1½" × 16 ga -two ⅜" dia Place fasteners in series, not side by side.	1" × 22 ga - 260 lbs. 1" × 20 ga - 320 lbs. 1" × 18 ga - 420 lbs. 1" × 16 ga - 700 lbs. 1½" × 16 ga - 1100 lbs.	0.106" - 80 lbs. 0.135" - 120 lbs. 0.162" - 160 lbs. ¼" - 270 lbs. ⅜" - 680 lbs. ½" - 1250 lbs. ⅝" - 2000 lbs. ¾" - 3000 lbs.

Table 5–1 Rectangular Duct Hangers Minimum Size

b. Tables allow for duct weight, 1 lb./sf insulation weight and normal reinforcement and trapeze weight, but no external loads!

Table 5-1, pg. 5.7

Hangers

Hangers:

- Sized by Calculating ½ the Duct Perimeter
- 4 Spacing Options
- 3 Material Types
- Maximum Loads for each

Maximum Half of Duct Perimeter	Pair at 10 ft Spacing		Pair at 8 ft Spacing		Pair at 5 ft Spacing		Pair at 4 ft Spacing	
	Strap	Wire/ Rod	Strap	Wire/ Rod	Strap	Wire/ Rod	Strap	Wire/ Rod
P/2 = 30"	1" × 22 ga	10 ga (.135")	1" × 22 ga	10 ga (.135")	1" × 22 ga	12 ga (.106")	1" × 22 ga	12 ga (.106")
P/2 = 72"	1" × 18 ga	⅜"	1" × 20 ga	⅜"	1" × 22 ga	⅜"	1" × 22 ga	⅜"
P/2 = 96"	1" × 16 ga	⅜"	1" × 18 ga	⅜"	1" × 20 ga	⅜"	1" × 22 ga	⅜"
P/2 = 120"	1½" × 16 ga	½"	1" × 16 ga	⅜"	1" × 18 ga	⅜"	1" × 20 ga	⅜"
P/2 = 168"	1½" × 16 ga	½"	1½" × 16 ga	½"	1" × 16 ga	⅜"	1" × 18 ga	⅜"
P/2 = 192"	Not Given	½"	1 ½" × 16 ga	½"	1" × 16 ga	⅜"	1" × 16 ga	⅜"
P/2 = 193" up	Special Analysis Required							

When Straps are Lap Joined Use These Minimum Fasteners:	Single Hanger Maximum Allowable Load	
	Strap	Wire or Rod (Dia.)
1" × 18, 20, 22 ga -two #10 or one ¼" bolt 1" × 16 ga -two ¼" dia. 1½" × 16 ga -two ⅜" dia Place fasteners in series, not side by side.	1" × 22 ga - 260 lbs. 1" × 20 ga - 320 lbs. 1" × 18 ga - 420 lbs. 1" × 16 ga - 700 lbs. 1½" × 16 ga - 1100 lbs.	0.106" - 80 lbs. 0.135" - 120 lbs. 0.162" - 160 lbs. ¼" - 270 lbs. ⅜" - 680 lbs. ½" - 1250 lbs. ⅝" - 2000 lbs. ¾" - 3000 lbs.

Table 5–1 Rectangular Duct Hangers Minimum Size

Figure 5-8, pg. 5.16

Riser Support From Floor

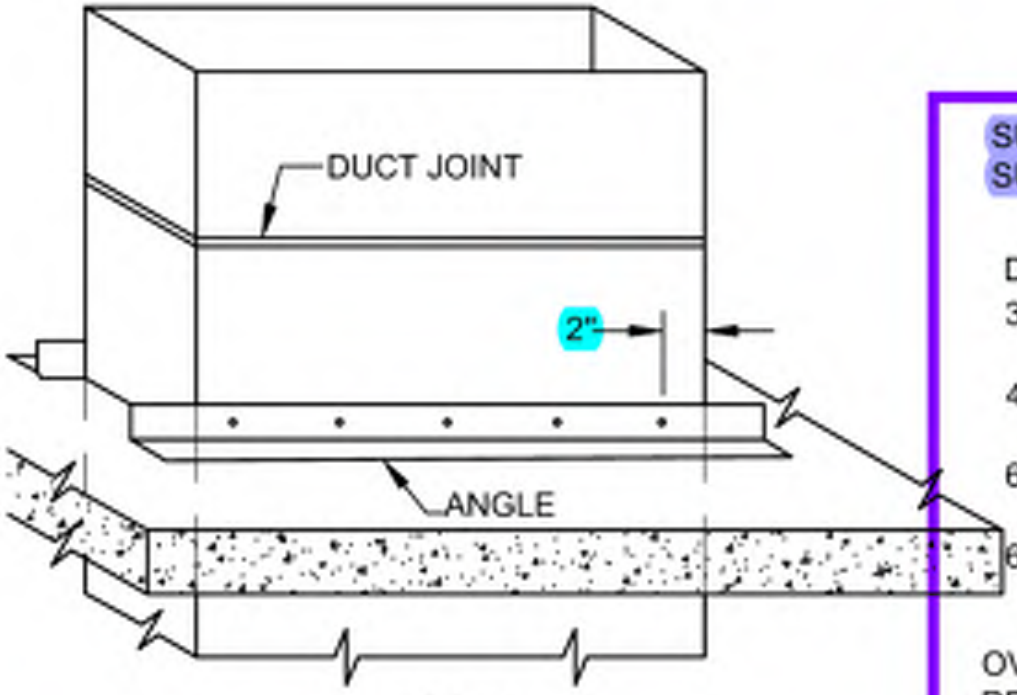


FIG. A

SUGGESTED SIZING FOR SUPPORT OF 12 FT. OF DUCT

DUCT SIZE	ANGLE
36" X 18"	1 ½" X 1 ½" X ⅛"
48" X 24"	1 ½" X 1 ½" X ⅛"
60" X 30"	1 ½" X 1 ½" X 3/16"
60" X 60"	1 ½" X 1 ½" X ¼" OR 2" X 2" X ⅛"

OVER 60" - INCREASE ANGLE SIZE AS REQUIRED FOR SPACE AND DUCT SIZE

FOR DUCT UPTO 96" - S = 6" MAX.
FOR DUCT OVER 96" - S = 3" MAX.
SELECT A PAIR OF ANGLES FROM TABLE 5-3 EACH OF WHICH HAS A CAPACITY OF AT LEAST 50% OF THE DUCT WEIGHT BEING SUPPORTED

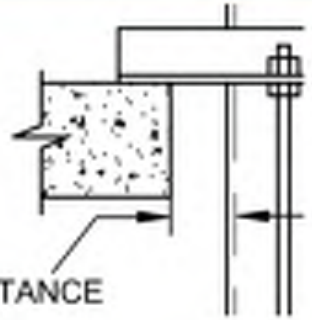
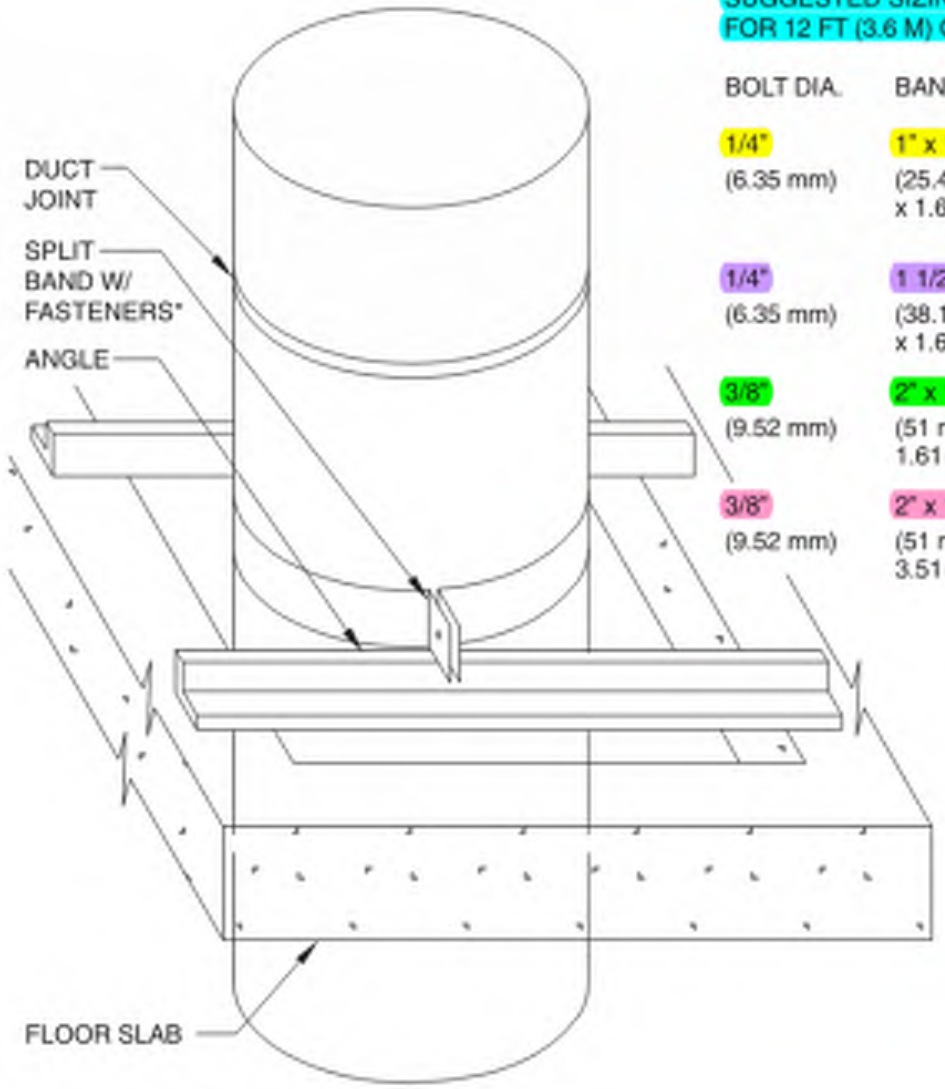


Fig 5-8

Figure 5-10, pg. 5.20

Riser Support From Floor



SUGGESTED SIZING FOR SPLIT BAND SUPPORT FOR 12 FT (3.6 M) OF DUCT

BOLT DIA.	BAND SIZE	DUCT DIA.
1/4" (6.35 mm)	1" x 16 GA (25.4 mm x 1.61 mm)	UP TO 12" DIA 24 GA (UP TO 305 mm DIA 0.70 mm)
1/4" (6.35 mm)	1 1/2" x 16 GA (38.1 mm x 1.61 mm)	13" TO 24" DIA 20 GA (330 mm TO 610 mm DIA 1.00 mm)
3/8" (9.52 mm)	2" x 16 GA (51 mm x 1.61 mm)	25" TO 36" DIA 20 GA (635 mm TO 914 mm DIA 1.00 mm)
3/8" (9.52 mm)	2" x 10 GA (51 mm x 3.51 mm)	37" TO 60" DIA 18 GA (940 mm TO 1524 mm DIA 1.31 mm)

* MINIMUM OF TWO FASTENERS IN EACH HALF OF BAND. OTHERWISE SPACE THEM AT 8" (200 mm) AND SO THAT THE LOAD SATISFIES TABLE 5–5 ON FIG. 5–9

SNAPSHOT: FIGURE 5-9, TABLE 5-5

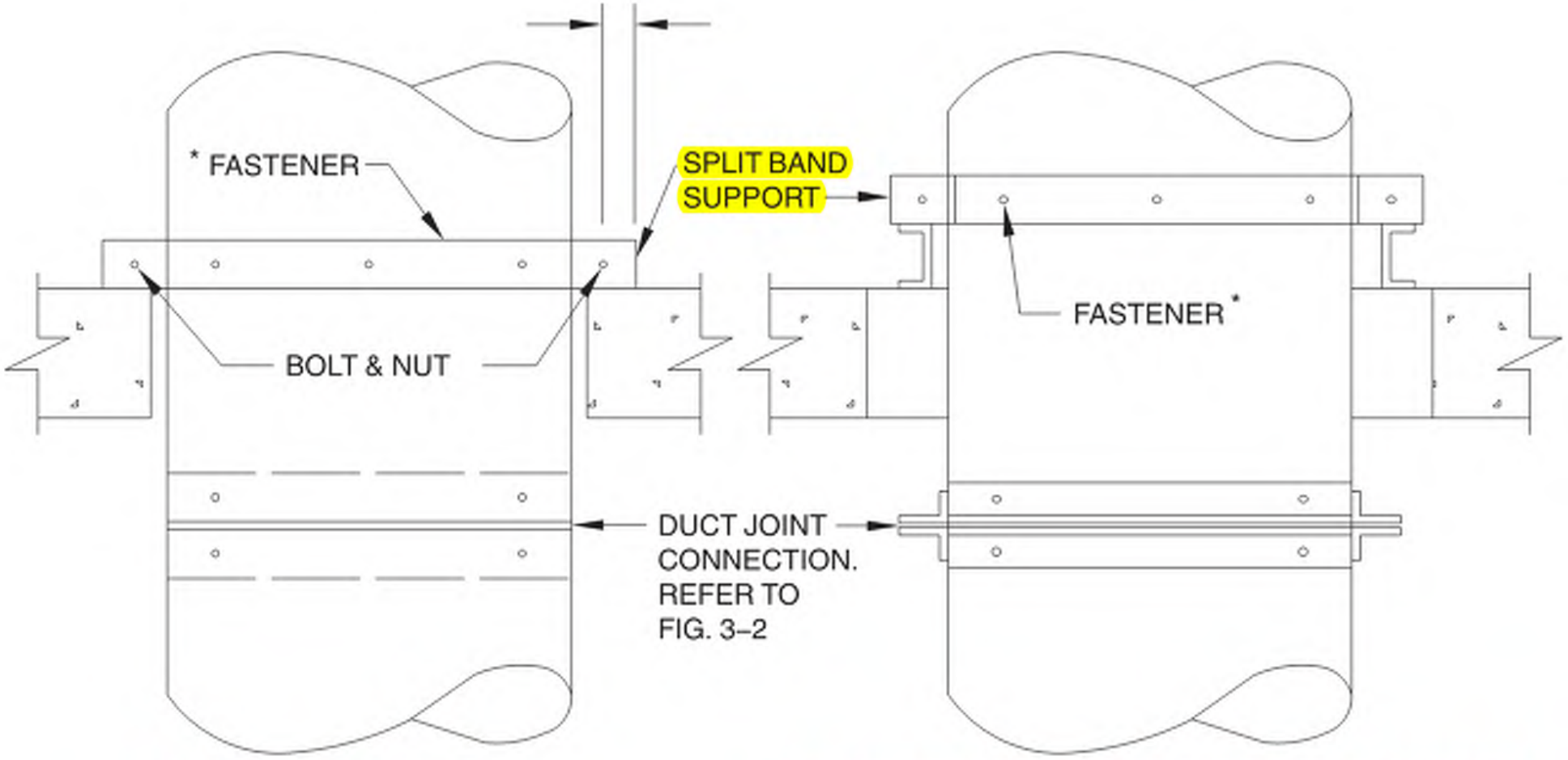
Table 5-5

DUCT GAGE	ALLOWABLE LOAD PER FASTENER*
28, 26	25 lb
24, 22, 20	35 lb
18, 16	50 lb

* WELD, BOLT OR NO. 8 SCREW (MIN.)

Figure 5-10, pg. 5.20

Risers Support From Floor



SPLIT BAND SUPPORT DIRECTLY ON FLOOR SLAB

SPLIT BAND SUPPORT BY SUPPLEMENTAL ANGLE OR CHANNEL SPANNING THE SLAB OPENING. USE AISC STEEL HANDBOOK FORMULA FOR SIZING BEAMS WITH TWO CONCENTRATED LOADS.

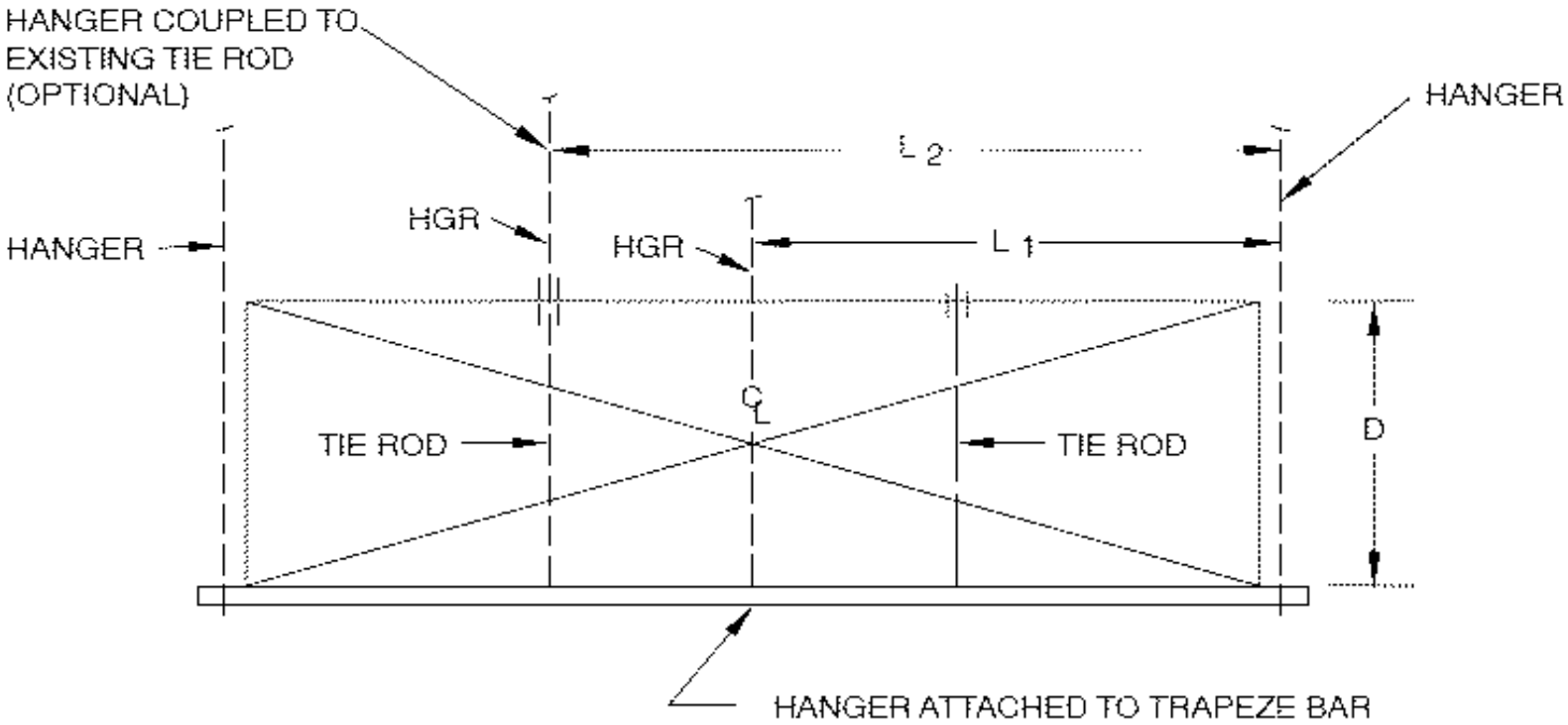
Risers

- Supports 1 to 2 story intervals. Max.12-24 ft.
  - Longer distances consult Industrial Manuals
- Risers must be hung in ***tension***
- Rectangular duct, 3”- 6” max duct wall to shaft wall
  - Larger dimension consult Industrial Manuals
- Round duct, tight to shaft wall
  - Larger dimension consult Industrial Manuals
- Round duct – if using supplemental steel below split band, consult RectIDCS for steel sizing
- Duct gage also determines fastener load
- Use trapeze table for +60” duct or heavy ducts

Figure 5-7, pg. 5.15

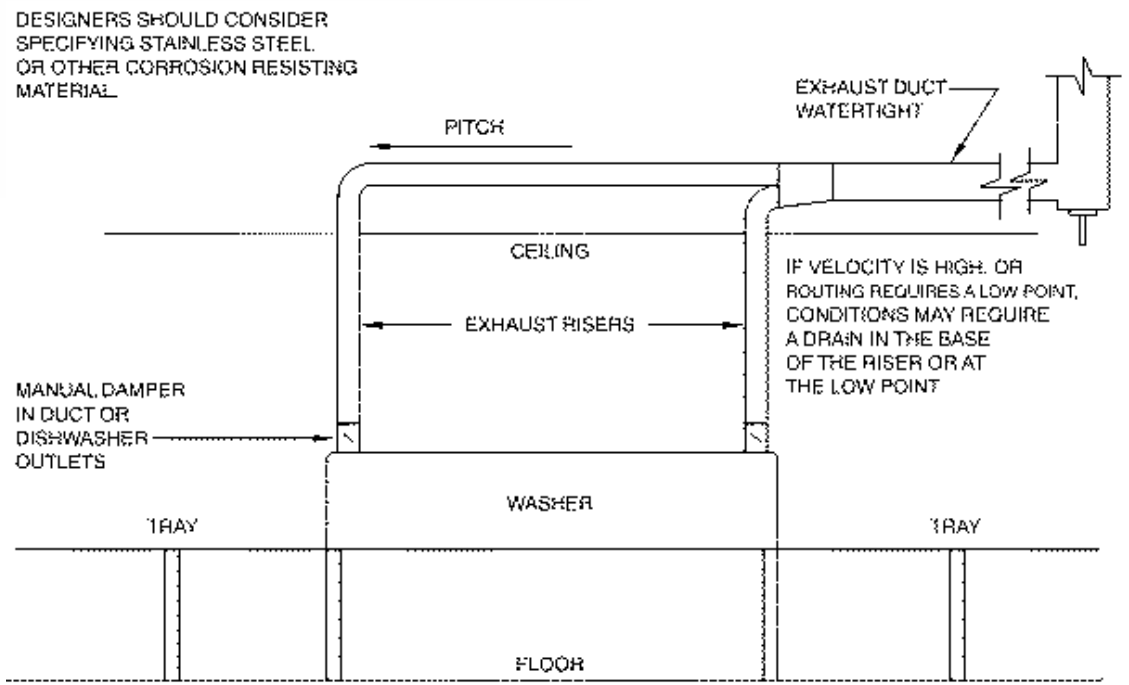
Large Duct Support

See Table 5-3 for trapeze up to 144” length



$L_1 + D$ OR $L_2 + D$ DEFINES P/2 FOR TABLE 5–1

Dishwasher Hoods



WASHER ELEVATION
CONNECTIONS IN WASHER

FIG. A

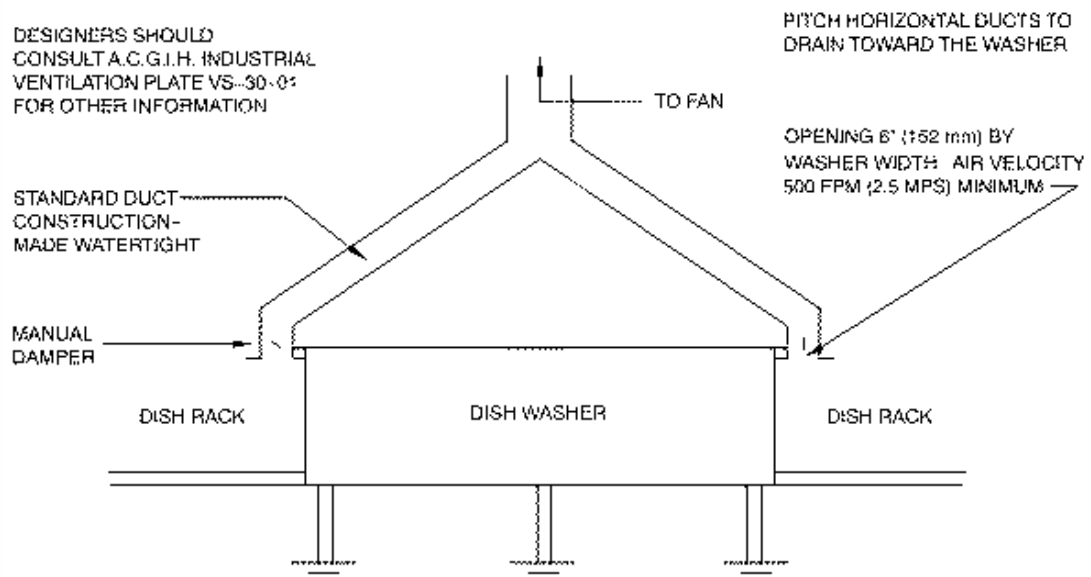
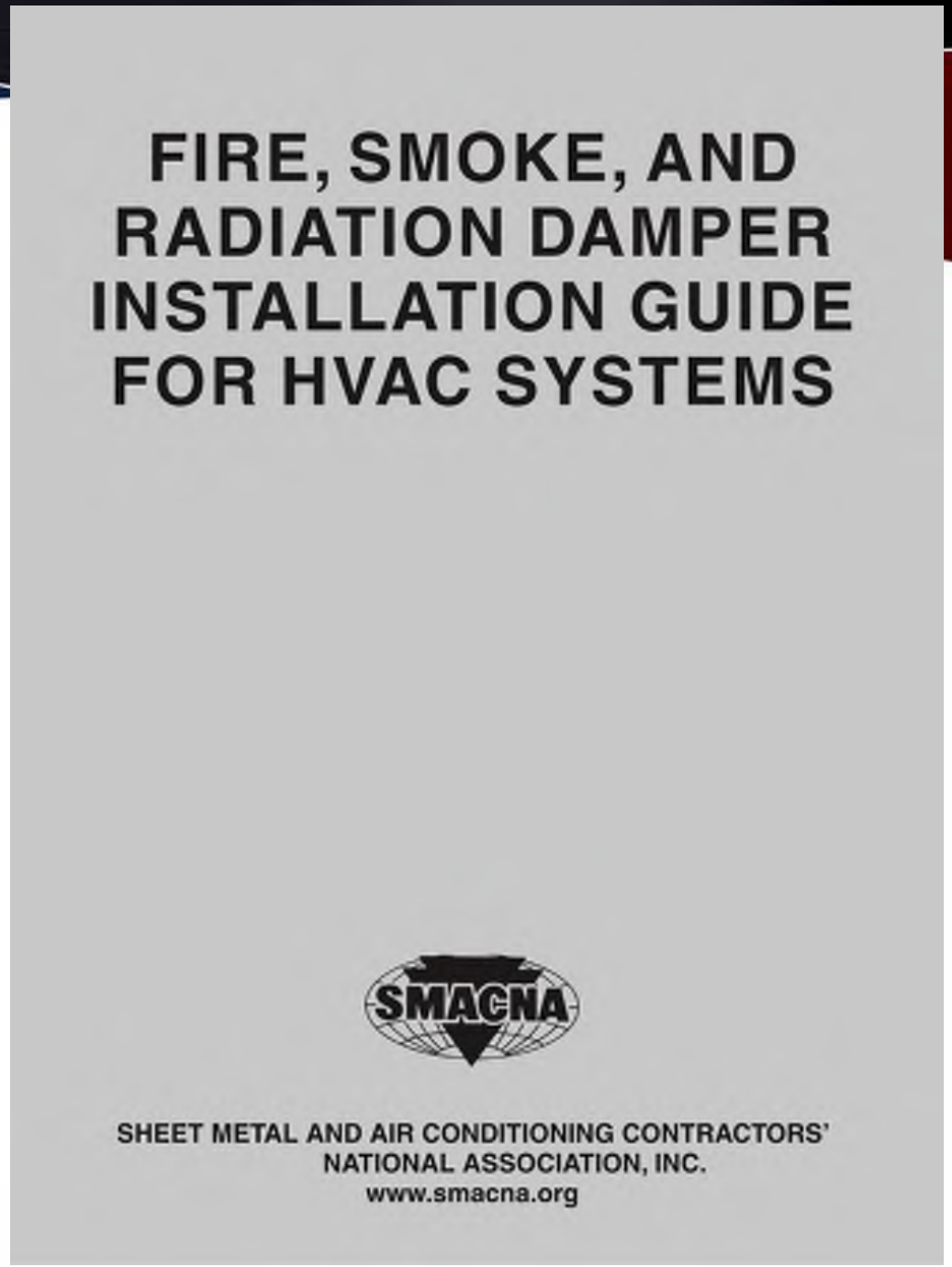


FIG. B

(ALTERNATIVE METHOD)

Section-02

FIRE, SMOKE, AND RADIATION DAMPERS



CODES AND REGULATIONS

- NFPA 90A
  Standard for the Installation of Air-Conditioning and Ventilation Systems
- UMC & IMC
  Uniform Mech & International Mech Codes
- NFPA 80
  Standard for Fire Doors & Other Opening Protectives
- NFPA 105
  Standard for Smoke Door Assemblies & Other Opening Protectives
- SMACNA Fire, Smoke & Radiation Damper Guide

- NFPA Codes contain recommended practices and technical data for determining fire-resistive requirements
- Often specs state that fire dampers shall be in accordance with 90A
- IMC contains the language and the requirements for the HVAC system, including dampers
- The SMACNA Fire, Smoke & Radiation Damper Manual is a guide. The exception is Michigan which incorporates the manual

WHO ESTABLISHES WHAT IS “ACCEPTABLE”?

- **THE DAMPER MANUFACTURER!**

**Anyone who requires or does any change not specifically shown or defined by the manufacturer *is not in compliance* with the “AS TESTED” UL safety label of that fire or smoke damper.

Roles and Responsibilities

- Design Team
  - Architect / Designer:
    - Clearly identify all fire-resistant assemblies and their hourly ratings on the drawings

  - Engineer:
    - Clearly identify on the project drawings all duct penetrations of fire-resistive assemblies and the details and methods required to maintain the fire-resistive integrity of those assemblies

      ❖Mandatory via Administrative Section of the Model Building Codes

      ❖NFPA 90A – Section 5.4.6

Roles and Responsibilities

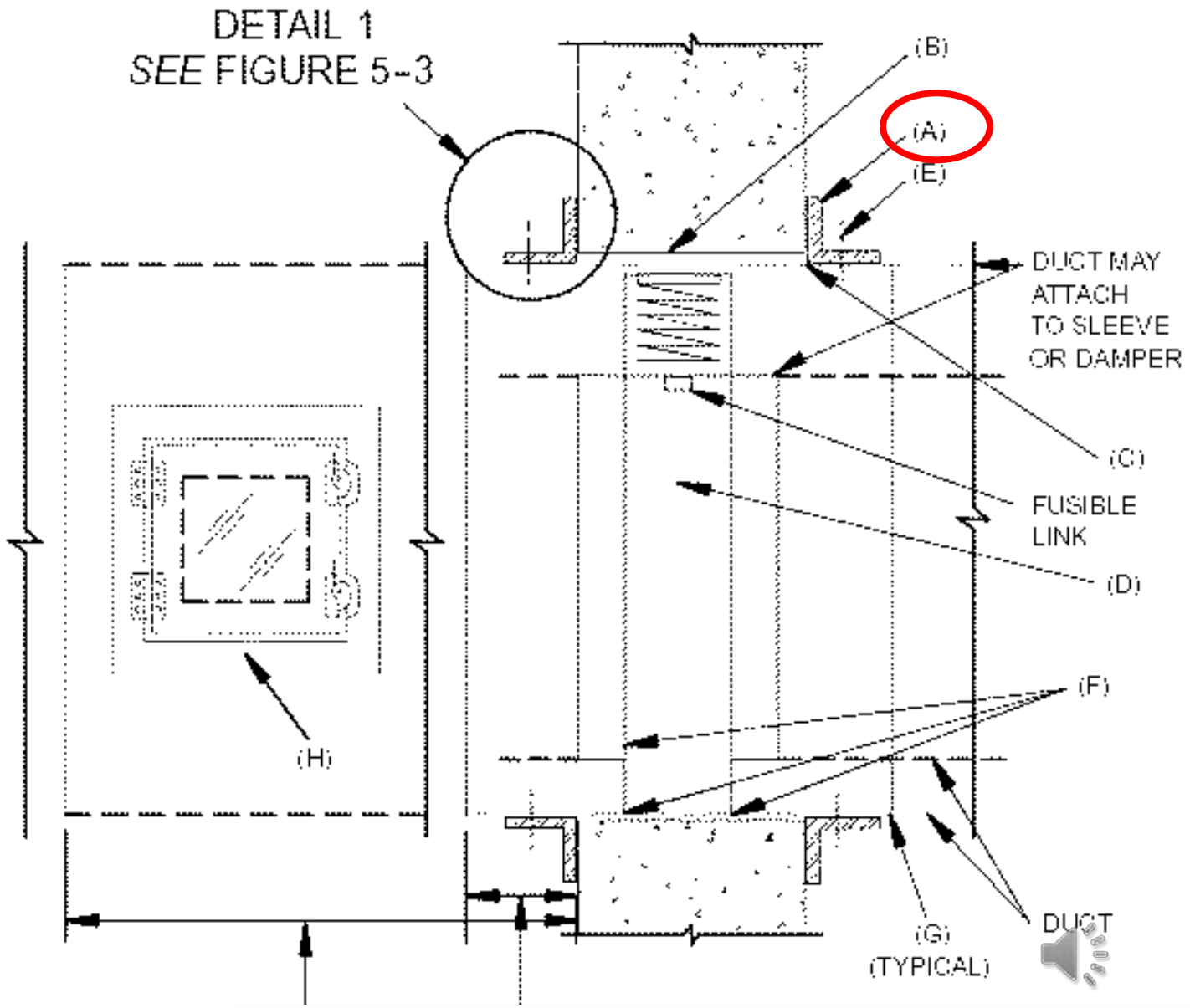
- Code Officials:
  - Verify plans and specs. comply with *Local Codes*
  - Verify that the plans and specifications completely identify all fire-resistant assemblies, and the details of how those penetrations are to be protected
  - Note: It is *Mandatory* that the plans and specifications completely identify all fire-resistant assemblies, the construction methods and materials, and the details of how those penetrations are to be protected

Roles and Responsibilities

- Contractor
  - The HVAC Contractor is not responsible for determining or specifying the quantity and location of fire, smoke, and ceiling radiation dampers

FIGURE 5-1
BASIC FIRE DAMPER INSTALLATIONS

A = Retaining Angle



A. Retaining Angles

1. Minimum 1½×1½×16ga (40×40×1.6mm)

   a. Retaining angles must overlap structure opening 1 inch minimum and cover corners of openings.

   b. 16 gage is the most commonly used thickness for the retaining angles. However, manufacturers may allow lighter gage angles on some smaller dampers and may require heavier gage angles on larger dampers. Consult the manufacturer's installation instructions for specifics.

FIG. 5-2
UNTESTED DAMPER ALTERATIONS

- **ITEM #1:**
  - SEALING RETAINING ANGLES TO WALLS

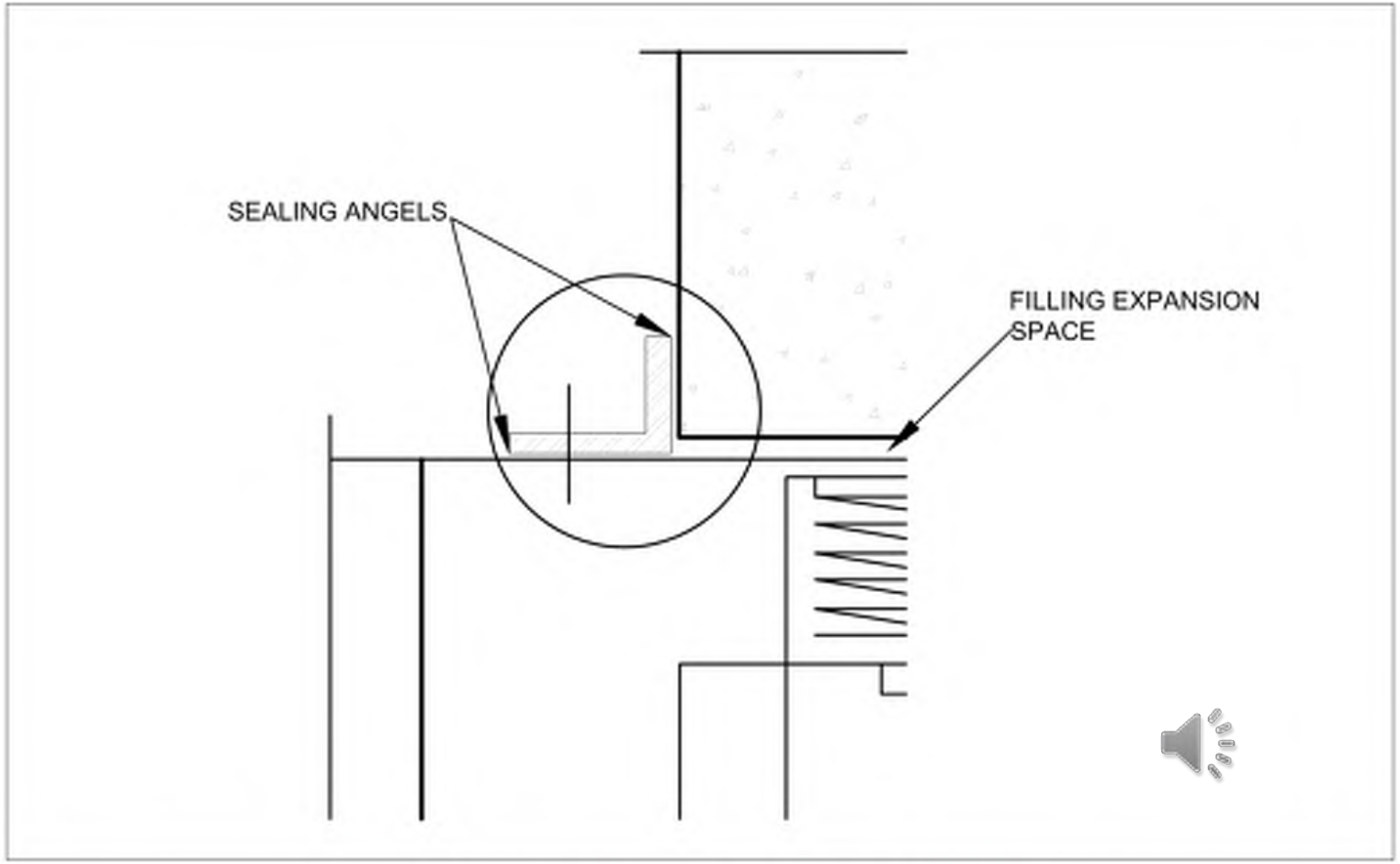
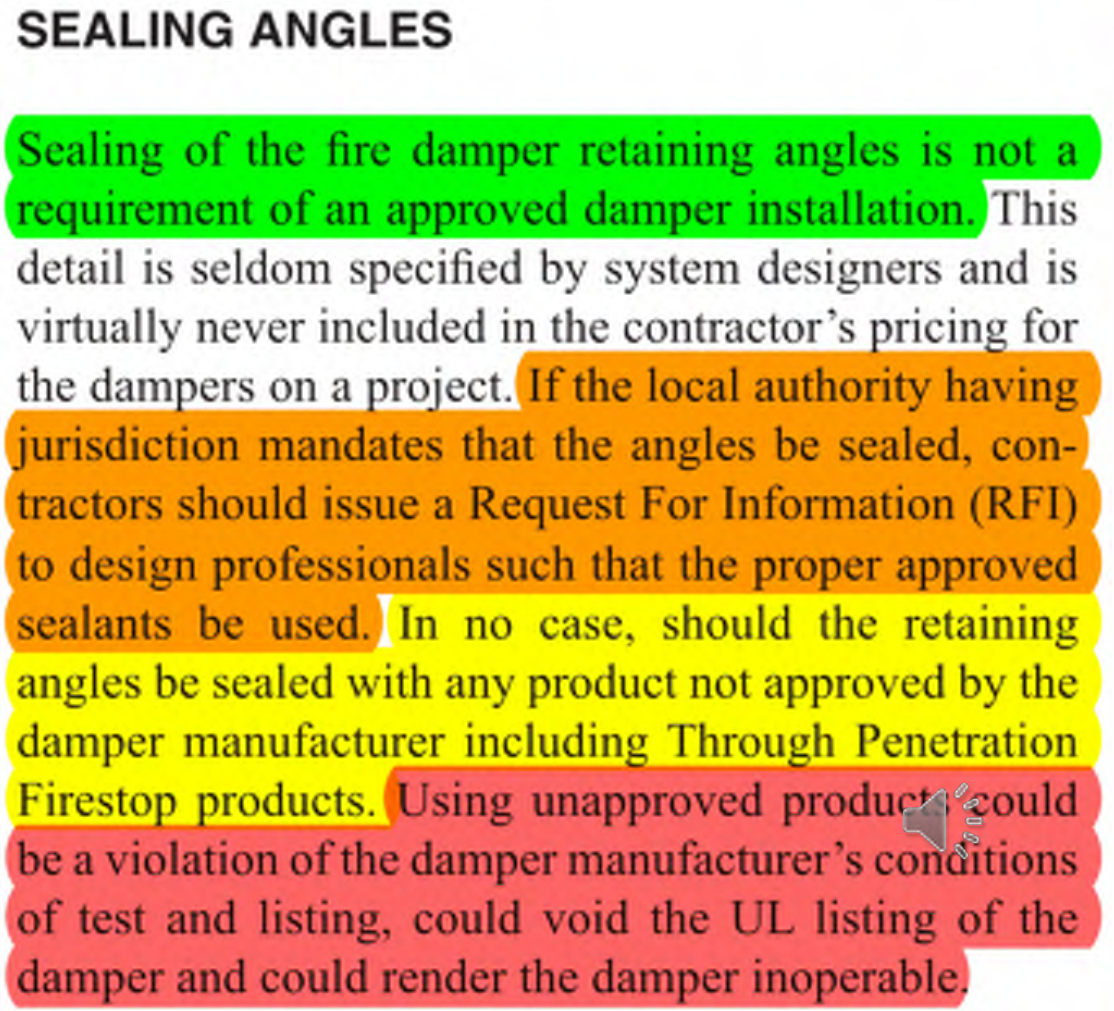


FIGURE 5–2 UNTESTED DAMPER ALTERATIONS

FIG. 5-2
UNTESTED DAMPER ALTERATIONS

- Sealing Angles to Walls
  - not required or recommended
- If Local Jurisdiction Requires it:
  - Contractor to RFI design team
- Sealant must be approved by the Damper Manufacturer

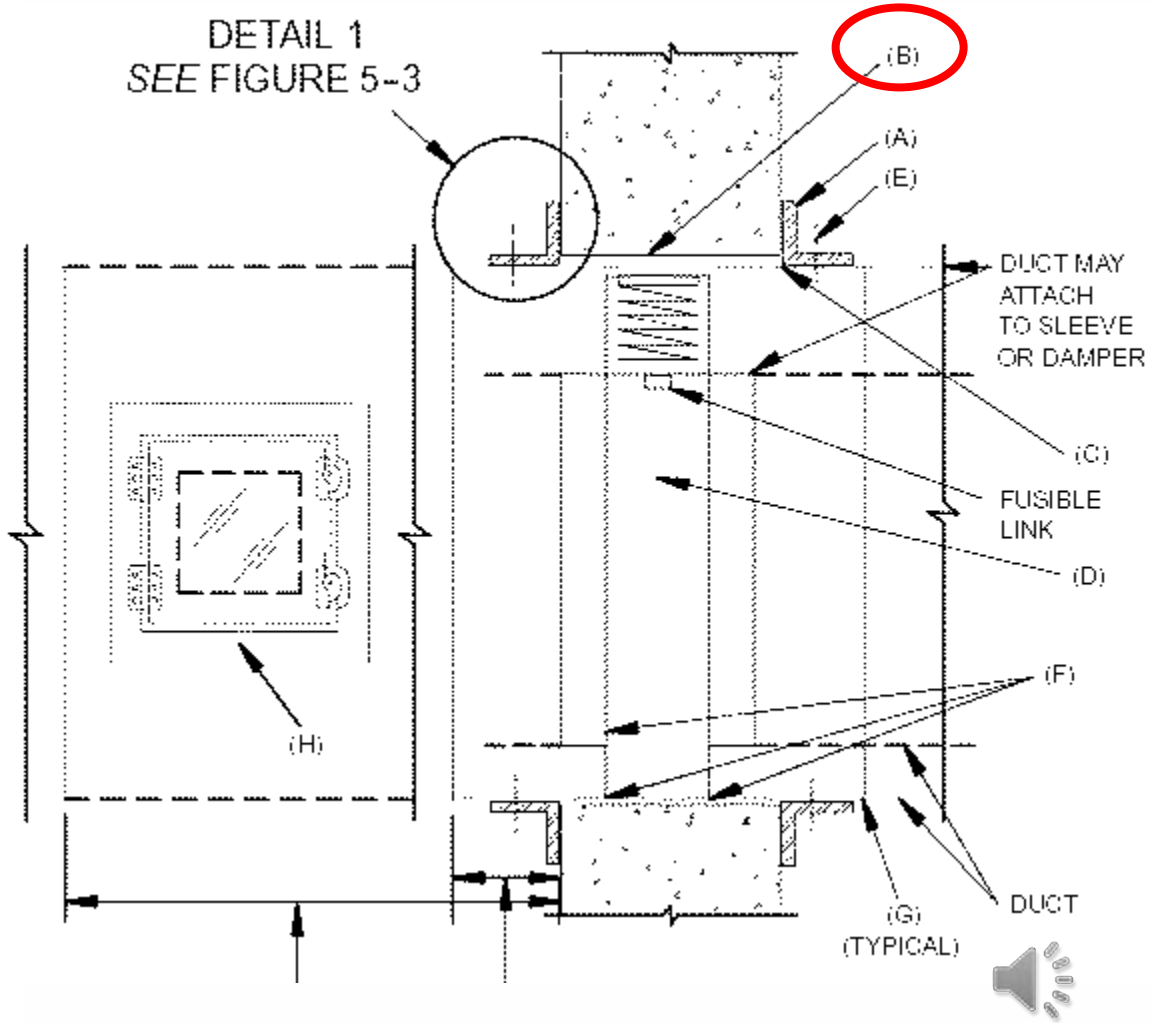


SEALING ANGLES

Sealing of the fire damper retaining angles is not a requirement of an approved damper installation. This detail is seldom specified by system designers and is virtually never included in the contractor's pricing for the dampers on a project. If the local authority having jurisdiction mandates that the angles be sealed, contractors should issue a Request For Information (RFI) to design professionals such that the proper approved sealants be used. In no case, should the retaining angles be sealed with any product not approved by the damper manufacturer including Through Penetration Firestop products. Using unapproved products could be a violation of the damper manufacturer's conditions of test and listing, could void the UL listing of the damper and could render the damper inoperable.

FIGURE 5-1
BASIC FIRE DAMPER INSTALLATIONS

B = Damper Expansion Space (Annular Space)



B. Expansion Space

1. Fire Damper Sleeve Clearance within Wall/ Floor Opening

   a. Minimum ⅛ inch per linear foot (10 mm per linear meter) of damper — both dimensions. (¼" (6 mm) minimum)

   b. Clearance requirements for damper sleeves within a wall opening are based on ⅛ inch per foot (10 mm per meter) of width (or height) unless otherwise stated in the listing of the assembly. The sleeve may rest on the bottom of the opening, and need not be centered. (Fractional dimensions shall be taken as the next largest whole foot.)

   c. The clearance may be greater than the ⅛ inch per foot (10 mm per meter) of damper as allowed by damper manufacturers installation instructions. Consult with manufacturers for maximum allowable.

FIG. 5-2
UNTESTED DAMPER ALTERATIONS

- **ITEM #2:**
  - FILLING ANULAR SPACE BETWEEN DAMPER AND STRUCTURE

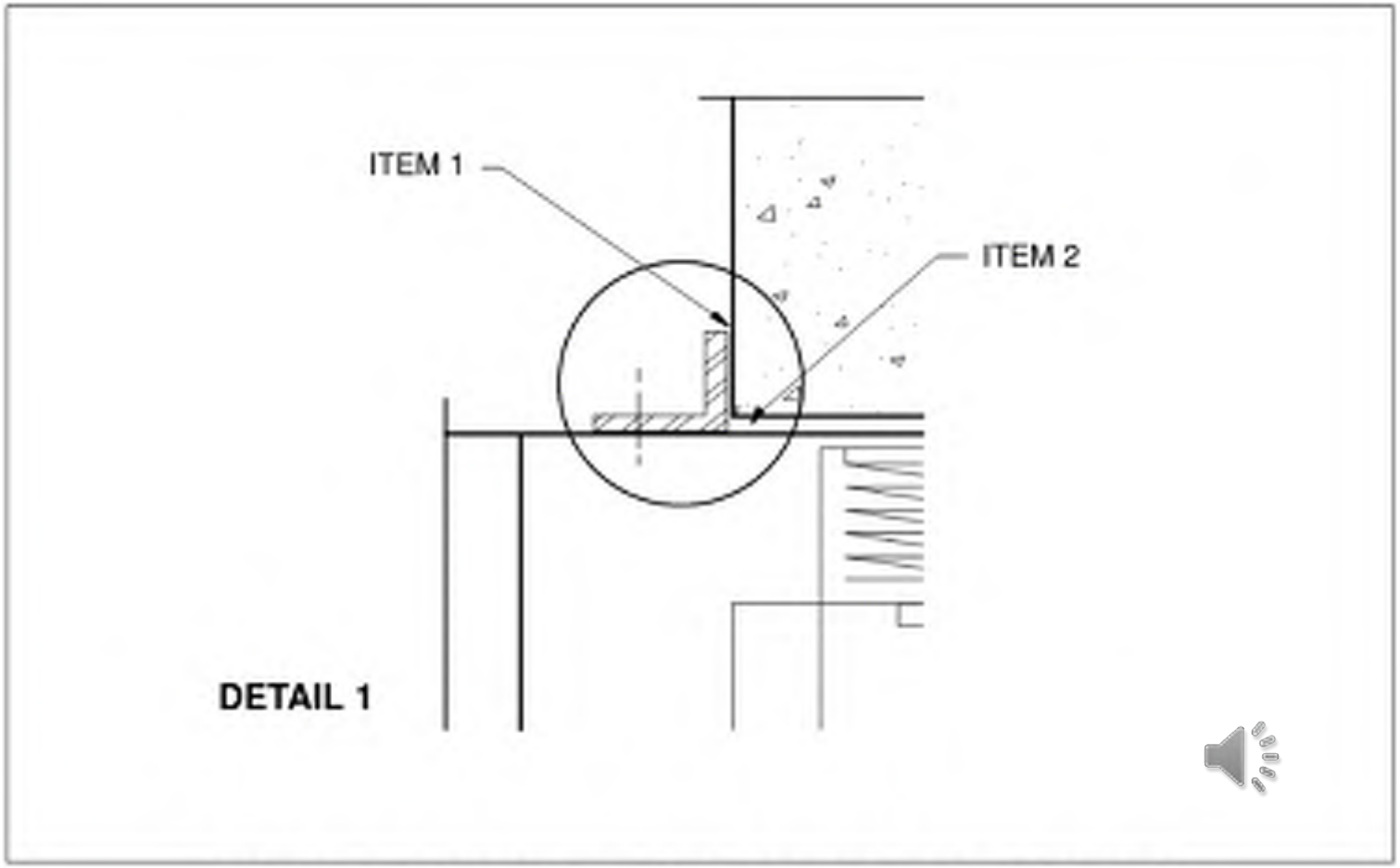


FIGURE 5-3 IMPROPER FIRE DAMPER INSTALLATIONS

FIG. 5-2
UNTESTED DAMPER ALTERATIONS

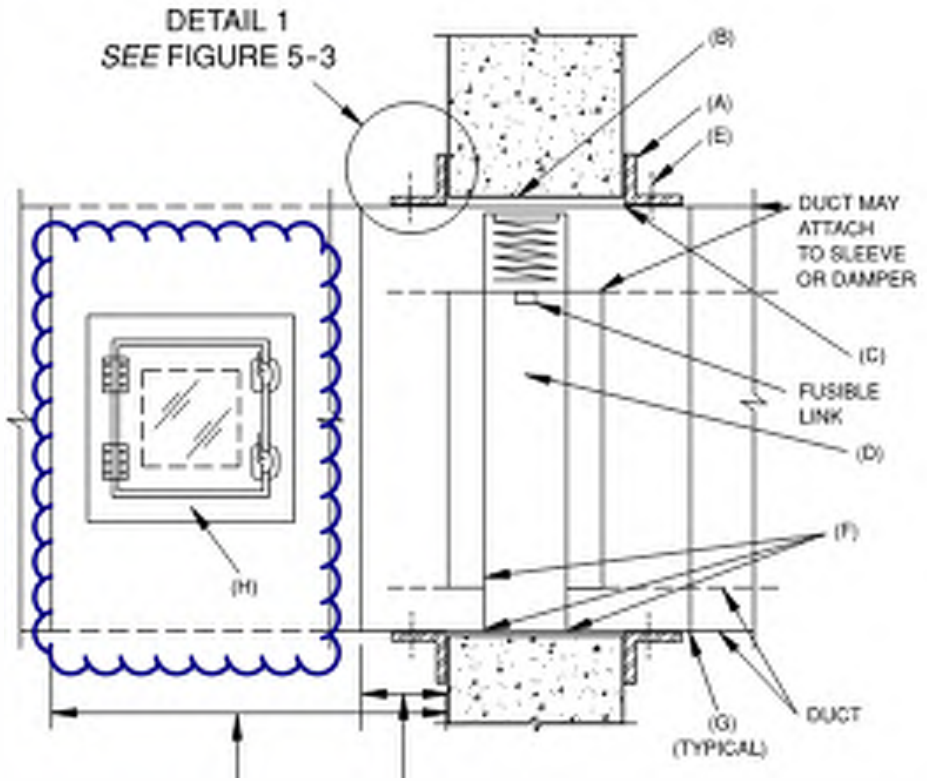
- Filling Expansion Space:
  - Not Tested
  - Not Approved
  - Not Permitted by Manufacturer's

FILLING EXPANSION SPACE

Introduction of any materials including mineral wool, ceramic fiber or sealants of any kind into the required expansion space between the damper sleeve and fire partition has not been tested, has not been approved, and is not permitted by damper manufacturers. Doing so could be a violation of the manufacturer's conditions of test and listing, could void the UL listing of the damper and could render the damper inoperable. Indiscriminate and unnecessary deviations from standard fire damper installations should be avoided. Unless a deviation is specifically approved by the damper manufacturer, it could compromise the function for which the damper was ultimately installed.

H. Access Door or Panel

1. Install as shown in Figure 5-1

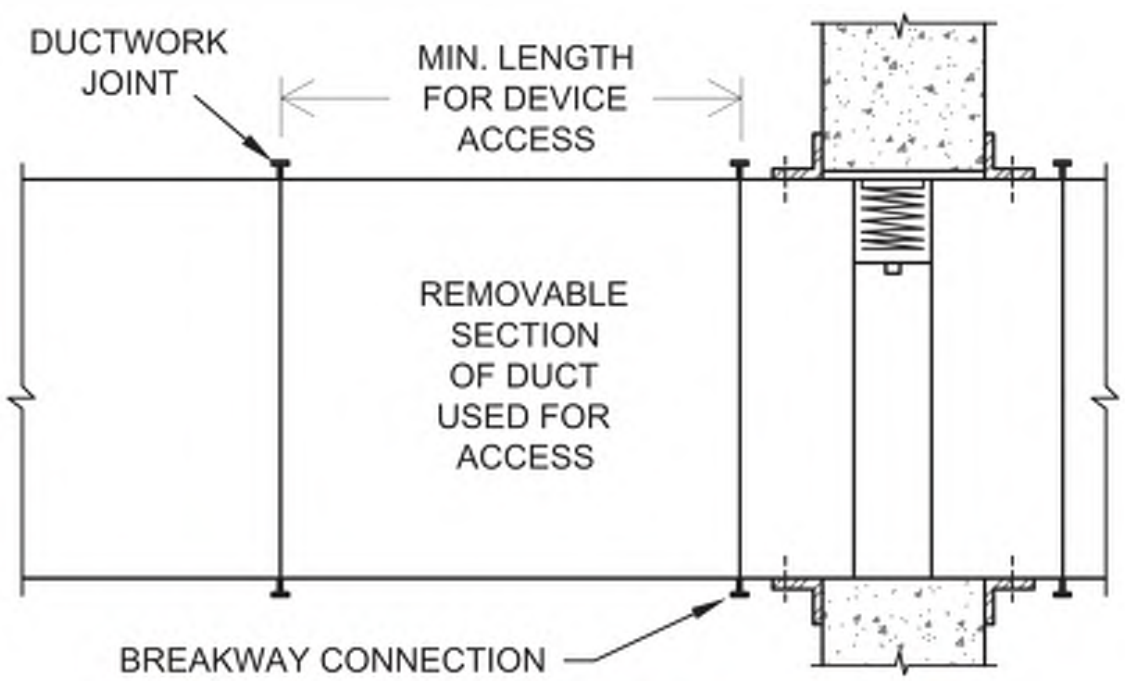


Snapshot: Figure 6-1 Access Doors & Panels

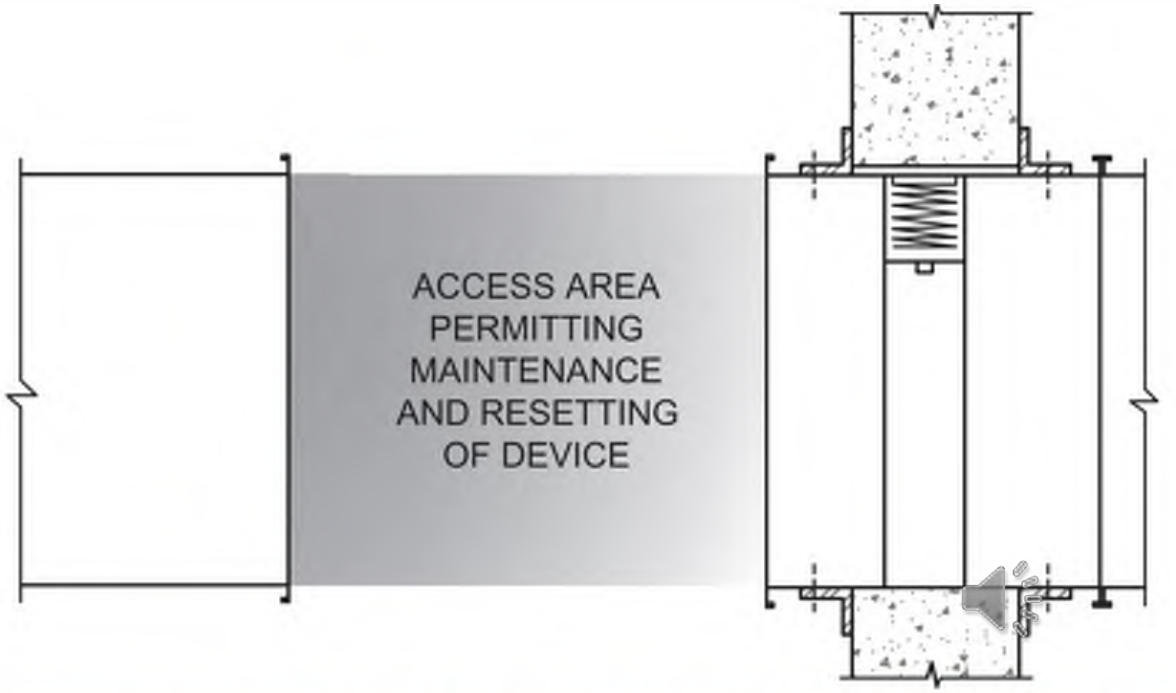
3. ACCESS DOORS AND PANELS ARE TO BE LARGE ENOUGH TO PERMIT MAINTENANCE AND RESETTING OF DEVICES. DUCT ACCESS DOORS SHALL BE A MAXIMUM OF 24 in. x 24 in. (610 mm x 610 mm) AND A MINIMUM OF 6 in. x 6 in. (150 mm x 150 mm) UNLESS THE DUCT SIZE DOES NOT ALLOW INSTALLATION OF THE DOOR, IN WHICH CASE, A REMOVABLE SECTION OF DUCT MUST BE USED FOR ACCESS.

H. Access Door or Panel

Figure 6-2: Removable Duct Section



REMOVABLE SECTION OF DUCT INSTALLED



REMOVABLE SECTION OF DUCT REMOVED ALLOWING DEVICE ACCESS

Breakaway Connection to Duct

Breakaway connections are required in order to allow the ductwork connecting a fire rated damper sleeve to "breakaway" from the damper sleeve so that the damper remains within the fire rated opening, thus maintaining the integrity of the wall or floor.

BREAKAWAY CONNECTIONS (others)

Manufacturers Installation Requirements

FLANGED SYSTEM BREAKAWAY CONNECTIONS
INSTALLATION INSTRUCTIONS SUPPLEMENT

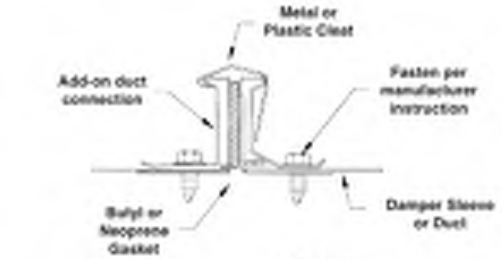
APPLICATION

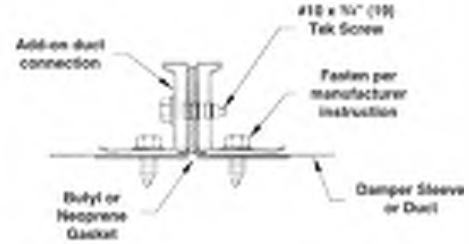
Flange breakaway connection for fire damper or combination fire smoke damper. These instructions apply to a connection between a manufactured flange system by Ward, Ductmate, Nexus, MEZ, TDC and TDF. These connections allow the use of combining mixed flange types or like for like. The following instruction depicts the use of Metal or Plastic Cleats, Butyl or Neoprene Gasket, and Bolted or Non-Bolted corners. Also the flanges may be connected with the use of #10 screws without the cleats.

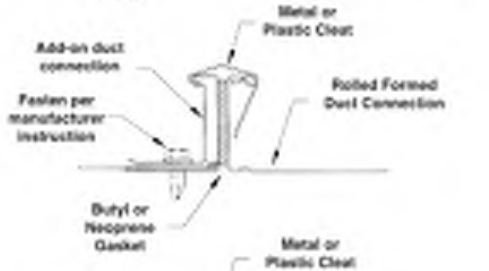
1. Install the manufactured flange system onto the damper sleeve or duct per the manufacturers instructions.
2. Seal the two flange systems together Neoprene or Butyl gasket may be applied to the mating surfaces.
3. Align the two flange systems together. A ⅜ in. (9mm) bolt may be used in the corners to help with the alignment The bolt does not have to be removed. Bolted corners are permitted.
4. Install the cleat or # 10 tek screw, approximately equally spaced, per the schedule described:

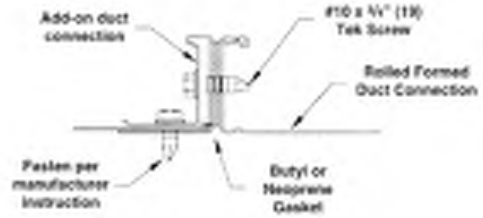
- Width or height less than 24 in. (610mm); use one cleat or screw per side
- Width or height 24 in. (610 mm) to less than 36 in. (914mm); use 2 cleats or screws per side
- Width or height 36 in. (914mm) to less than 54 in. (1372mm); use 3 cleats or screws per side
- Width or height 54 in. (1372mm) to less than 72 in. (1829mm); use 4 cleats or screws per side
- Width or height 72 in. (1829mm) or greater; use 5 cleats or screws per side.

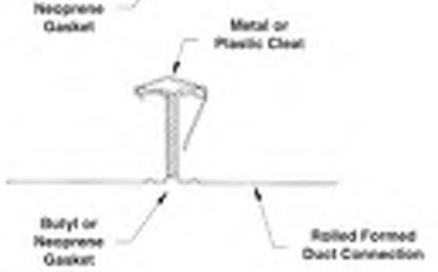
CLASSIFIED c UL us — SEE COMPLETE MARKING ON PRODUCT











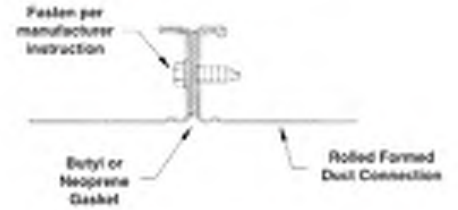
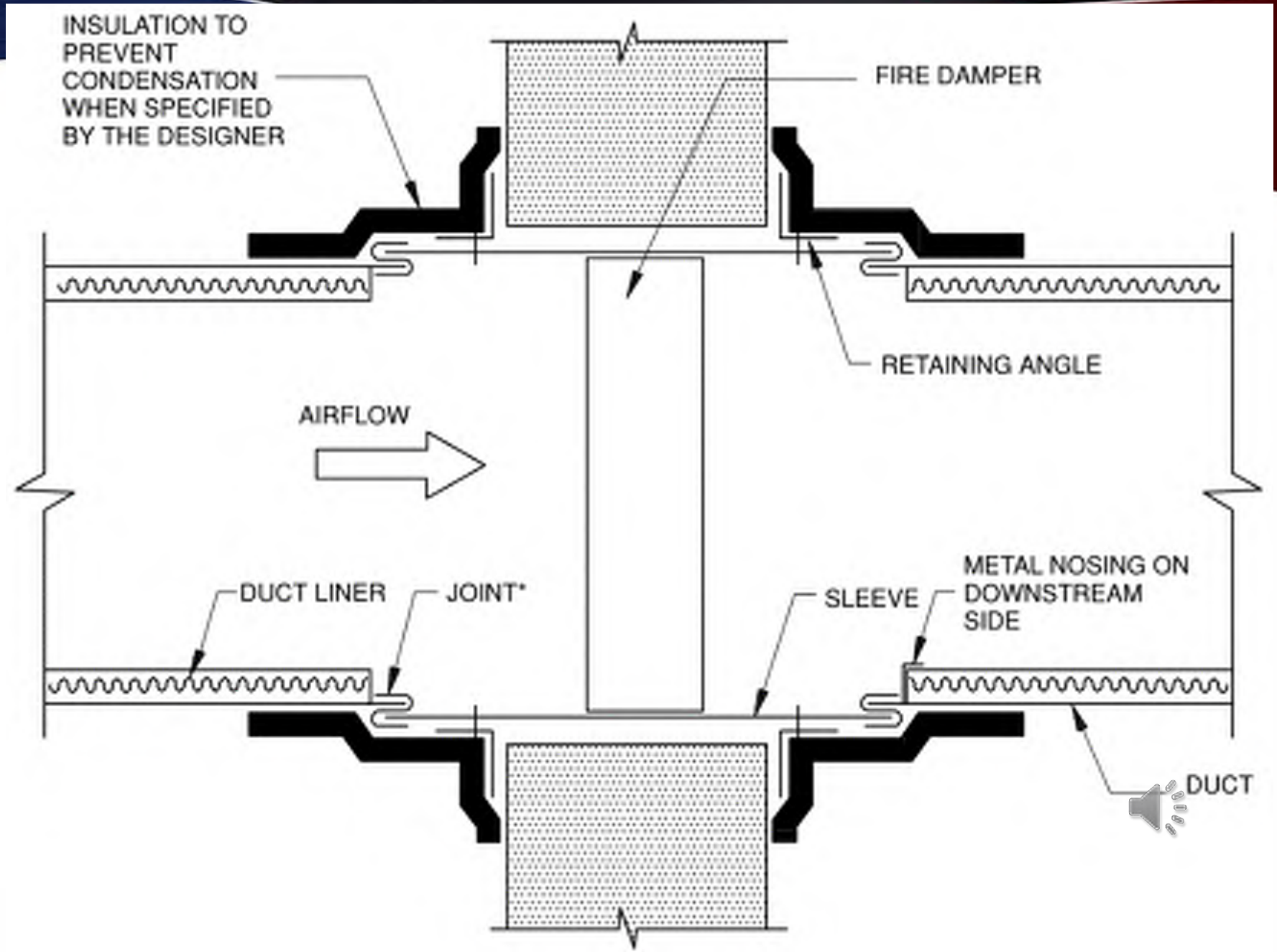


FIG. 5-9
DUCT LINER INTERRUPTION

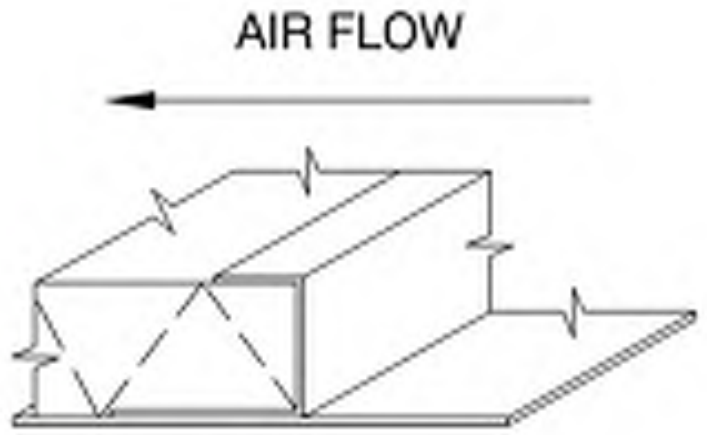


METAL NOSING

SAFETY STOP!!

- *Metal nosing is required whenever liner is preceded by unlined metal*

METAL NOSING MUST BE USED WHEREVER LINER IS PRECEDED BY UNLINED METAL; OTHERWISE WHEN VELOCITY EXCEEDS 4000 FPM (20.3 MPS) USE METAL NOSING ON EVERY LEADING EDGE. NOSING MAY BE FORMED ON DUCT OR BE CHANNEL OR ZEE ATTACHED BY SCREWS, RIVETS OR WELDS.



DETAIL – A

METAL NOSING
CHANNEL OR ZEE

SNAPSHOT: FIG 7-11, HVAC-DCS

Fig. A-3
Diagonal Penetration

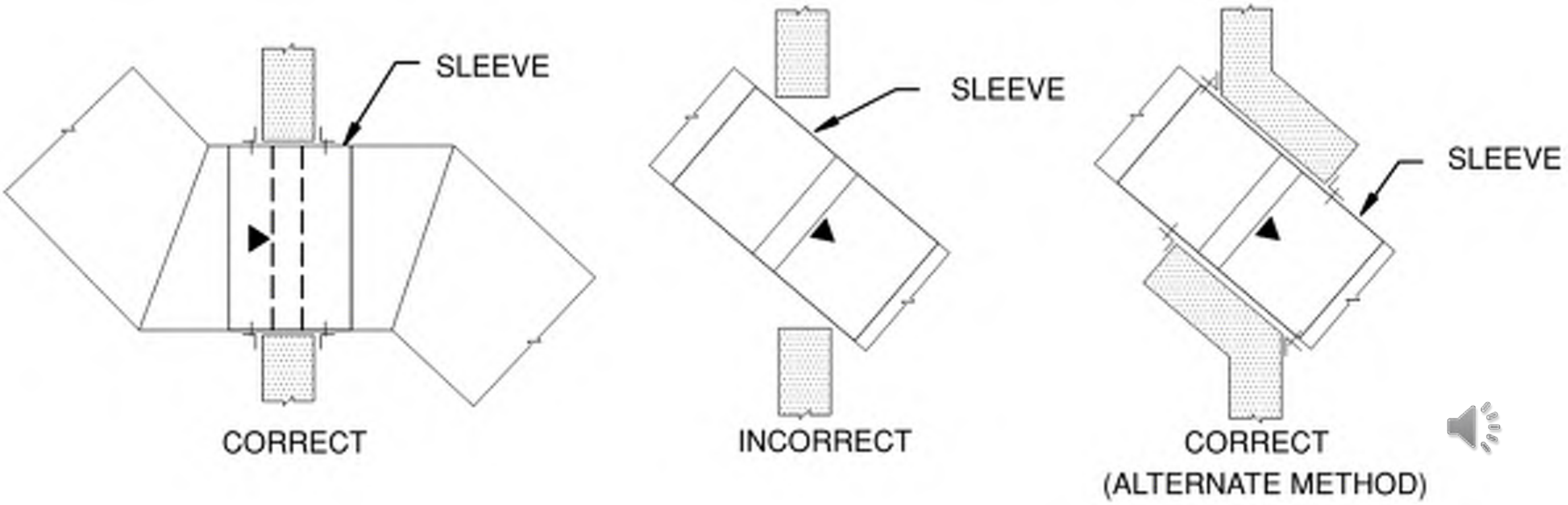
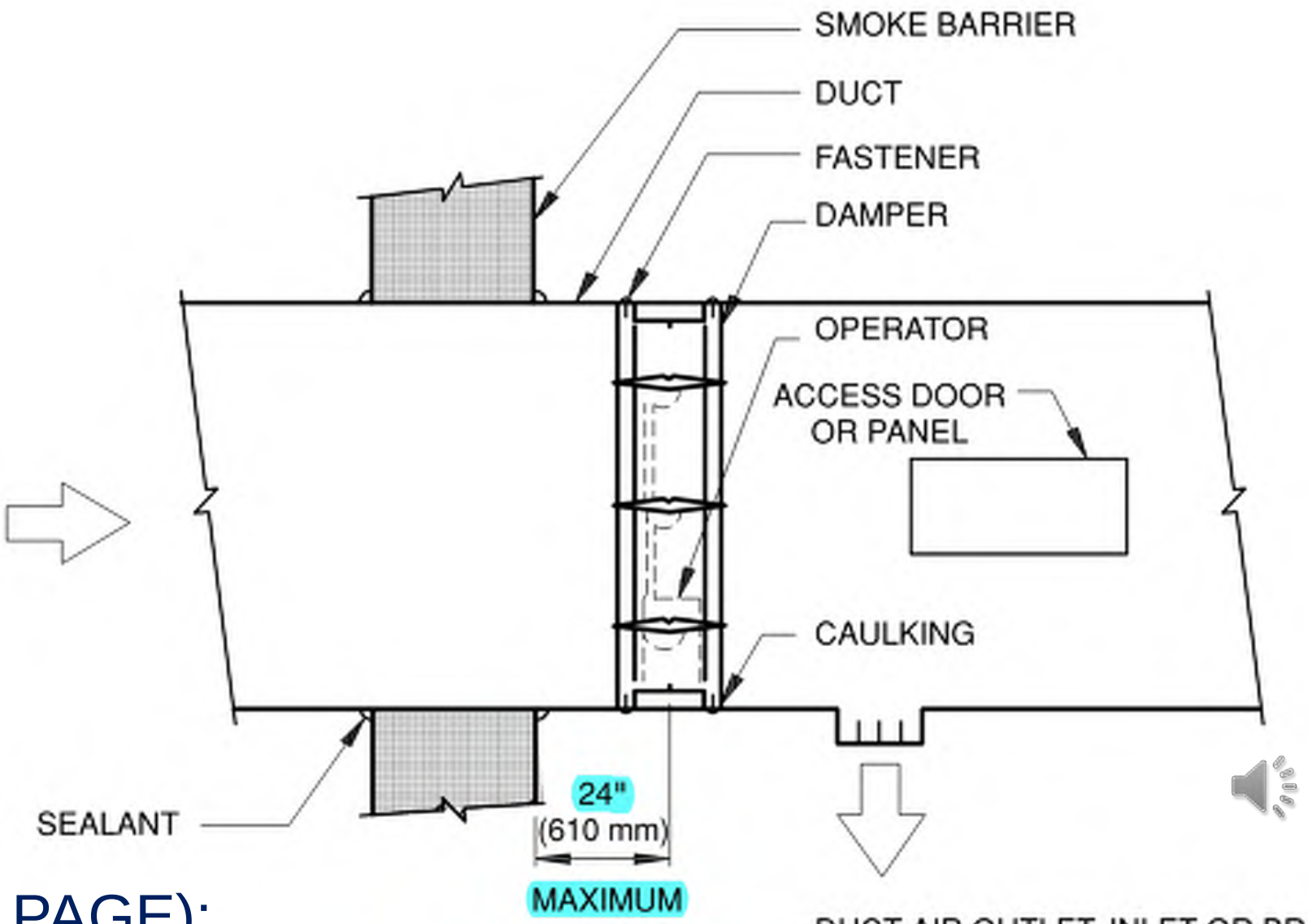


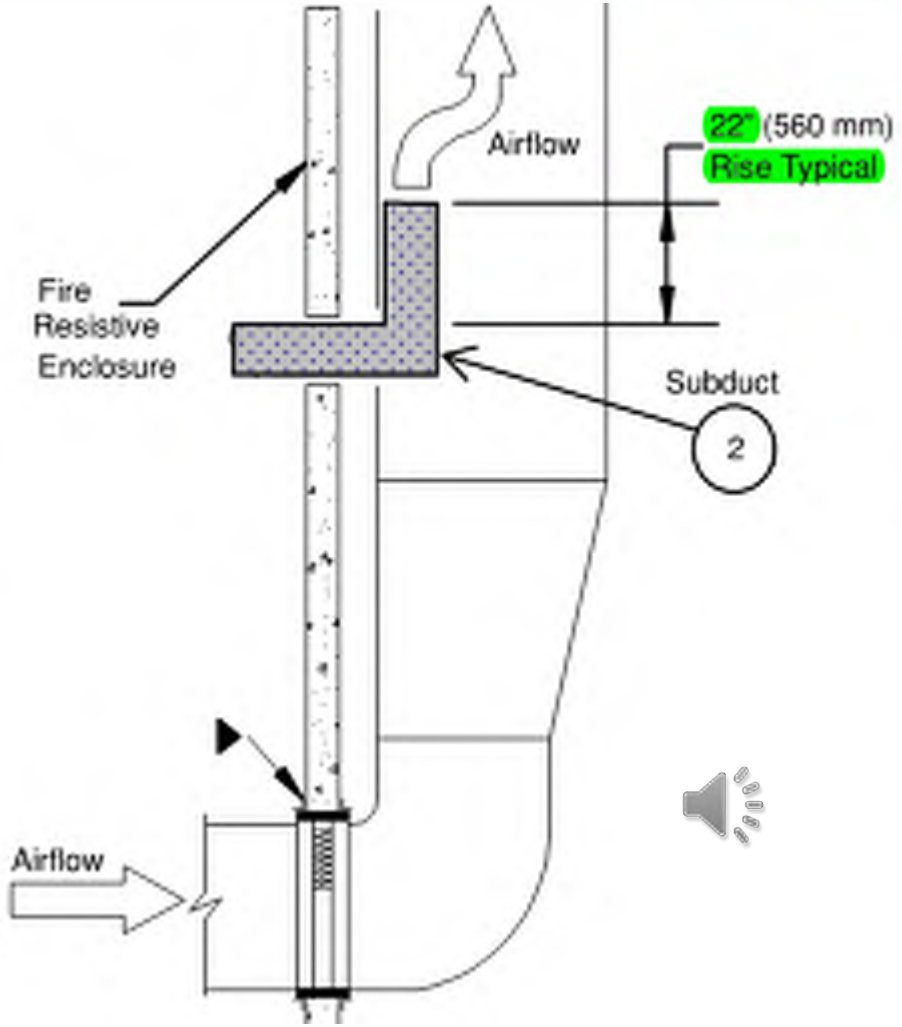
FIG. 3-3
SMOKE DAMPER



SEE NOTES (NEXT PAGE):

EXCEPTIONS – SHAFT ENCLOSURES

- Shaft Enclosures: Ducted Riser
  - Steel Subduct Assemblies
  - 22” Minimum Rise (Inside)



EXCEPTIONS – SHAFT ENCLOSURES

- Non-Ducted Shaft with Subduct Assemblies
  - Steel Subduct Assemblies
  - 22” Minimum Rise (Inside)

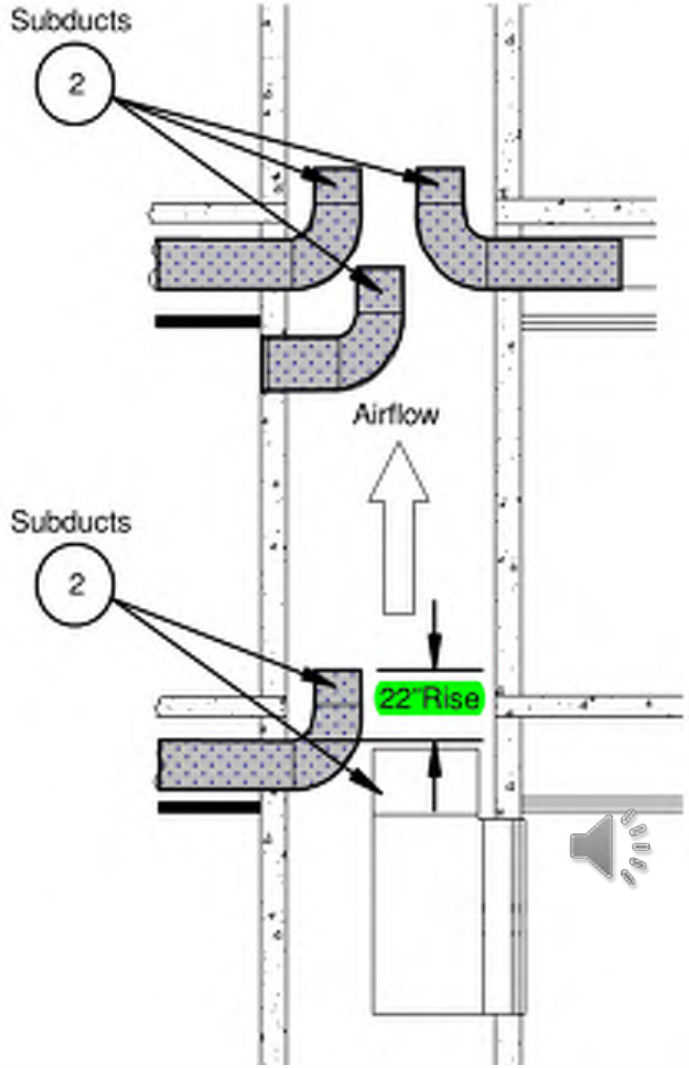
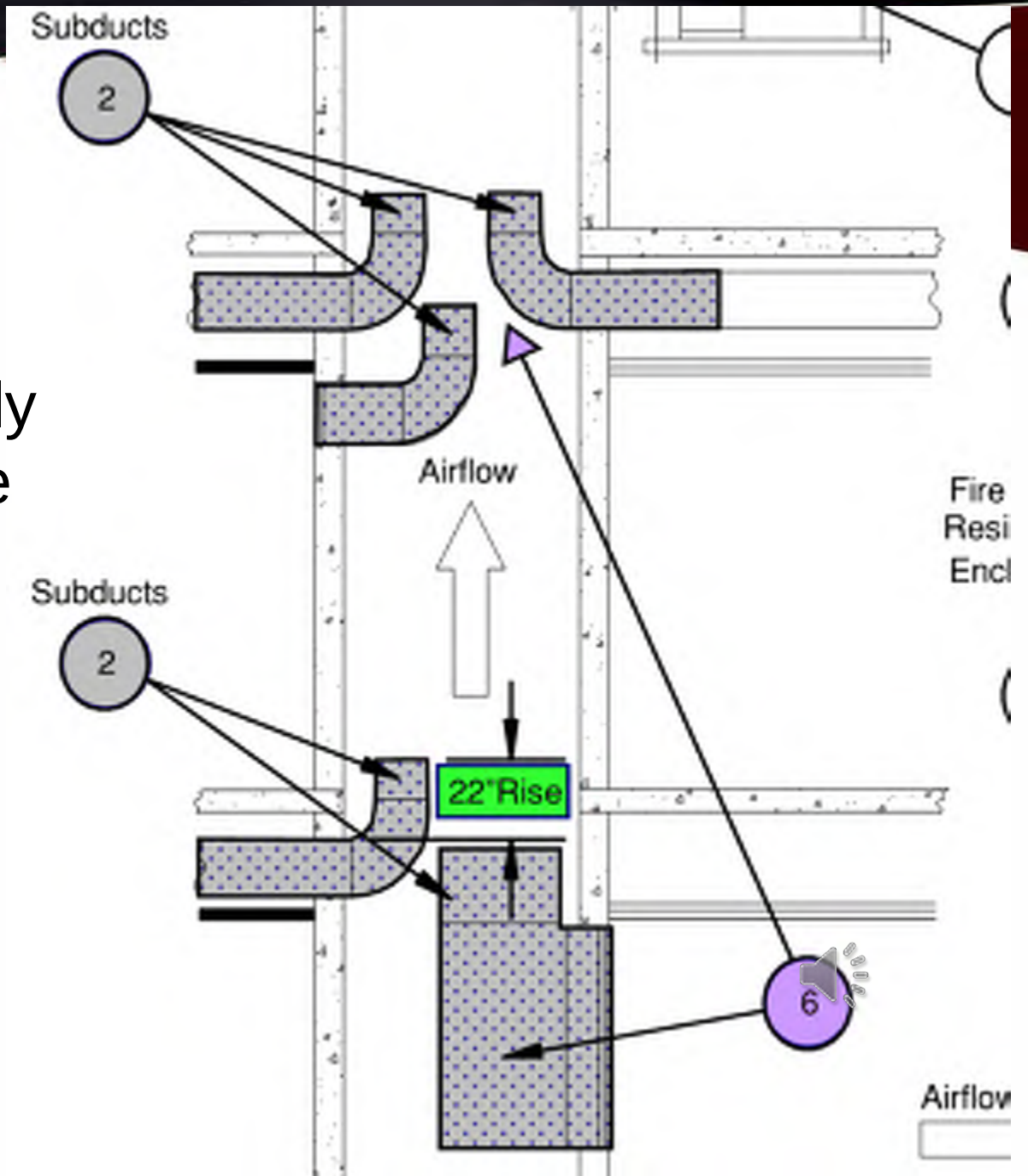


FIG. 12-1
SUBDUCTS

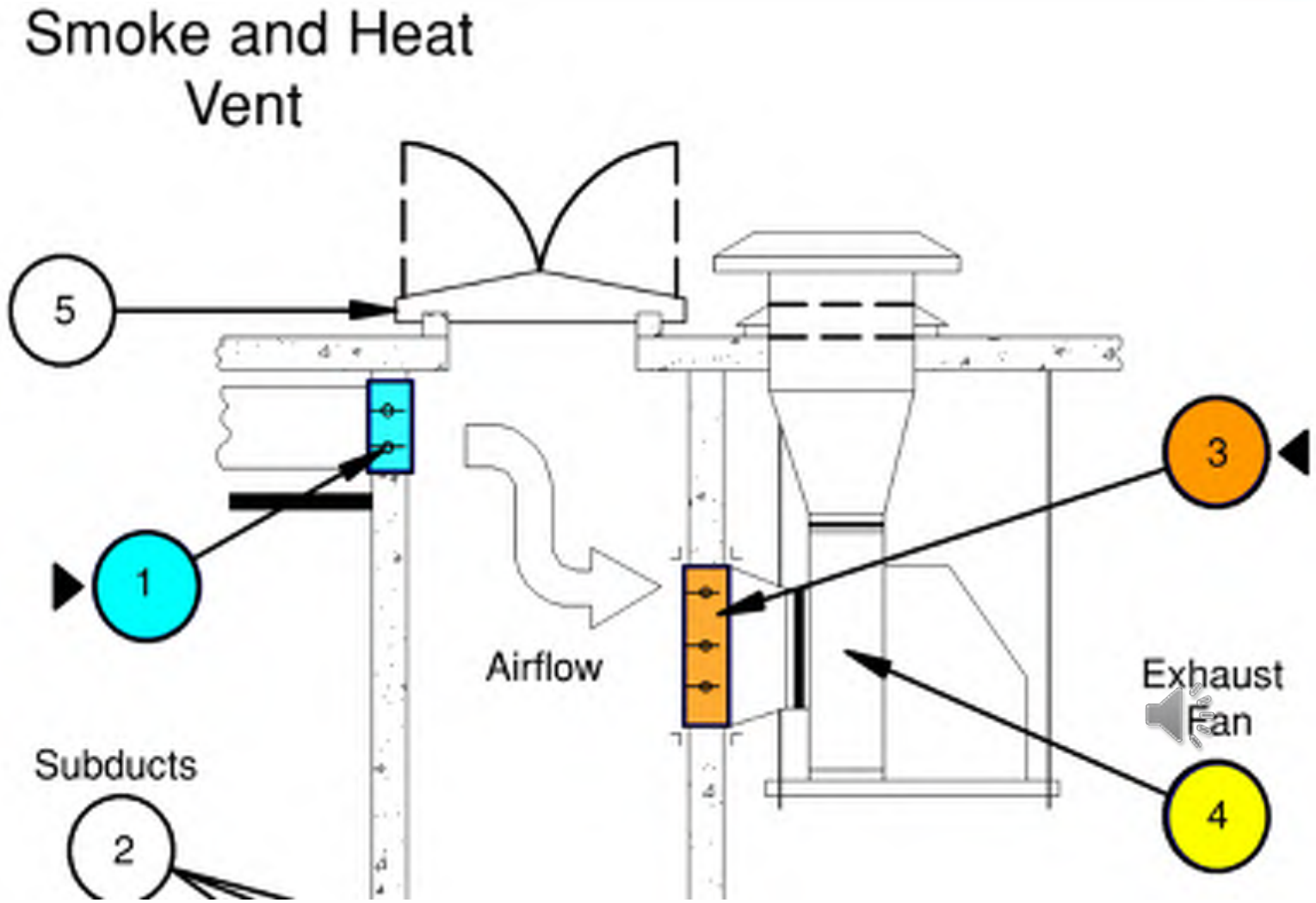
- Where Subducts enter the shaft directly opposite each other, or if Subducts are of a large size ⑥, subduct shall not create an obstruction to airflow

- Rule of Thumb: Total area of subducts entering the shaft at the same level shall not equal more than 25% of the total shaft cross section



SUBDUCTS

- Fire dampers ③ are used at fan connections ④
- Shaft penetrations above fans must use fire dampers ①



TESTING & INSPECTION

- Fire/Smoke Dampers
- Smoke Control Systems

INSPECTION, TESTING & MAINTENANCE

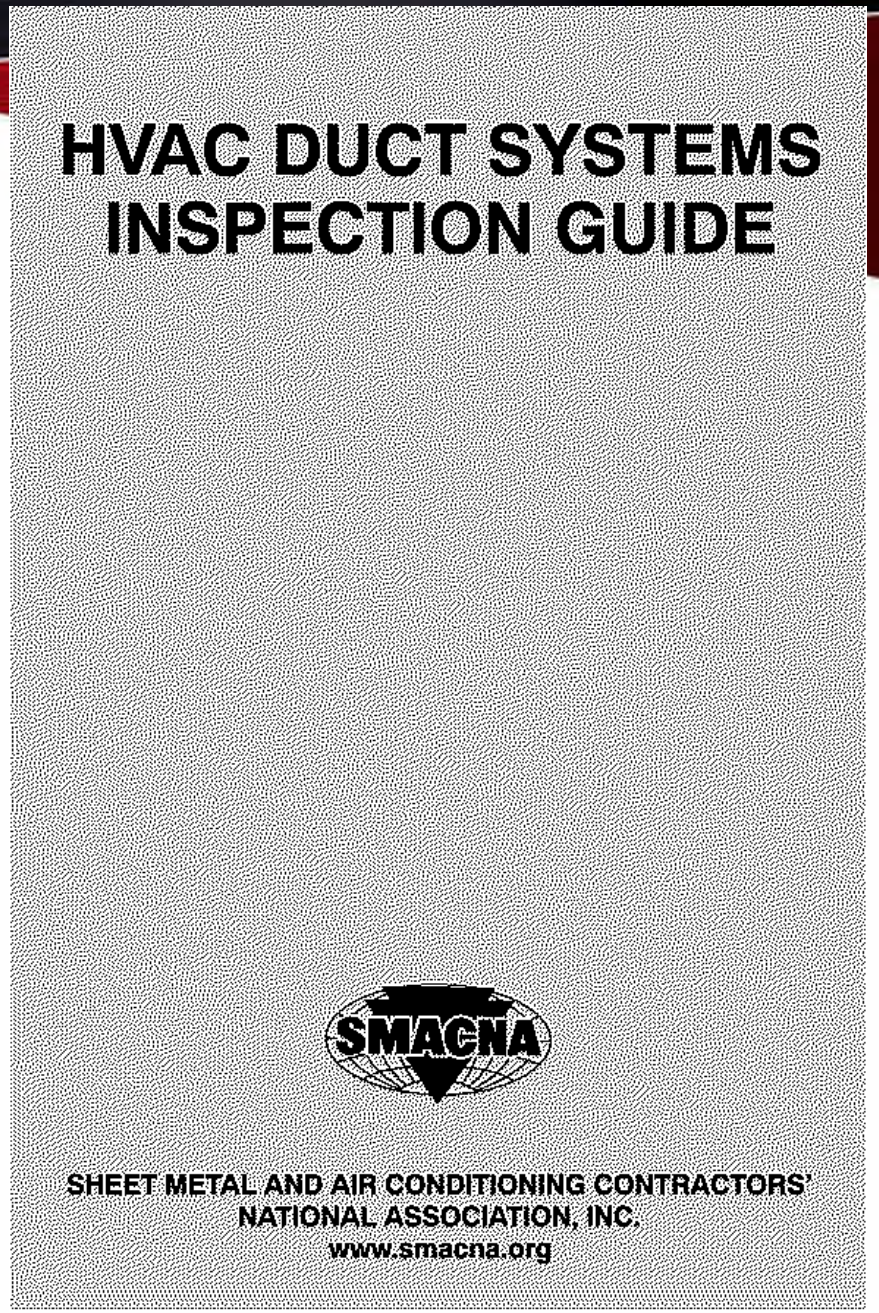
- Dampers to be tested and inspected 1 year after installation
- Test & inspection frequency shall be every 4 years, except in hospitals where frequency is every 6 years
- Operational test after installation for dynamic fire dampers and combination fire smoke dampers

- NFPA requires periodic performance testing on fire dampers and smoke dampers
- NFPA also requires acceptance & periodic testing for engineered smoke control systems

Section – 3
Duct Inspection

- 3rd edition - 2006
  - 4th edition currently in review

- Administrative Guide to Duct System Inspection



HVAC Duct Systems Inspection Guide

Duct Inspections Overview - Reviews

1. Material Requirements
2. Duct Construction Schedules
   - Panel Thickness, Reinforcements, Joints/Seams
   - Pressure Classifications
3. Duct System Supports
   - Support Methods for Duct and Connected Apparatus
4. Flexible Duct / Connector
   - Length, Type, Support
5. Sealants
   - Types and Required Use
6. Barrier Penetrations
   - Methods to penetrating and protecting from Fire / Smoke
7. Access
   - Maintenance Requirements
8. Air Terminals
   - Provisions for Locating
   - Support of Grilles / Reg./ Diff.

HVAC Duct Systems Inspection Guide

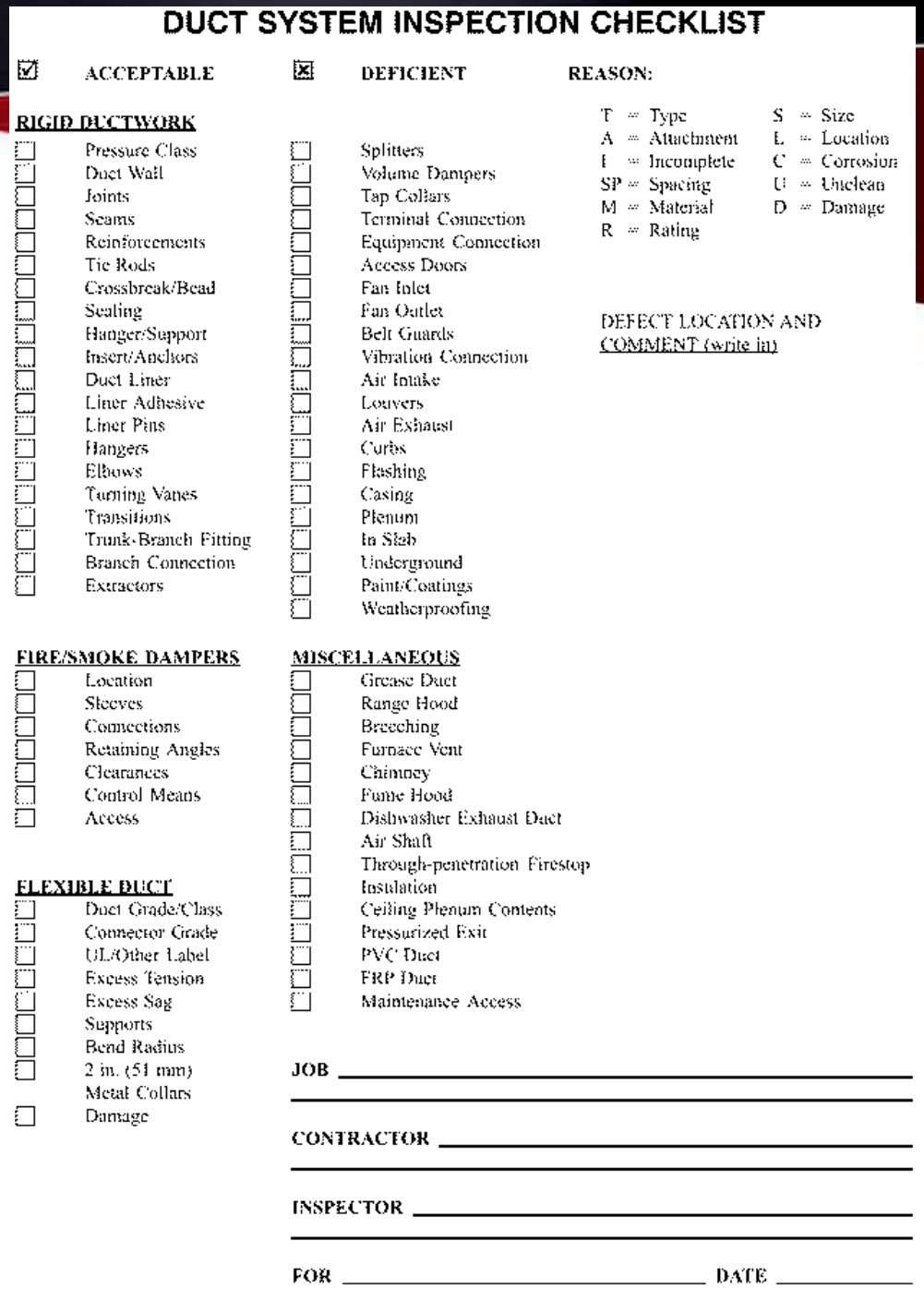
Duct Inspections Overview – Reviews (Cont.)

9. Volume Control Dampers
   - Manual / Automatic
10. Building Compartment Leakage
   - Investigate the Airtightness of Building Compartments to be ***pressurized*** under emergency mode situations
11. Plenums
   - Review Construction of Field Erected Plenums and Casings
   - Maintenance Requirements
12. Special Duty Systems
   - Grease / Fume Hood Systems
   - Shower Rooms
   - Smoke Control Systems
13. Insulation
   - Review types and applications
14. Tests
   - Determine what Tests are required
   - Establish Testing Procedure

HVAC Duct Systems Inspection Guide

Duct System Inspections Checklist

- Pass / Fail Checklist
- Deficiency Notated by Code
  - T = Type
  - I = Incomplete



DUCT SYSTEM INSPECTION CHECKLIST

☑ ACCEPTABLE ☒ DEFICIENT REASON:

T = Type, A = Attachment, I = Incomplete, SP = Spacing, M = Material, R = Rating, S = Size, L = Location, C = Corrosion, U = Unclean, D = Damage

DEFECT LOCATION AND COMMENT (write in)

RIGID DUCTWORK
- Pressure Class
- Duct Wall
- Joints
- Seams
- Reinforcements
- Tie Rods
- Crossbreak/Bead
- Sealing
- Hanger/Support
- Insert/Anchors
- Duct Liner
- Liner Adhesive
- Liner Pins
- Hangers
- Elbows
- Turning Vanes
- Transitions
- Trunk-Branch Fitting
- Branch Connection
- Extractors

- Splitters
- Volume Dampers
- Tap Collars
- Terminal Connection
- Equipment Connection
- Access Doors
- Fan Inlet
- Fan Outlet
- Belt Guards
- Vibration Connection
- Air Intake
- Louvers
- Air Exhaust
- Curbs
- Flashing
- Casing
- Plenum
- In Slab
- Underground
- Paint/Coatings
- Weatherproofing

FIRE/SMOKE DAMPERS
- Location
- Sleeves
- Connections
- Retaining Angles
- Clearances
- Control Means
- Access

MISCELLANEOUS
- Grease Duct
- Range Hood
- Breeching
- Furnace Vent
- Chimney
- Fume Hood
- Dishwasher Exhaust Duct
- Air Shaft
- Through-penetration Firestop
- Insulation
- Ceiling Plenum Contents
- Pressurized Exit
- PVC Duct
- FRP Duct
- Maintenance Access

FLEXIBLE DUCT
- Duct Grade/Class
- Connector Grade
- UL/Other Label
- Excess Tension
- Excess Sag
- Supports
- Bend Radius
- 2 in. (51 mm) Metal Collars
- Damage

JOB _____

CONTRACTOR _____

INSPECTOR _____

FOR _____ DATE _____

HVAC Duct Systems Inspection Guide

Appendix A:

Function of Ducted Air Handling Systems

- List and Descriptions of Specific Systems
- Example: A.5 Room Pressure Control
  - Narrative description of the System

A.5 ROOM PRESSURE CONTROL

Rooms are designed to have positive pressure or negative pressure. In general those that have more fan powered supply air than fan powered exhaust will have positive pressure. When the opposite situation exists, the room will have negative pressure. The intended balance can be upset by unplanned opening of doors or windows, the wrong position of dampers, failure of interacting controls, unanticipated wind pressure on the building exterior, and other circumstances. Pressure control is critical in a fire situation and in chemically or biologically contaminated zones. Normal and emergency states of operation of fan systems must be understood in order to preserve health and safety.

HVAC Duct Systems Inspection Guide

Appendix A:
Function of Ducted Air Handling Systems

Example:

- Figure A-5 Variable Volume System
- Illustrated description of the System

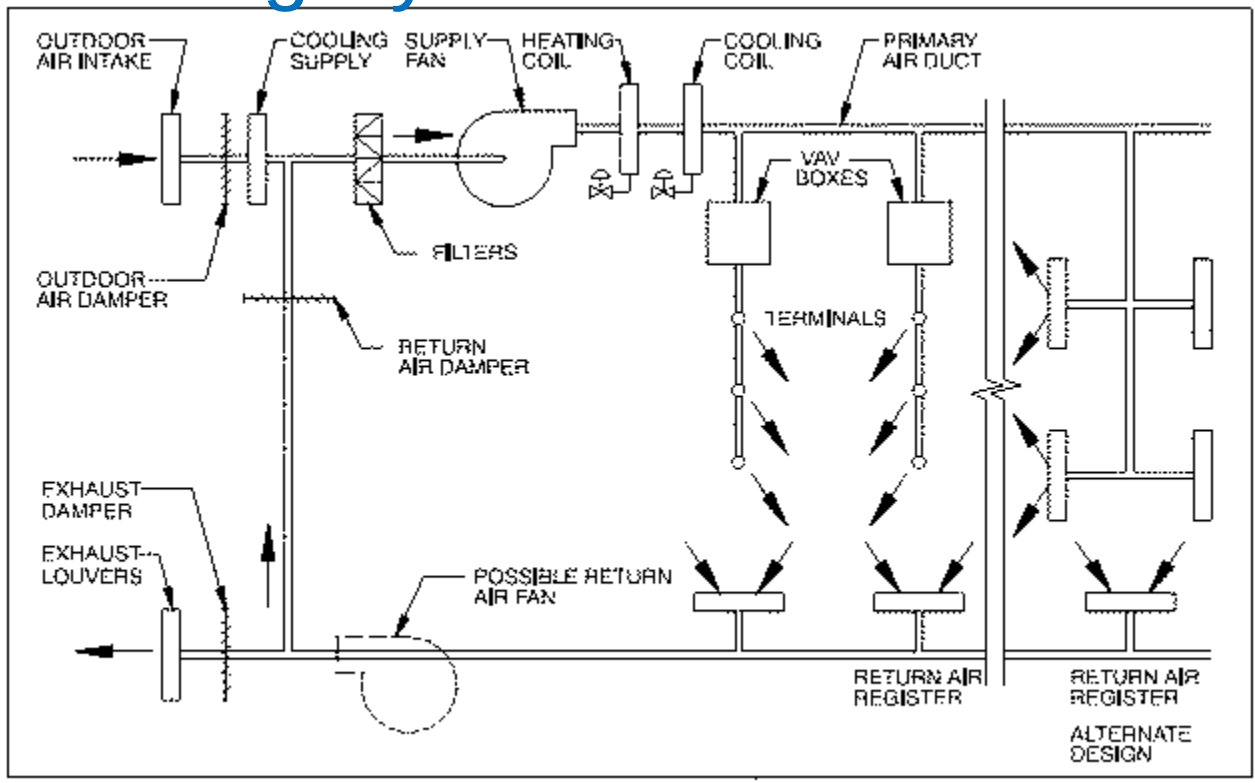


FIGURE A–5 VARIABLE VOLUME SYSTEM

HVAC Duct Systems Inspection Guide

Appendix B:
Duct Construction Materials

Descriptions of Specific Materials

Example:

- Table B-3 Stainless Steel Sheet Thickness

Gage	Thickness in Inches				Weight				Thickness in Millimeters		
	Min.	Max.	Tolerance	Nom.	lb/ft²		kg/m²		Nom.	Min.	Max.
					300	400	300	400			
31	0.0089	0.0129	0.002	0.0109	0.459	0.451	2.239	2.200	0.2769	0.2269	0.3269
30	0.0105	0.0145	0.002	0.0125	0.525	0.515	2.562	2.512	0.3175	0.2675	0.3675
29	0.0121	0.0161	0.002	0.0141	0.591	0.579	2.883	2.825	0.3581	0.3081	0.4081
28	0.0136	0.0176	0.002	0.0156	0.656	0.644	3.201	3.142	0.3962	0.3462	0.4462
27	0.0142	0.0202	0.003	0.0172	0.722	0.708	3.522	3.454	0.4369	0.3569	0.5169
26	0.0158	0.0218	0.003	0.0188	0.788	0.773	3.844	3.771	0.4775	0.3975	0.5575
25	0.0189	0.0249	0.003	0.0219	0.919	0.901	4.483	4.395	0.5562	0.4762	0.6362
24	0.0230	0.0280	0.003	0.0250	1.050	1.030	5.122	5.025	0.6350	0.5550	0.7150
23	0.0245	0.0321	0.004	0.0281	1.181	1.159	5.763	5.654	0.7137	0.6137	0.8137
22	0.0273	0.0353	0.004	0.0313	1.313	1.288	6.405	6.283	0.7950	0.6950	0.8950
21	0.0304	0.0384	0.004	0.0344	1.444	1.416	7.044	6.908	0.8738	0.7738	0.9738
20	0.0335	0.0415	0.004	0.0375	1.575	1.545	7.683	7.537	0.9525	0.8525	1.0525
19	0.0388	0.0488	0.005	0.0438	1.838	1.803	8.966	8.796	1.1125	0.9835	1.2425
18	0.0450	0.0550	0.005	0.0500	2.100	2.060	10.245	10.050	1.2700	1.1400	1.4000
17	0.0513	0.0613	0.005	0.0563	2.363	2.318	11.528	11.308	1.4300	1.3000	1.5600
16	0.0563	0.0685	0.006	0.0625	2.625	2.575	12.806	12.562	1.5875	1.4375	1.7375
15	0.0643	0.0763	0.006	0.0703	2.953	2.897	14.406	14.133	1.7856	1.6356	1.9356
14	0.0711	0.0851	0.007	0.0781	3.281	3.219	16.006	15.704	1.9837	1.8037	2.1637
13	0.0858	0.1018	0.008	0.0938	3.938	3.863	19.213	18.845	2.3825	2.1825	2.5825
12	0.1000	0.1184	0.009	0.1094	4.594	4.506	22.418	21.982	2.7788	2.5488	2.9788
11	0.1150	0.1350	0.010	0.1250	5.250	5.150	25.612	25.124	3.1750	2.9250	3.4250
10	0.1286	0.1526	0.012	0.1406	5.906	5.794	28.812	28.265	3.5713	3.2712	3.8712
9	0.1423	0.1703	0.014	0.1563	6.563	6.438	32.017	31.407	3.9700	3.6100	4.3300
8	0.1579	0.1859	0.014	0.1719	7.219	7.081	35.217	34.544	4.3663	4.0063	4.7263

Table B–3 Stainless Steel Sheet Thickness

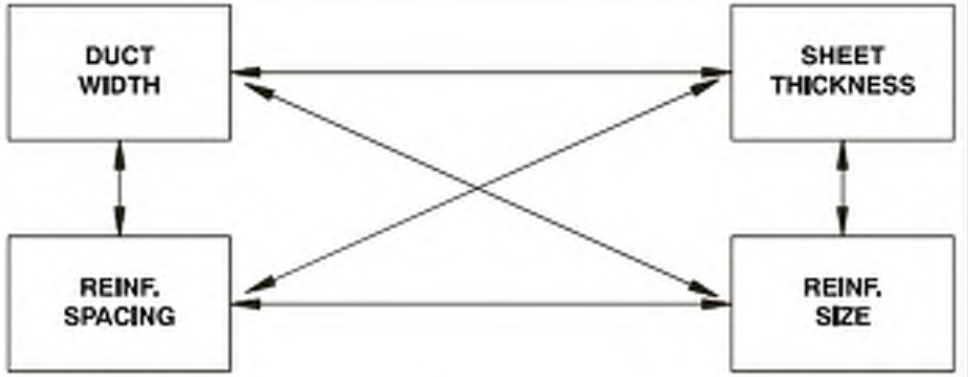
HVAC Duct Systems Inspection Guide

Appendix C: HVAC Duct Construction Standards

Excerpts from the HVAC-DCS (earlier in the presentation)

Example

- Figure C-1 Dependent Variables



RELATIONSHIPS:

a. For each pressure level and a constant duct size, the thicker the sheet the more distant the reinforcement spacing; the thinner the sheet the closer the reinforcement spacing.

b. For a given sheet thickness and constant duct size, reinforcement size, and reinforcement spacing, reduce with pressure reduction and increase with pressure increase.

c. The larger a duct at a given pressure, the larger the reinforcement and the closer the reinforcement spacing on a selected gage.

d. For each combination of sheet thickness, pressure, and duct width, a maximum reinforcement spacing occurs beyond which sheet deflection is not controlled by reinforcement size nor reinforcement position.

Maximum Deflection		Maximum Test Pressure
Joint and Reinf. 1/4 in. on 48 in.W. on W/200 on 49 – 120 in.	Sheet: 3/8 in. on 12 in. Dn. 1/2 in. on 13 – 18 in. 5/8 in. on 19 – 24 in. 3/4 in. on 25 – 84 in. 1 in. on 85 – 120 in.	Lab: Class Rating + 50% Field: Class Rating + 25%
Tolerance: +7.75%	Tolerance: +10%	

Maximum Deflection		Maximum Test Pressure
Joint and Reinf. 6.4 mm on 1200 mm W. on W/200 on 1201 – 3000 mm	Sheet: 9.53 mm on 300 mm Dn. 12.7 mm on 301 – 450 mm 15.9 mm on 451 – 600 mm 19.0 mm on 601 – 2100 mm 25 mm on 2101 – 3000 mm	Lab: Class Rating + 50% Field: Class Rating + 25%
Tolerance: +7.75%	Tolerance: +10%	

FIGURE C-1 DEPENDENT VARIABLES

HVAC Duct Systems Inspection Guide

Appendix C: HVAC Duct Construction Standards

Excerpts from the HVAC-DCS (earlier in the presentation)

Example

- Figure C-9 Rectangular Duct / Transverse Joints

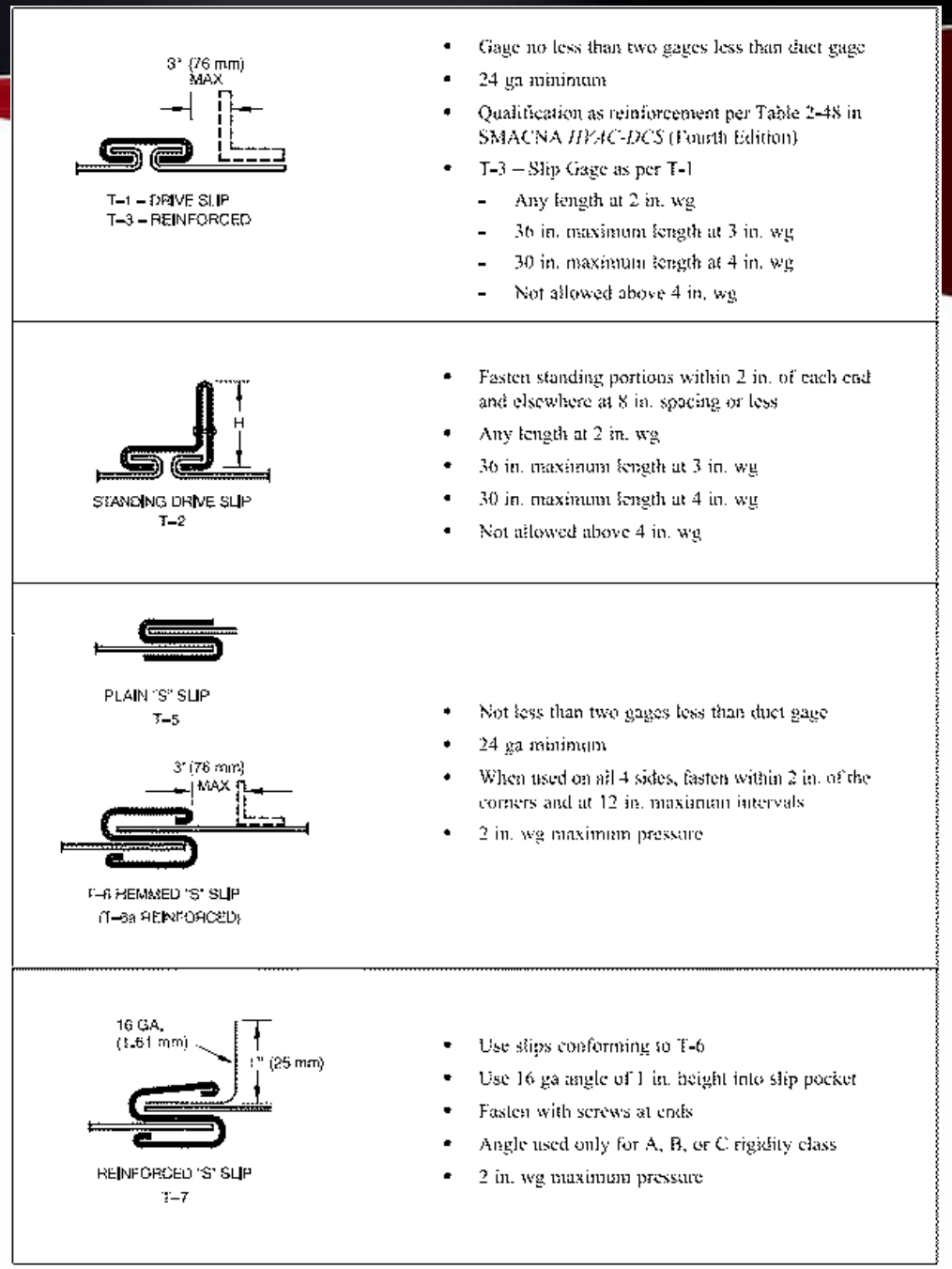


FIGURE C–9 RECTANGULAR DUCT/TRANSVERSE JOINTS

HVAC Duct Systems Inspection Guide

Appendix D:
Fire, Smoke, & Radiation Damper Guide

Excerpts from the Fire Damper Guide (earlier in the presentation)

Example

- Figure D-3 Fire Damper Opening Protection

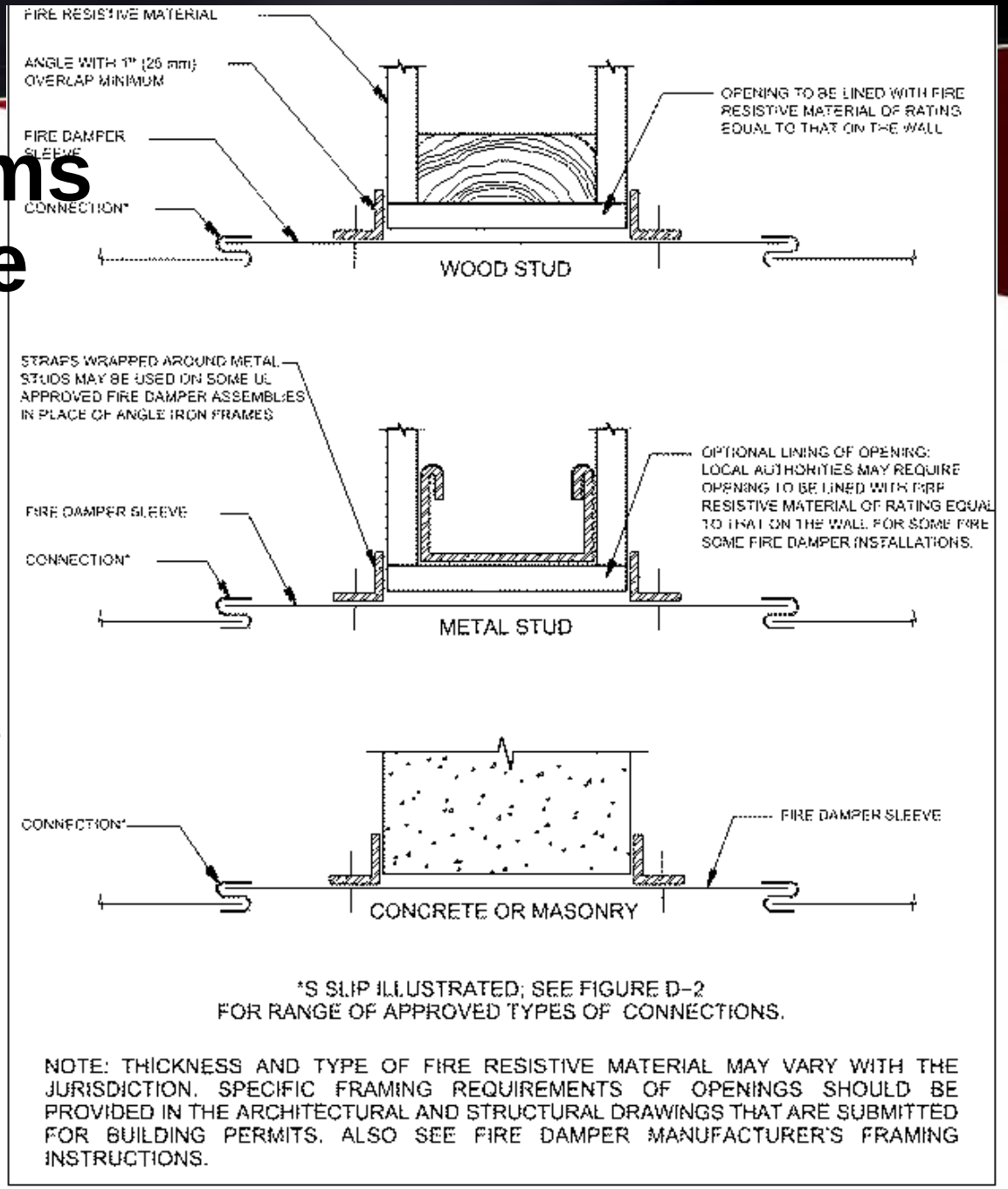


FIGURE D–3 FIRE DAMPER OPENING PROTECTION

HVAC Duct Systems Inspection Guide

Appendix E:
Fibrous Glass Duct Construction

Excerpts from the Fibrous Glass Duct Construction Standards (7th ed.)

Example

- Figure E-1 & E-2

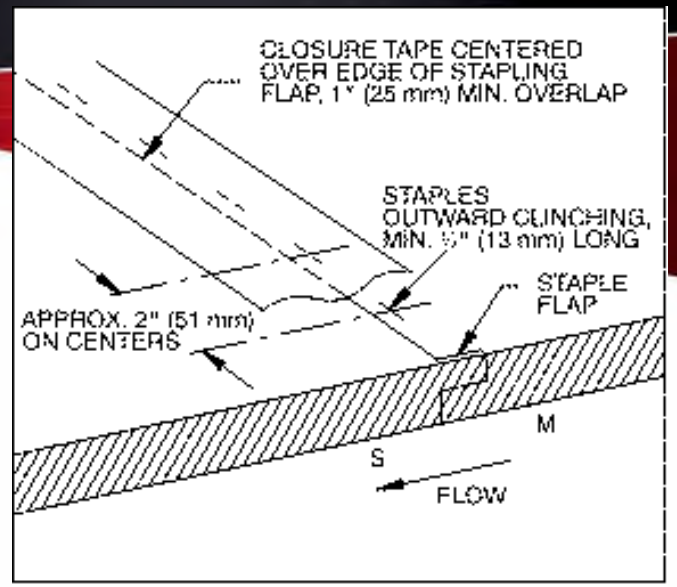


FIGURE E–1 TAPE CLOSURE JOINT, WITH STAPLE FLAP

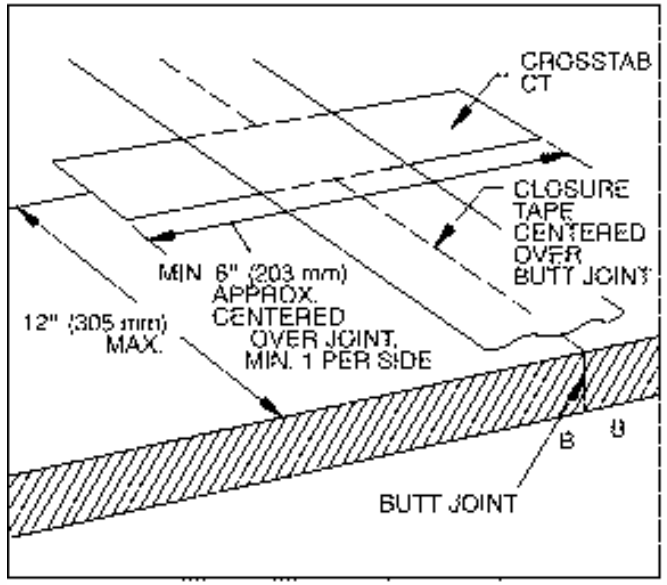


FIGURE E–2 TAPE CLOSURE JOINT, WITHOUT STAPLE FLAP

SHEET METAL & AIR CONDITIONING
CONTRACTORS' NATIONAL ASSOCIATION

Questions?

William C. Farrell II
Senior Project Manager
SMACNA Technical Resources
www.smacna.org