



ANSI/SMACNA 006-2006

HVAC Duct Construction Standards

Eli P. Howard, III
Sheet Metal and Air Conditioning
Contractors' National Association

Documents Preceding 3rd Edition HVAC-DCS

- **HVAC Duct Construction Standards --
Metal and Flexible**
 - **First Edition 1985**
 - **Second Edition 1995**

Model Codes

- **ICC**
International Mechanical Code (IMC)
- **IAPMO**
Uniform Mechanical Code (UMC)
- **NFPA**
90A & 90B

HVAC-DCS 3rd Edition 2005

- **Physical Duct Specimen Testing**
- **Finite Element Analysis (FEA) Modeling**
- **ANSI/SMACNA HVAC-DCS Chapter 11
“Functional Criteria For Ducts”**



Finite Element Analysis (FEA)

- **Translational / Rotational Restraint**
- **Internal / External Pressure (+/-)**
- **Total Displacement**
- **Surface & Membrane Stress (Panel, Joints, Seams)**



HVAC Duct Construction Standards

WHAT? WHY? HOW?

- 1. Review Joints and Limitations**
- 2. Reinforcements – Joints and External Structural Members**
- 3. Use of the Pressure Class Tables**
- 4. Mid-Panel Tie Rods (MPTs)**

Chapter 1

- **Model Specs**
- **Duct Sealing**
- **Dependent Variables**

Information Required for Duct Construction

- 1. A comprehensive duct layout indicating sizes, design airflows, pressure class, and routing of the duct system.**
- 2. The types of fittings to be used based on the designer's calculations of fitting losses (i.e., square versus 45° entry taps, conical versus straight taps, etc.).**

Information Required for Duct Construction

- 3. Use of turning vanes or splitter vanes.**
- 4. Location of access doors.**
- 5. Location and type of control and balancing dampers.**
- 6. Location and types of diffusers.**
- 7. Requirements for duct insulation.**

Information Required for Duct Construction

- 8. Location and types of any fire protection device including fire dampers, smoke dampers, combination fire/smoke dampers, and ceiling dampers. Building codes require this information to be shown on the design documents submitted for building permit.**

ENGINEER

Design Considerations:

CFM

Static Pressure

Duct Size

Fitting Type

**Construction Pressure
Class**

CONTRACTOR

Construction Considerations:

Panel Thickness (Gage)

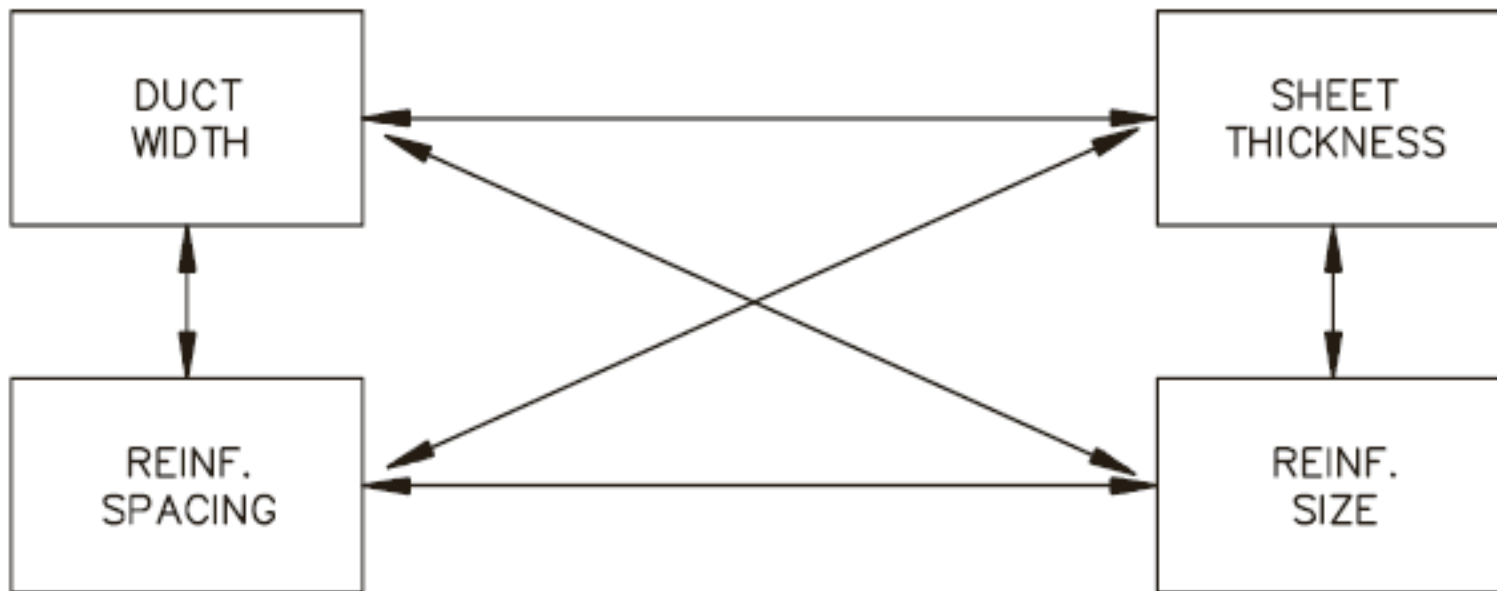
Pressure Class (as specified)

Panel Width/Height

Joint Type/Spacing

**Intermediate Reinforcement
Type/Spacing**

DEPENDENT VARIABLES



REGULAR DUCTS

Maximum Deflection		Maximum Test Pressure
Joint and Reinf.	Duct Wall:	Lab:
1/4" on 48" w.	3/8" on 12" Dn.	Class Rating + 50%
W/200 on	1/2" on 13"-18"	
49"-120"	5/8" on 19"-24"	Field:
	3/4" on 25"-84"	Class Rating + 25%
	1" on 85"-120"	
Tolerance:	Tolerance:	
+7.5%	+10%	

Chapter 2

Rectangular Duct Construction

Rectangular Duct Construction

- **Tabular Details of**
 - **Transverse Joints**
 - **Longitudinal Seams**
 - **Reinforcements**
- **TDC/TDF Tables**
- **Mid Panel Tie Rods**

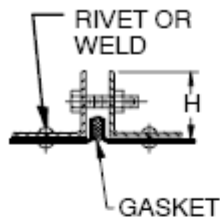
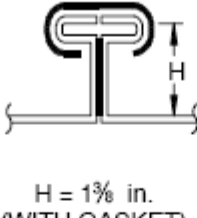
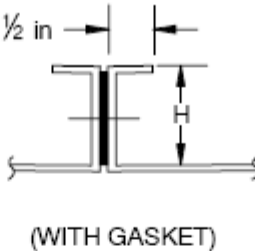
Reinf. Class								 T-25a Flanged  T-25b Flanged			
		T-22 Companion Angles		T-24 Flanged		T-24a Flanged				Slip-On Flange	
	EI*	H × T	WT LF	T (Nom.)	WT LF	H × T (Nom.)	WT LF	H × T (Nom.)	WT LF	Consult manufacturers for ratings established by performance documented to functional criteria in Chapter 11. See text S1.18 on page 2.4.	
B	1.0	Use E		Use D		Use D		Use D			
C	1.9	Use E		Use D		Use D		Use D			
D	2.7	Use E		26 ga	0.5	1 × 22 ga	0.4	26 ga	0.5		
E	6.5	C 1 × 1/8	1.7	24 ga	0.6	Use F		24 ga	0.6		
F	12.8	H 1 × 1/8	1.7	22 ga	0.7	1 1/2 × 20 ga	0.6	22 ga	0.7		
G	15.8	1 1/4 × 1/8	2.1	22 ga (R) 20 G	1.0	1 1/2 × 18 ga	0.8	22 ga (R) 20 ga	1.0		
H	26.4	C 1 1/2 × 1/8 (+) H 1 1/2 × 1/8	2.6	18 ga	1.1	SEE TIE ROD TEXT		18 ga	1.1		
I	69	1 1/2 × 1/4	3.7	20 ga (R)	1.0			20 ga (R)	1.0		
J	80	1 1/2 × 1/4 (+) 2 × 1/8	4.7	18 ga (R)	1.1			18 ga (R)	1.1		
K	103	2 × 3/16	5	18 ga (R)	1.1			18 ga (R)	1.1		
L	207	H 2 × 1/4	6.5	18 ga (R)	1.1			18 ga (R)	1.1		

Table 2-32 Transverse Joint Reinforcement



T-1 – DRIVE SLIP
T-3 – REINFORCED

- 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

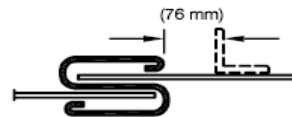


STANDING DRIVE SLIP
T-2

- Fasten standing portions within 2 in. of each end and elsewhere at 8 in. spacing or less
- 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

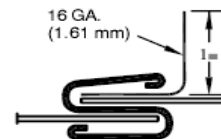


PLAIN "S" SLIP
T-5



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 ft maximum intervals
- 2 in. wg maximum pressure



REINFORCED "S" SLIP
T-7

- Use slips conforming to T-6
- Use 16 ga angle of 1 in. height into slip pocket
- Fasten with screws at ends
- Angle used only for A, B, or C rigidity class
- 2 in. wg maximum pressure

FIGURE 2-1 RECTANGULAR DUCT/TRANSVERSE JOINTS

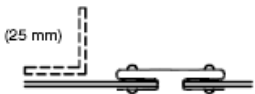
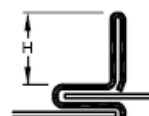
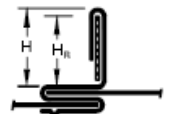
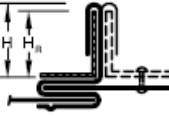
 T-8 DOUBLE "S" SLIP (T-8a REINFORCED)	■ 24 ga for 30 inch width or less ■ 22 ga over 30 inch width ■ Fasten to each section of the duct within 2 in. from corners and at 6 in. maximum intervals ■ 5/8 in. minimum tabs to close corners
 STANDING S T-10  STANDING S (ALT.) T-11  STANDING S (ALT.) T-12	■ When 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 (BAR REINFORCED) T-13	■ 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	■ Fasten as per Joint T-10 ■ Fasten angle to the connector or duct wall 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

FIGURE 2-1 RECTANGULAR DUCT/TRANSVERSE JOINTS (CONTINUED)

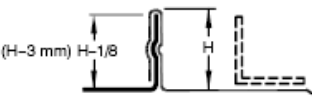
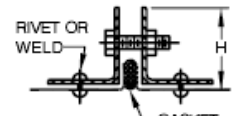
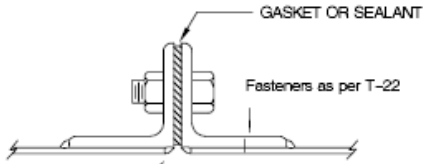
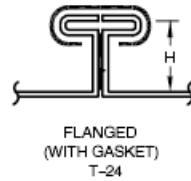
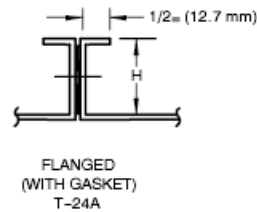
 STANDING SEAM T-15 ANGLE REINFORCED STANDING SEAM T-16	■ Button punch or otherwise fasten within 2 in. of each corner and at 6 in. maximum intervals ■ Seal and fold corners ■ Stagger joints on adjacent sides if using standing seam on all four sides ■ Hammer longitudinal seam at ends of standing seam
 T-21 WELDED FLANGE (T-21a REINFORCED W.F.)	■ Use 1/2 in. minimum flange and end weld ■ Flanges larger than 5/8 in. must be spot welded, bolted, riveted or screwed to prevent separation (2 in. from ends and at 8 in. maximum intervals) ■ On 24, 22 or 20 ga, brace or weld 1/4 in. $\equiv$ 4 in. rod in corners or provide hangers at every joint
 COMPANION ANGLES (CAULK OR GASKET) T-22	■ 3/8 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 - 3/4 in. angle requires 4 in. maximum spacing at 4 in. wg - 4 in. maximum spacing at higher pressures
 COMPANION ANGLES T-22 ALT.	■ Hold duct back 1/8 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

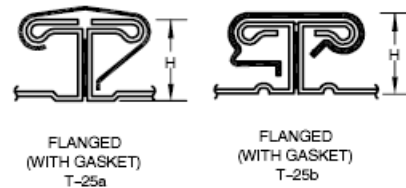
FIGURE 2-1 RECTANGULAR DUCT/TRANSVERSE JOINTS (CONTINUED)



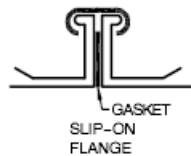
- Close corners with minimum 16 ga corner pieces and 7/8 in. diameter bolts
- Gasket to be located to form an effective seal
- Lock flanges together with 6 in. long clips located within 6 in. of each corner
- Clips spaced at 15 in. maximum for 3 in. wg pressure class or lower
- Clips spaced at 12 in. maximum for 4, 6 and 10 in. wg
- See Figure 2-16



- Bolt, rivet 1 in. maximum from ends and at 6 in. maximum intervals
- Limited to 2 in. wg pressure class
- See Figure 2-16
- Gasket to be located to form an effective seal



- Assemble per Figure 2-17
- 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



- Consult manufacturers for ratings established by performance documented to functional criteria in Chapter 11.

FIGURE 2-1 RECTANGULAR DUCT/TRANSVERSE JOINTS (CONTINUED)

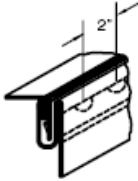
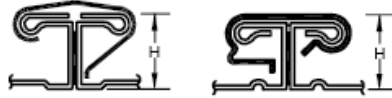
 L-1 ALSO SEAL THIS POCKET AT ENDS WHEN SEALING SEAMS PITTSBURGH LOCK	■ Pocket depth from ¼ in. to ⅝ in. ■ Use on straight duct and fittings ■ To ± 10 in. wg
 L-2 BUTTON PUNCH SNAP LOCK	■ ⅝ in. pocket depth for 20, 22 & 24 ga ■ ½ in. pocket depth for 24 & 26 ga ■ To ± 4 in. wg ■ Screws must be added at 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-3 GROOVED SEAM ALSO CALLED FLAT LOCK AND PIPE LOCK	■ To ± 10 in. wg
 SEE FIG. 1-6 ALSO L-4 STANDING SEAM	■ To ± 10 in. wg ■ 1 in. seam up to duct width of 42 in. ■ 1 ½ in. seam for larger ducts ■ May be used on duct interiors ■ Fasten at 2 in. maximum from ends and at 8 in. maximum intervals
 L-5 SINGLE CORNER SEAM	■ To ± 10 in. wg ■ Fasten as per L-4
 FLANGED (WITH GASKET) T-25a FLANGED (WITH GASKET) T-25b	■ Assemble per Figure 2-17 ■ 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

FIGURE 2-2 RECTANGULAR DUCT/LONGITUDINAL SEAMS

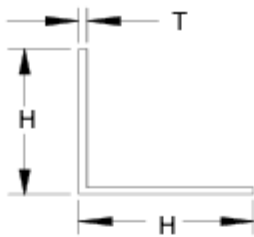
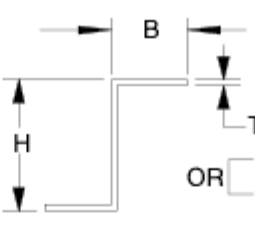
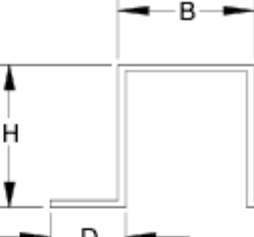
							
Reinf. Class		Angle		Channel or Zee		Hat Section	
	EI*	H × T (MIN)	WT LF	H × T (MIN)	WT LF	H × T (MIN)	WT LF
A	0.43	Use C		Use B		Use F	
B	1.0	Use C		$\frac{3}{4} \times \frac{1}{2} \times 20$ ga	0.24	Use F	
C	1.9	C1 × 16 ga $C\frac{3}{4} \times \frac{1}{8}$	0.40 0.57	$\frac{3}{4} \times \frac{1}{2} \times 18$ ga $1 \times \frac{3}{4} \times 20$ ga	0.31	Use F	
D	2.7	H $\frac{3}{4} \times \frac{1}{8}$ C1 × $\frac{1}{8}$	0.57 0.80	$1 \times \frac{3}{4} \times 18$ ga	0.45	Use F	
E	6.5	C1 $\frac{1}{4} \times 12$ ga H1 × $\frac{1}{8}$	0.90	$2 \times 1 \frac{1}{8} \times 20$ ga	0.60	Use F	
F	12.8	H1 $\frac{1}{4} \times \frac{1}{8}$	1.02	$1 \frac{1}{2} \times \frac{3}{4} \times 18$ ga	0.54	$1 \frac{1}{2} \times \frac{3}{4} \times \frac{5}{8} \times 18$ ga $1 \frac{1}{2} \times 1 \frac{1}{2} \times \frac{3}{4} \times 20$ ga	0.90 0.83
G	15.8	$1 \frac{1}{2} \times \frac{1}{8}$	1.23	$1 \frac{1}{2} \times \frac{3}{4} \times 16$ ga	0.66	$1 \frac{1}{2} \times \frac{3}{4} \times \frac{5}{8} \times 18$ ga	0.80
H	26.4	$1 \frac{1}{2} \times \frac{3}{16}$ $2 \times \frac{1}{8}$	1.78 1.65	$1 \frac{1}{2} \times \frac{3}{4} \times \frac{1}{8}$	1.31	$1 \frac{1}{2} \times 1 \frac{1}{2} \times \frac{3}{4} \times 18$ ga $2 \times 1 \times \frac{3}{4} \times 20$ ga	1.08 0.90
I	69	C2 × $\frac{3}{16}$ $2 \frac{1}{2} \times \frac{1}{8}$	2.44 2.10	$2 \times 1 \frac{1}{8} \times 12$ ga $3 \times 1 \frac{1}{8} \times 16$ ga	1.60 1.05	$2 \times 1 \times \frac{3}{4} \times 16$ ga	1.44
J	80	H2 × $\frac{3}{16}$ C2 × $\frac{1}{4}$ $2 \frac{1}{2} \times \frac{1}{8}$ (+)	2.44 3.20 2.10	$2 \times 1 \frac{1}{8} \times \frac{1}{8}$	1.85	$2 \times 1 \times \frac{3}{4} \times 12$ ga $2 \frac{1}{2} \times 2 \times \frac{3}{4} \times 18$ ga	2.45 1.53
K	103	$2 \frac{1}{2} \times \frac{3}{16}$	3.10	$3 \times 1 \frac{1}{8} \times 12$ ga	2.00	$2 \frac{1}{2} \times 2 \times \frac{3}{4} \times 16$ ga $3 \times 1 \frac{1}{2} \times \frac{3}{4} \times 16$ ga	1.88 2.00
L	207	H2 $\frac{1}{2} \times \frac{1}{4}$	4.10	$3 \times 1 \frac{1}{8} \times \frac{1}{8}$	2.29	$2 \frac{1}{2} \times 2 \times \frac{3}{4} \times \frac{1}{8}$ $3 \times 1 \frac{1}{2} \times \frac{3}{4} \times 12$ ga	3.70 3.40

Table 2-29 Intermediate Reinforcement

See para 2.1.4. Nominal EI is number listed times 10^5 before adjustment for bending moment capacity. C and H denote cold formed and hot rolled ratings; when neither is listed, either may be used. See tie rod options elsewhere.

**FRAMING CHANNEL (STRUT) MAY BE USED AS DUCT
REINFORCEMENT AS FOLLOWS:**

Channel (Strut)			Reinforcement Class Per Table 2-29
H	W	GA	
$1\frac{3}{16}$ in.	$1\frac{5}{8}$ in.	14	A, B, C
$1\frac{3}{16}$ in.	$1\frac{5}{8}$ in.	14	D
$\frac{7}{8}$ in.	$1\frac{5}{8}$ in.	12	D, E
$1\frac{3}{8}$ in.	$1\frac{5}{8}$ in.	12	F, G
$2\frac{7}{8}$ in.	$1\frac{5}{8}$ in.	12	H, I, J
$3\frac{1}{4}$ in.	$1\frac{5}{8}$ in.	12	K, L

Table 2-30

NOTE: Framing channels having the same physical dimensions as those listed above, but fabricated from thicker steel may be used at the reinforcement class assigned to the lighter version.

$\frac{1}{2}$ in. wg Static Pos. or Neg.	No Reinforcement Required	Reinforcement Code for Duct Gage Number							
Duct Dimension		Reinforcement Spacing Options							
		10 ft	8 ft	6 ft	5 ft	4 ft	3 ft	2½ ft	2 ft
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
10 in. and under	26 ga.	Not Required							
11 – 12 in.	26 ga.								
13 – 14 in.	26 ga.								
15 – 16 in.	26 ga.								
17 – 18 in.	26 ga.								
19 – 20 in.	24 ga.	B-26	B-26	E-26	B-26	E-26	B-26	A-26	A-26
21 – 22 in.	22 ga.	B-26	B-26	E-26	B-26	B-26	B-26	B-26	A-26
23 – 24 in.	22 ga.	C-26	C-26	C-26	B-26	B-26	B-26	B-26	B-26
25 – 26 in.	20 ga.	C-26	C-26	C-26	C-26	B-26	B-26	B-26	B-26
27 – 28 in.	18 ga.	C-24	C-26	C-26	C-26	C-26	B-26	B-26	B-26
29 – 30 in.	18 ga.	C-24	C-26	C-26	C-26	C-26	B-26	B-26	B-26
31 – 36 in.	18 ga.	D-22	D-24	C-26	C-26	C-26	C-26	C-26	B-26
37 – 42 in.	16 ga.	E-20	E-24	D-24	D-26	C-26	C-26	C-26	C-26
43 – 48 in.	16 ga.	E-20	E-22	E-24	E-26	D-26	D-26	C-26	C-26
49 – 54 in.	Not Designed	F-18	F-20	F-22	E-26	E-26	E-26	D-26	C-26
55 – 60 in.		G-18	F-20	F-22	E-24	E-24	E-26	E-26	D-26
61 – 72 in.		H-16	H-18	F-20	F-22	F-24	E-24	E-24	E-24
73 – 84 in.			I-16G	H-18G	H-22G	G-24	F-24	F-24	F-24
85 – 96 in.			I-16G	I-18G	H-20G	H-22G	G-22	F-22	F-22
97 – 108 in.				I-16G	I-18G	I-18G	H-18G	H-18G	G-18
109 – 120 in.					I-16G	I-16G	I-18G	H-18G	H-18G

Table 2-1 Rectangular Duct Reinforcement

1 in. wg Static Pos. or Neg.	No Reinforcement Required	Reinforcement Code for Duct Gage Number							
Duct Dimension		Reinforcement Spacing Options							
		10 ft	8 ft	6 ft	5 ft	4 ft	3 ft	2½ ft	2 ft
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
10 in. and under	26 ga.	Not Required							
11 – 12 in.	26 ga.								
13 – 14 in.	26 ga.								
15 – 16 in.	26 ga.								
17 – 18 in.	24 ga.		B-26	B-26	B-26	B-26	B-26	B-26	B-26
19 – 20 in.	24 ga.		C-26	C-26	C-26	C-26	B-26	B-26	B-26
21 – 22 in.	22 ga.	C-24	C-24	C-26	C-26	C-26	B-26	B-26	B-26
23 – 24 in.	22 ga.	C-24	C-24	C-26	C-26	C-26	C-26	B-26	B-26
25 – 26 in.	20 ga.	D-22	D-24	C-26	C-26	C-26	C-26	C-26	B-26
27 – 28 in.	18 ga.	D-22	D-24	D-26	C-26	C-26	C-26	C-26	C-26
29 – 30 in.	18 ga.	E-22	D-24	D-26	D-26	C-26	C-26	C-26	C-26
31 – 36 in.	18 ga.	E-20	E-22	E-24	D-24	D-26	C-26	C-26	C-26
37 – 42 in.	16 ga.	F-18	F-20	E-22	E-24	E-26	D-26	D-26	C-26
43 – 48 in.	16 ga.	G-18	G-18	F-20	F-22	E-24	E-26	E-26	D-26
49 – 54 in.	Not Designed	H-18	H-18	G-20	F-22	F-24	E-24	E-24	E-24
55 – 60 in.		I-16	H-18	G-20	G-22	F-24	F-24	E-24	E-24
61 – 72 in.			I-16G	H-18G	H-18G	H-22G	F-24	F-24	F-24
73 – 84 in.				I-18G	I-18G	I-20G	H-22G	H-22G	G-22
85 – 96 in.				J-16H	I-18H	I-18H	I-20G	H-20G	H-22G
97 – 108 in.					J-16H	I-18H	I-18G	I-18G	I-18G
109 – 120 in.						J-16H	I-18H	I-18H	I-18G

Table 2-2 Rectangular Duct Reinforcement

2 in. wg Static Pos. or Neg.	No Reinforcement Required	Reinforcement Code for Duct Gage Number								
Duct Dimension		Reinforcement Spacing Options								
		10 ft	8 ft	6 ft	5 ft	4 ft	3 ft	2½ ft	2 ft	
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	
10 in. and under	26 ga.	Not Required								
11 – 12 in.	26 ga.									
13 – 14 in.	24 ga.		B-26	B-26	B-26	B-26	B-26	B-26	B-26	
15 – 16 in.	24 ga.		C-26	C-26	C-26	C-26	C-26	B-26	B-26	
17 – 18 in.	22 ga.		C-26	C-26	C-26	C-26	C-26	C-26	B-26	
19 – 20 in.	20 ga.	C-22	C-24	C-26	C-26	C-26	C-26	C-26	C-26	
21 – 22 in.	18 ga.	D-22	D-24	D-26	D-26	C-26	C-26	C-26	C-26	
23 – 24 in.	18 ga.	E-22	E-24	D-26	D-26	D-26	C-26	C-26	C-26	
25 – 26 in.	18 ga.	E-22	E-22	E-24	D-26	D-26	C-26	C-26	C-26	
27 – 28 in.	18 ga.	F-20	E-20	E-22	E-24	D-26	D-26	C-26	C-26	
29 – 30 in.	18 ga.	F-20	F-20	E-22	E-24	E-26	D-26	D-26	C-26	
31 – 36 in.	16 ga.	G-18	G-20	F-22	F-24	E-24	E-26	D-26	D-26	
37 – 42 in.	Not Designed	H-16	H-18	G-20	G-22	F-24	E-24	E-26	E-26	
43 – 48 in.			I-18	H-20	H-22	G-22	F-24	F-24	E-24	
49 – 54 in.			I-16G	I-18G	H-20G	H-20G	G-24	F-24	F-24	
55 – 60 in.				I-18G	I-20G	H-20G	G-22	G-24	F-24	
61 – 72 in.				J-16H	J-18H	I-20G	H-22G	H-22G	H-24	
73 – 84 in.					J-16H	I-20G	I-20G	I-22G	I-22G	
85 – 96 in.							J-18H	I-18H	I-20H	I-22H
97 – 108 in.							K-16I	K-18H	J-18H	I-18H
109 – 120 in.								K-16I	K-18I	J-18I

Table 2–3 Rectangular Duct Reinforcement

3 in. wg Static Pos. or Neg.	No Reinforcement Required	Reinforcement Code for Duct Gage Number							
Duct Dimension		Reinforcement Spacing Options							
		10 ft	8 ft	6 ft	5 ft	4 ft	3 ft	2½ ft	2 ft
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
10 in. and under	24 ga.	Not Required		B-26	B-26	B-26	B-26	B-26	B-26
11 – 12 in.	24 ga.			B-26	B-26	B-26	B-26	B-26	B-26
13 – 14 in.	22 ga.			C-24	C-24	C-26	C-26	B-26	B-26
15 – 16 in.	22 ga.			C-24	C-24	C-26	C-26	C-26	C-26
17 – 18 in.	20 ga.		D-24	D-24	C-24	C-26	C-26	C-26	C-26
19 – 20 in.	18 ga.		D-22	D-22	D-24	D-24	C-26	C-26	C-26
21 – 22 in.	18 ga.		E-22	E-22	D-24	D-24	D-26	C-26	C-26
23 – 24 in.	18 ga.		E-20	E-22	E-24	E-24	D-26	D-26	C-26
25 – 26 in.	18 ga.		F-20	E-22	E-24	E-24	D-26	D-26	C-26
27 – 28 in.	18 ga.		F-20	F-20	F-22	E-24	E-26	D-26	D-26
29 – 30 in.	18 ga.		G-20	F-20	F-22	E-24	E-26	E-26	D-26
31 – 36 in.	16 ga.	H-18G	H-18G	H-18G	G-20	F-22	F-24	E-26	E-26
37 – 42 in.	Not Designed		I-16G	H-18G	H-20G	G-22	F-24	F-24	E-26
43 – 48 in.			J-16H	I-18G	I-18G	H-20	G-22	G-24	F-24
49 – 54 in.				J-16H	I-18G	I-18G	H-22G	G-24	G-24
55 – 60 in.				J-16H	I-18G	I-18G	H-20G	H-22G	G-24
61 – 72 in.					J-16I	J-18H	I-20G	I-22G	I-24G
73 – 84 in.					L-16I	K-16H	J-18H	I-20H	I-22G
85 – 96 in.						L-16I	K-18I	J-18I	I-20H
97 – 108 in.							L-16I	L-18I	K-18I
109 – 120 in.							L-16I	L-18I	K-18I

Table 2–4 Rectangular Duct Reinforcement

4 in. wg Static Pos. or Neg.	No Reinforcement Required	Reinforcement Code for Duct Gage Number								
Duct Dimension		Reinforcement Spacing Options								
		10 ft	8 ft	6 ft	5 ft	4 ft	3 ft	2½ ft	2 ft	
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	
8 in. and under	24 ga.	Not Required		B-26	B-26	B-26	B-26	B-26	B-26	
9 – 10 in.	22 ga.			B-24	B-26	B-26	B-26	B-26	B-26	
11 – 12 in.	22 ga.		B-24	C-24	C-26	C-26	C-26	B-26	B-26	
13 – 14 in.	20 ga.		C-22	C-22	C-24	C-26	C-26	C-26	C-26	
15 – 16 in.	20 ga.		D-22	D-22	C-24	C-26	C-26	C-26	C-26	
17 – 18 in.	18 ga.		D-22	D-22	D-24	D-26	C-26	C-26	C-26	
19 – 20 in.	18 ga.		E-20	E-22	E-24	D-24	D-26	C-26	C-26	
21 – 22 in.	18 ga.		E-20	E-20	E-24	E-24	D-26	D-26	C-26	
23 – 24 in.	18 ga.		F-20	F-20	E-22	E-24	E-26	D-26	D-26	
25 – 26 in.	16 ga.	G-18	G-18	F-20	F-22	E-24	E-26	E-26	D-26	
27 – 28 in.	16 ga.	H-18G	G-18	G-20	F-22	F-24	E-26	E-26	D-26	
29 – 30 in.	16 ga.	H-18G	H-18G	G-18	G-22	F-24	E-26	E-26	E-26	
31 – 36 in.	Not Designed	J-16H	I-16G	H-18G	H-20	G-22	F-24	F-26	E-26	
37 – 42 in.			J-16H	I-16G	I-18G	H-20G	G-22	G-24	F-26	
43 – 48 in.				J-16H	I-18G	I-18G	H-22G	H-24G	G-24	
49 – 54 in.				J-16H	I-18H	I-18G	I-20G	H-22G	H-24G	
55 – 60 in.					J-16I	I-18H	I-20G	I-22G	H-24G	
61 – 72 in.						K-16H	J-18H	I-20H	I-22G	
73 – 84 in.								K-16I	J-18I	I-20H
85 – 96 in.								L-16I	K-18I	J-20I
97 – 108 in.								L-16I	L-18I	L-18I
109 – 120 in.								L-16I	L-18J	L-18J

Table 2–5 Rectangular Duct Reinforcement

6 in. wg Static Pos. or Neg.	No Reinforcement Required	Reinforcement Code for Duct Gage Number							
Duct Dimension		Reinforcement Spacing Options							
		10 ft	8 ft	6 ft	5 ft	4 ft	3 ft	2½ ft	2 ft
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
8 in. and under	24 ga.	Not Required			C-26	C-26	B-26	B-26	B-26
9 – 10 in.	24 ga.			B-24	C-24	C-24	B-26	B-26	B-26
11 – 12 in.	20 ga.		C-22	C-22	C-24	C-24	C-26	C-26	C-26
13 – 14 in.	20 ga.		C-22	D-20	D-22	C-24	C-26	C-26	C-26
15 – 16 in.	18 ga.		D-20	D-20	D-22	D-24	D-26	C-26	C-26
17 – 18 in.	18 ga.		E-20	E-20	E-22	E-24	D-26	D-26	C-26
19 – 20 in.	16 ga.	F-18	F-20	F-20	E-22	E-24	D-24	D-26	D-26
21 – 22 in.	16 ga.	F-18	F-18	F-20	F-22	F-24	E-24	E-26	D-26
23 – 24 in.	16 ga.	G-18	G-18	G-20	F-22	F-22	E-24	E-26	E-26
25 – 26 in.	Not Designed	H-16G	H-16G	G-18	G-20	F-22	F-24	E-24	E-24
27 – 28 in.			H-16G	H-18G	H-20G	G-22	F-24	F-24	E-24
29 – 30 in.			I-16G	H-18G	H-18G	G-22	F-24	F-24	E-24
31 – 36 in.				I-16H	I-18H	H-20G	H-22G	G-24	F-24
37 – 42 in.				J-16H	I-16H	I-18G	H-20G	H-22G	G-22
43 – 48 in.					J-16H	I-18H	I-20H	I-22G	I-22G
49 – 54 in.						J-16H	I-18H	I-20G	I-22G
55 – 60 in.						J-16H	J-18H	I-20H	I-22G
61 – 72 in.							K-16I	J-18I	J-20H
73 – 84 in.							L-16J	L-18J	K-18I
85 – 96 in.							It-16	It-16	L-18J
97 – 108 in.							Jt-16	Jt-16	L-18J
109 – 120 in.							Kt-16	Kt-16	Kt-18

Table 2–6 Rectangular Duct Reinforcement

10 in. wg Static Pos. or Neg.	No Reinforcement Required	Reinforcement Code for Duct Gage Number								
Duct Dimension		Reinforcement Spacing Options								
		10 ft	8 ft	6 ft	5 ft	4 ft	3 ft	2½ ft	2 ft	
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	
8 in. and under	22 ga.	Not Required		C-20	C-24	C-26	C-26	C-26	C-26	
9 – 10 in.	20 ga.			C-20	C-22	C-24	C-26	C-26	C-26	
11 – 12 in.	18 ga.		C-20	D-20	D-22	D-24	C-26	C-26	C-26	
13 – 14 in.	18 ga.		D-20	E-20	E-20	D-22	D-24	D-26	C-26	
15 – 16 in.	16 ga.	E-18	E-18	E-18	E-20	E-20	E-24	D-24	D-26	
17 – 18 in.	16 ga.	F-18	F-18	F-18	F-20	F-20	E-24	E-24	D-26	
19 – 20 in.		G-16	G-18	G-18	G-18	F-20	F-22	E-24	E-24	
21 – 22 in.		H-16G	H-18G	H-18G	G-18	G-20	F-22	F-24	E-24	
23 – 24 in.		I-16G	I-18G	H-18G	H-18G	H-20G	G-22	F-24	F-24	
25 – 26 in.			J-16G	I-16G	H-18G	H-20G	G-22	F-24	F-24	
27 – 28 in.				I-16G	I-18G	H-18G	H-22G	G-24	F-24	
29 – 30 in.				J-16G	I-18G	I-18G	H-22G	H-24G	G-24	
31 – 36 in.						J-16H	I-18H	I-20G	H-22G	H-24G
37 – 42 in.						J-16I	J-18I	I-18G	I-20H	I-22G
43 – 48 in.							J-16I	J-18I	I-18H	I-22H
49 – 54 in.			Not Designed				L-16I	K-18I	J-18H	I-20H
55 – 60 in.							L-16I	K-18I	J-20I	
61 – 72 in.							L-16I	L-18I	L-18I	
73 – 84 in.								L-16J	L-18J	
85 – 96 in.									Lt-16	
97 – 108 in.									Lt-16	
109 – 120 in.									Lt-16	

Table 2–7 Rectangular Duct Reinforcement

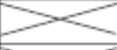
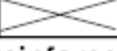
2 in. wg Static Pos. or Neg.	4 ft Joints			4 ft Joints w/2 ft Reinf. Spacing				
	Min ga	Joint Reinf.	Alt. Joint Reinf.	Joints/Reinf.			Int. Reinf.	
				Min ga	Joint Reinf.	Alt. Joint Reinf.	Tie Rod	Alt. Reinf.
10 in. dn	26	N/R	N/A	Use 4 ft Joints				
11, 12 in.	26	N/R	N/A					
13, 14 in.	26	N/R	N/A					
15, 16 in.	26	N/R	N/A					
17, 18 in.	26	N/R	N/A					
19, 20 in.	26	N/R	N/A					
21, 22 in.	26	N/R	N/A					
23, 24 in.	26	N/R	N/A					
25, 26 in.	26	N/R	N/A					
27, 28 in.	26	N/R	N/A					
29, 30 in.	24	N/R	N/A	26	N/R	N/A	MPT	C
31-36 in.	24	N/R	N/A	26	N/R	N/A	MPT	D
37-42 in.	22	N/R	N/A	24	N/R	N/A	MPT	E
43-48 in.	22	JTR	(2) C	24	N/R	N/A	MPT	E
	20	N/R	—					
49-54 in.	20	JTR	(2) E	22	N/R	N/A	MPT	F
55-60 in.	20	JTR	(2) E	22	N/R	N/A	MPT	F
61-72 in.	20	JTR	(2) H	20	JTR	(2) E	MPT	H
				18	N/R	N/A		
73-84 in.	20	JTR	(2) H	20	JTR	(2) H	2 MPT	I
85-96 in.	18	JTR	(2) H	20	JTR	(2) H	2 MPT	I
97-108 in.	16	JTR	(2) I	18	JTR	(2) H		I
109-120 in.	Not Designed			18	JTR	(2) H		J

Table 2-10 4 ft Coil/Sheet Stock/T25a/T25b (TDC/TDF) Duct Reinforcement

N/R – Not Required
N/A – Not Applicable

JTR – Joint Tie Rod
MPT – Mid Panel Tie Rod (s)

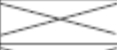
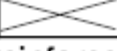
2 in. wg Static Pos. or Neg.	4 ft Joints			4 ft Joints w/2 ft Reinf. Spacing				
	Min ga	Joint Reinf.	Alt. Joint Reinf.	Joints/Reinf.			Int. Reinf.	
				Min ga	Joint Reinf.	Alt. Joint Reinf.	Tie Rod	Alt. Reinf.
10 in. dn	26	N/R	N/A	Use 4 ft Joints				
11, 12 in.	26	N/R	N/A					
13, 14 in.	26	N/R	N/A					
15, 16 in.	26	N/R	N/A					
17, 18 in.	26	N/R	N/A					
19, 20 in.	26	N/R	N/A					
21, 22 in.	26	N/R	N/A					
23, 24 in.	26	N/R	N/A					
25, 26 in.	26	N/R	N/A					
27, 28 in.	26	N/R	N/A					
29, 30 in.	24	N/R	N/A	26	N/R	N/A	MPT	C
31-36 in.	24	N/R	N/A	26	N/R	N/A	MPT	D
37-42 in.	22	N/R	N/A	24	N/R	N/A	MPT	E
43-48 in.	22	JTR	(2) C	24	N/R	N/A	MPT	E
	20	N/R	—					
49-54 in.	20	JTR	(2) E	22	N/R	N/A	MPT	F
55-60 in.	20	JTR	(2) E	22	N/R	N/A	MPT	F
61-72 in.	20	JTR	(2) H	20	JTR	(2) E	MPT	H
				18	N/R	N/A		
73-84 in.	20	JTR	(2) H	20	JTR	(2) H	2 MPT	I
85-96 in.	18	JTR	(2) H	20	JTR	(2) H	2 MPT	I
97-108 in.	16	JTR	(2) I	18	JTR	(2) H		I
109-120 in.	Not Designed			18	JTR	(2) H		J

Table 2-10 4 ft Coil/Sheet Stock/T25a/T25b (TDC/TDF) Duct Reinforcement

N/R – Not Required
N/A – Not Applicable

JTR – Joint Tie Rod
MPT – Mid Panel Tie Rod (s)

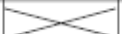
4 in. wg Static Pos. or Neg.	5 ft Joints			5 ft Joints w/2 ½ ft Reinf. Spacing				
	Min ga	Joint Reinf.	Alt. Joint Reinf.	Joints/Reinf.			Int. Reinf.	
				Min ga	Joint Reinf.	Alt. Joint Reinf.	Tie Rod	Alt. Reinf.
8 in. dn	26	N/R	N/R	Use 5 ft Joints				
9, 10 in.	26	N/R	N/R					
11, 12 in.	26	N/R	N/R					
13, 14 in.	24	N/R	N/R	26	N/R	N/R	MPT	C
15, 16 in.	24	N/R	N/R	26	N/R	N/R	MPT	C
17, 18 in.	24	N/R	N/R	26	N/R	N/R	MPT	C
19, 20 in.	24	N/R	N/R	26	N/R	N/R	MPT	C
21, 22 in.	24	N/R	N/R	26	N/R	N/R	MPT	D
23, 24 in.	22	N/R	N/R	26	N/R	N/R	MPT	D
25, 26 in.	22	N/R	N/R	24	N/R	N/R	MPT	E
27, 28 in.	22	N/R	N/R	24	N/R	N/R	MPT	E
29, 30 in.	20	N/R	N/R	24	N/R	N/R	MPT	E
31-36 in.	20	JTR	(2) E	22	N/R	N/R	MPT	F
37-42 in.	18	JTR	(2) H	22	JTR	(2) C	MPT	G
				20	N/R	N/R		
43-48 in.	18	JTR	(2) H	20	JTR	(2) E	MPT	H
				18	N/R	N/R		
49-54 in.	18	JTR	(2) H	20	JTR	(2) E	MPT	H
				18	N/R	N/R		
55-60 in.	16	JTR	(2) H	20	JTR	(2) I	MPT	I
61-72 in.	Not Designed			20	JTR	(2) I	(2) MPT	I
73-84 in.				18	JTR	(2) I	(2) MPT	J
85-96 in.				18	JTR	(2) I	(2) MPT	K
97-108 in.				18	JTR	(2) K		L
109-120 in.				18	JTR	(2) K		L

Table 2-19 5 ft Coil/Sheet Stock/T25a/T25b (TDC/TDF) Duct Reinforcement

N/R – Not Required

JTR – Joint Tie Rod

N/A – Not Applicable

MPT – Mid Panel Tie Rod (s)

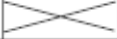
4 in. wg Static Pos. or Neg.	6 ft Joints			6 ft Joints w/3 ft Reinf. Spacing				
	Min ga	Joint Reinf.	Alt. Joint Reinf.	Joints/Reinf.			Int. Reinf.	
				Min ga	Joint Reinf.	Alt. Joint Reinf.	Tie Rod	Alt. Reinf.
8 in. dn	26	N/R	N/A	Use 6 ft Joints				
9, 10 in.	24	N/R	N/A	26	N/R	N/A	N/A	B
11, 12 in.	24	N/R	N/A	26	N/R	N/A	N/A	C
13, 14 in.	22	N/R	N/A	26	N/R	N/A	N/A	C
15, 16 in.	22	N/R	N/A	26	N/R	N/A	N/A	C
17, 18 in.	22	N/R	N/A	26	N/R	N/A	N/A	C
19, 20 in.	22	N/R	N/A	26	N/R	N/A	N/A	D
21, 22 in.	20	N/R	N/A	26	N/R	N/A	N/A	D
23, 24 in.	20	N/R	N/A	24	N/R	N/A	N/A	E
25, 26 in.	20	N/R	N/A	24	N/R	N/A	N/A	E
27, 28 in.	20	N/R	N/A	24	N/R	N/A	N/A	E
29, 30 in.	18	N/R	N/A	24	N/R	N/A	N/A	E
31-36 in.	18	N/R	N/A	22	N/R	N/A	MPT	F
37-42 in.	16	JTR	(2) H	22	JTR	(2) C	N/A	G
				20	N/R	N/A		
43-48 in.	16	JTR	(2) H	22	JTR	(2) E	N/A	H
				18	N/R	N/A		
49-54 in.	16	JTR	(2) H	20	JTR	(2) H	MPT	I
55-60 in.	Not Designed			20	JTR	(2) H	2 MPT	I
61-72 in.				18	JTR	(2) H	2 MPT	J
73-84 in.				16	JTR	(2) I	2 MPT	K
85-96 in.				16	JTR	(2) K	N/A	L
97-108 in.				16	JTR	(2) K		L
109-120 in.				16	JTR	(2) K		L

Table 2-26 6 ft Coil/Sheet Stock/T25a/T25b (TDC/TDF) Duct Reinforcement

N/R – Not Required

JTR – Joint Tie Rod

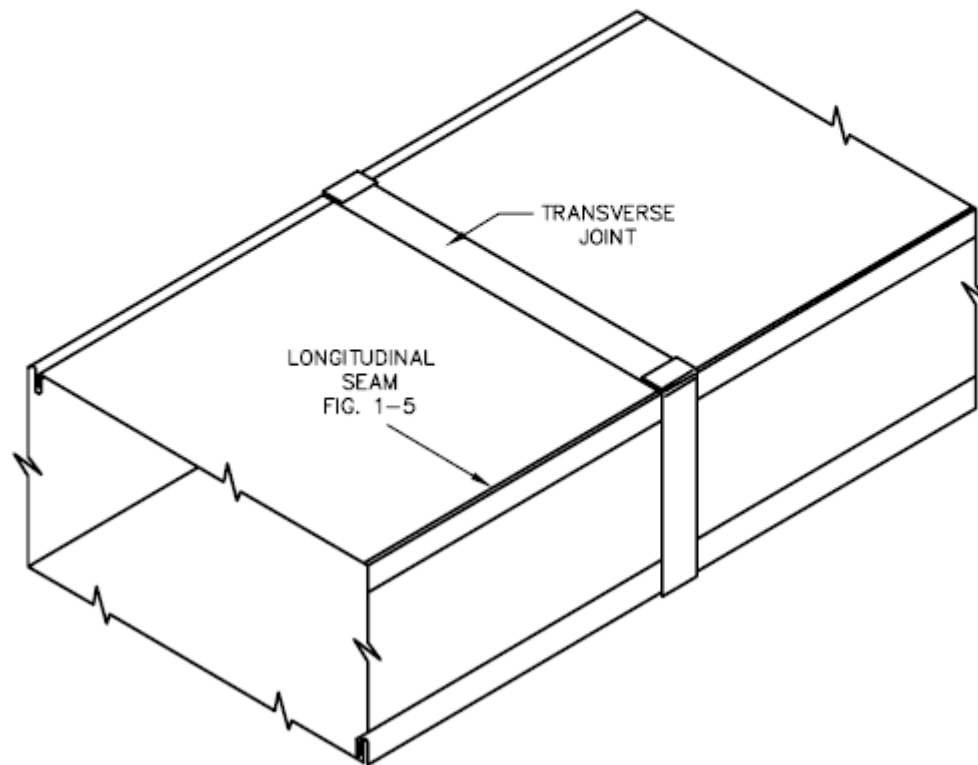
N/A – Not Applicable

MPT – Mid Panel Tie Rod (s)

	RS	16 ga	18 ga	20 ga	22 ga	24 ga	26 ga
$\pm\frac{1}{2}$ in. wg	3 ft				To 96(1)	To 84(1)	To 60(1)
	2 $\frac{1}{2}$ ft				To 96(1)	To 84(1)	To 60(1)
	2 ft				To 96(1)	To 84(1)	To 60(1)
± 1 in. wg	3 ft		To 96(1)*	To 84(1)* 85-96(2)	To 72(1)* 73-84(2)	To 60(1) 61-72(2)	To 48(1)
	2 $\frac{1}{2}$ in.		To 96(1)*	To 84(1)* 85-96(2)	To 72(1)* 73-84(2)	To 60(1) 61-72(2)	To 48(1)
	2 ft		To 96(1)*	To 84(1)* 85-96(2)	To 72(1) 73-96(2)	To 72(1)	To 48(1)
± 2 in. wg	3 ft		To 84(1)* To 96(2)	To 60(1)* 61-84(2)	To 48(1)* 49-72(2)	To 42(1) 43-54(2)	To 36(1)
	2 $\frac{1}{2}$ ft		To 84(1)* 85-96(2)	To 72(1)* 73-96(2)	To 60(1)* 61-84(2)	To 54(1) 55-60(2)	To 42(1)
	2 ft		To 96(1)*	To 72(1)* 73-96(2)	To 60(1) 61-96(2)	To 60(1) 61-72(2)	To 42(1)
± 3 in. wg	3 ft		To 72(1)* 73-84(2)	To 54(1)* 55-72(2)	To 48(1) 49-54(2)		To 30(1)
	2 $\frac{1}{2}$ ft		To 72(1)* To 96(2)	To 60(1)* 61-84(2)	To 54(1)* 55-72(2)	To 42(1) 43-54(2)	To 36(1)
	2 ft		To 84(1)* 85-96(2)	To 72(1)* 73-96(2)	To 60(1)* 61-84(2)	To 54(1) 55-72(2)	To 42(1)
± 4 in. wg	3 ft	To 84(2)	To 60(1)* 61-72(2)	To 54(1)* 55-60(2)	To 48(1)	To 36(1)	To 30(1)
	2 $\frac{1}{2}$ ft		To 72(1)* 73-96(2)	To 60(1)* 61-72(2)	To 48(1) 49-60(2)	To 48(1)	To 36(1)
	2 ft		To 84(1)* 85-96(2)	To 60(1)* 61-96(2)	To 60(1) 61-72(2)	To 48(1) 49-60(2)	To 42(1)
± 6 in. wg	3 ft	To 72(2)	To 54(1)* 55-60(2)	To 42(1)	To 36(1)	N/A	N/A
	2 $\frac{1}{2}$ in.	To 96(2)	To 72(1)*	To 54(1) 55-60(2)	To 48(1)	To 36(1)	N/A
	2 ft		To 72(1)* 73-96(2)	To 60(1)* 61-72(2)	To 48(1) 49-60(2)	To 36(1)	N/A

Table 2-41 Midpanel Tie Rod (MPT) Schedule (RS)

SEE TABLES 2-47 AND 2-48.
DUCTS WITH FLAT SLIP CONNECTORS
AND NO REINFORCEMENT
SEE OTHER FIGURES AND TEXT
FOR COMPLETE REQUIREMENTS
AND LIMITATIONS



JOINT OPTIONS

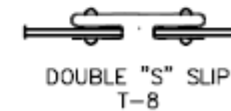
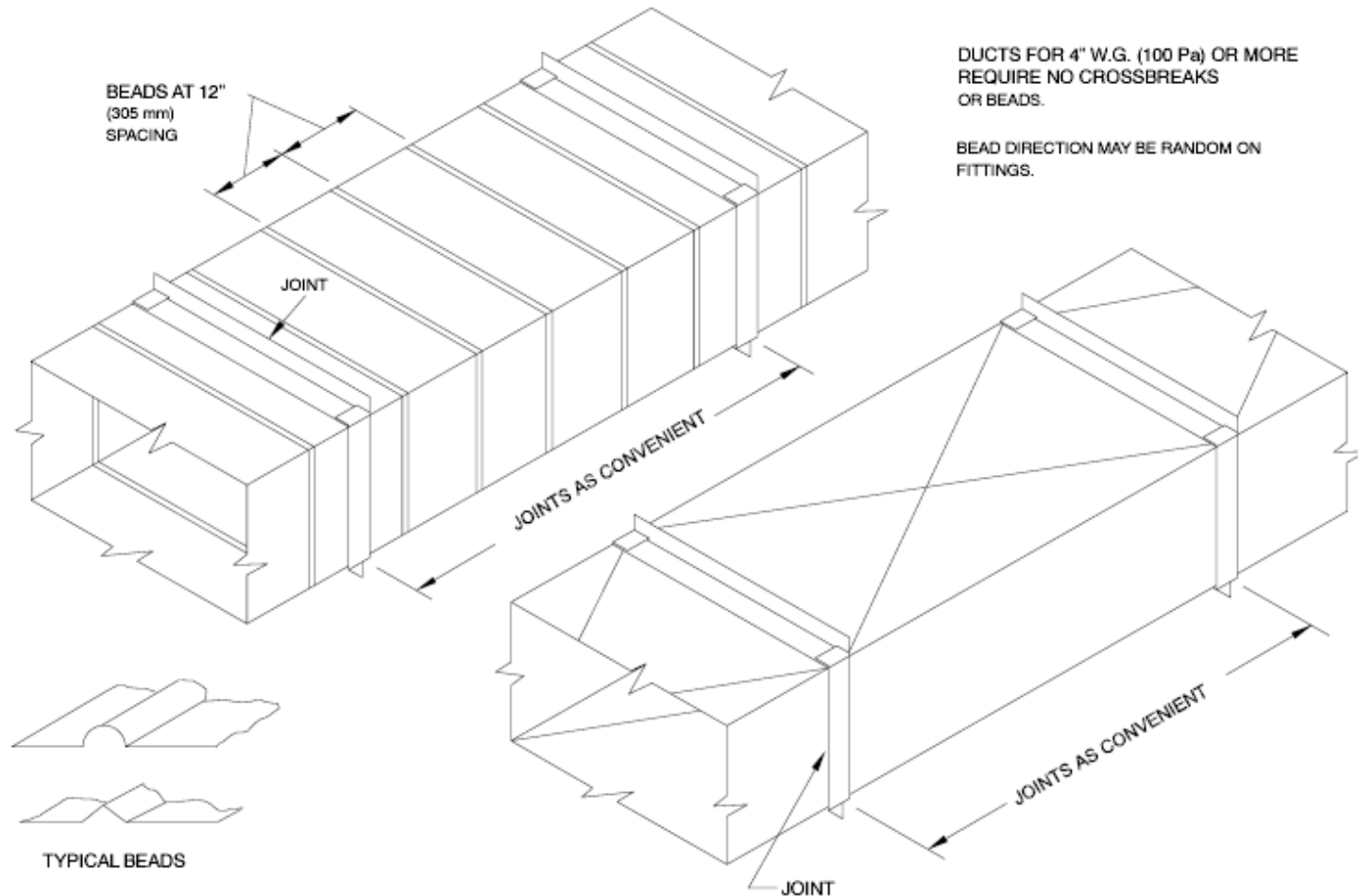


FIGURE 2-8 UNREINFORCED DUCT

DUCT SIZES 19" (483 mm) WIDE AND LARGER WHICH HAVE MORE THAN 10 SQUARE FEET (0.93 SQUARE METER) OF UNBRACED PANEL SHALL BE BEADED OR CROSS BROKEN UNLESS DUCTS WILL HAVE INSULATION COVERING OR ACOUSTICAL LINER. THIS REQUIREMENT IS APPLICABLE TO 20 GAGE (1.00 mm) OR LESS THICKNESS AND 3" W.G. (750 Pa) OR LESS. IT IS UNNECESSARY TO BREAK OR BEAD ALL SIDES UNLESS EACH DUCT DIMENSION REQUIRES IT.



NOTICE: NEITHER BEADS NOR CROSSBREAKS AFFECT REINFORCEMENT SPACING SCHEDULE.

FIGURE 2-9 CROSSBROKEN AND BEADED DUCT

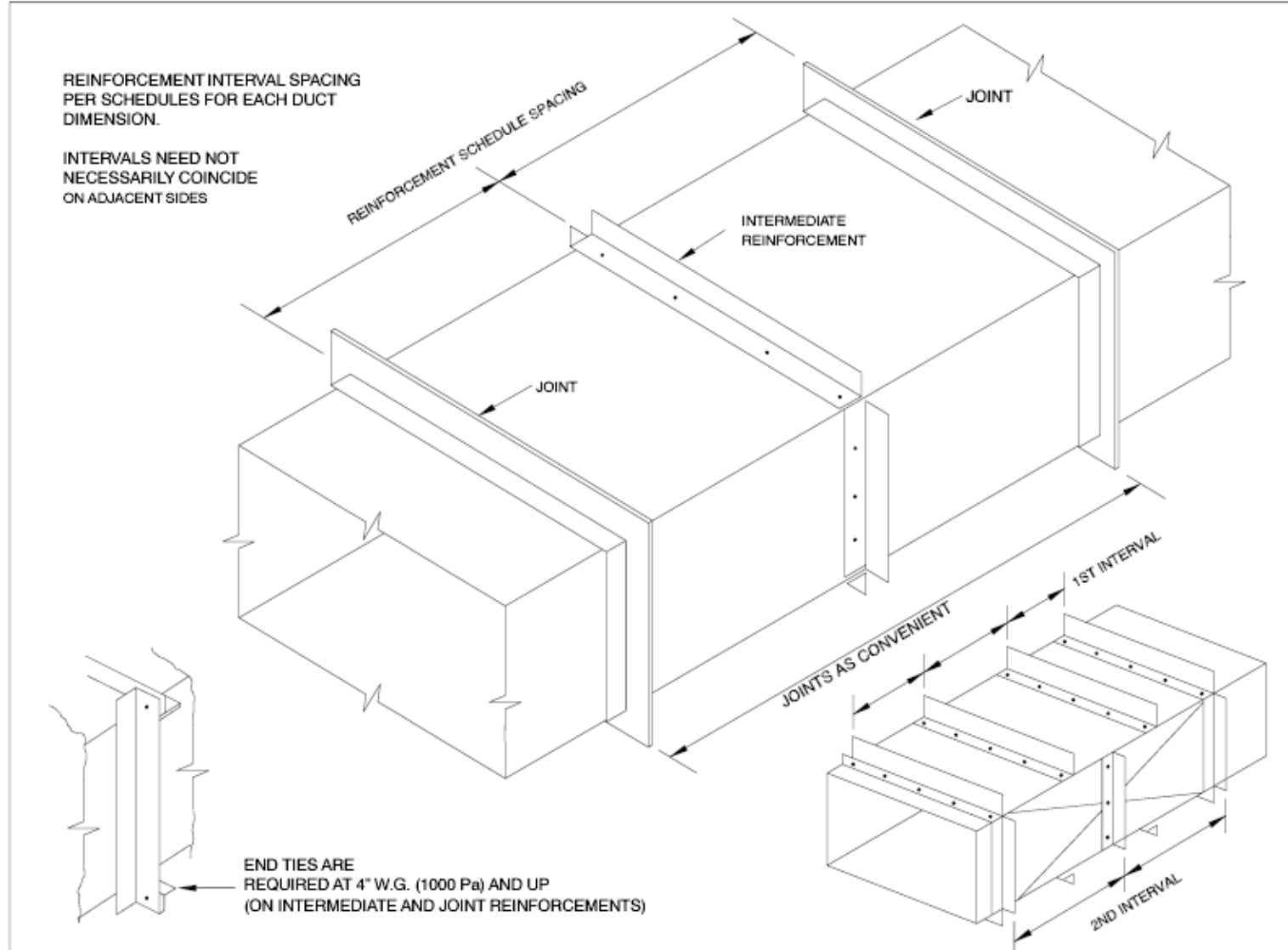
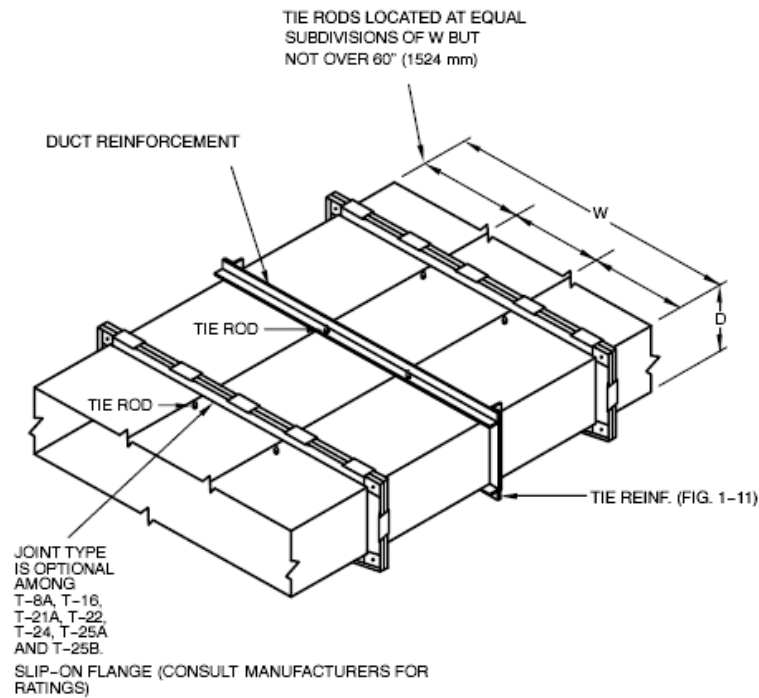


FIGURE 2-11 DUCT REINFORCED ON ALL SIDES



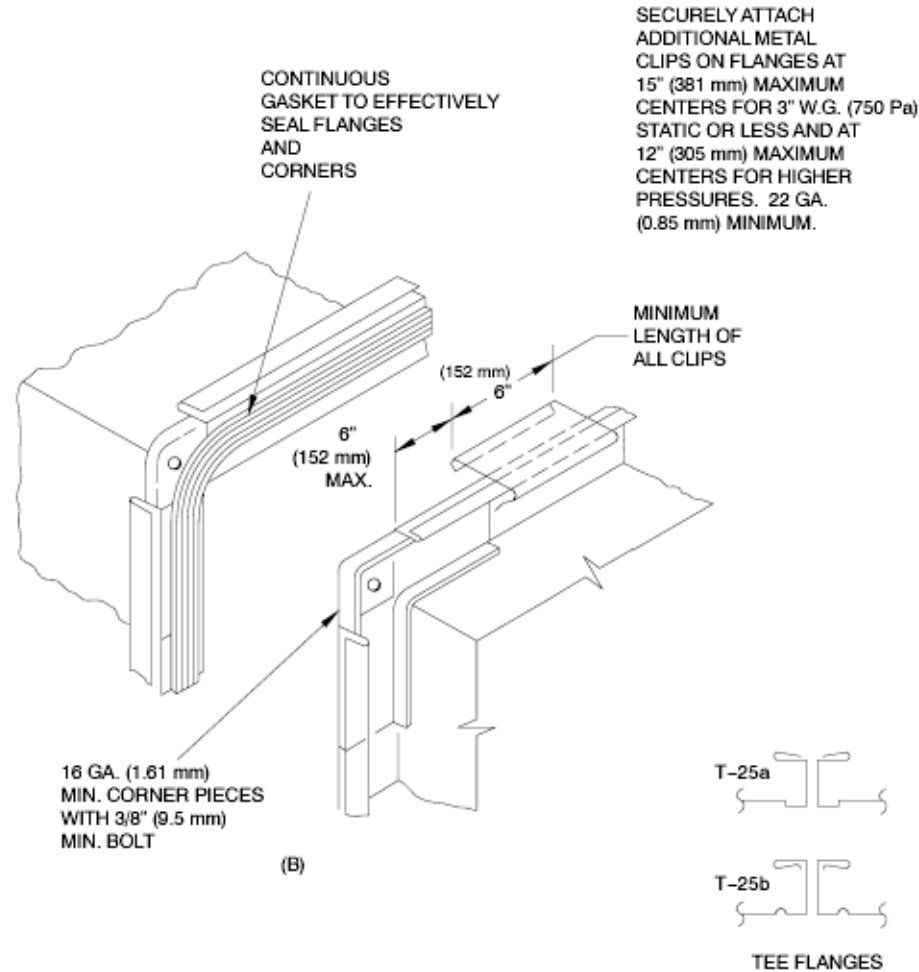
Duct Pressure Class

	½ in.	1 in.	2 in.	3 in.	4 in.	6 in.	10 in.
Panel Ga	18	18	18	18	18	18	16
Reinf. Size	It	It	It	It	Jt	Kt	Lt
Reinf. Spacing (ft)	2 ½ ft	2 ½ ft	2 ½ ft	2 ½ ft	2 ½ ft	2	2
Max. Tie Rod Spacing (ft)	5	5	5	5	5	5	4

Table 2-49 Large (Over 120 in.) Duct Construction

- See tie rod text.
- See Reinforcement Attachment in Figure 2-12.
- See Figure 3-7 for large duct supports. Duct over 100 in. width may require other internal supports for shape retention.

FIGURE 2-13 DUCT OVER 120 IN. (3048 MM) WIDE



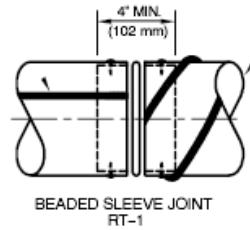
SCREWS MAY BE USED IN LIEU OF METAL CLIPS. INSTALL 1" MAX. FROM END OF CORNER PIECE AND AT 6" MAX. INTERVALS.

EQUIVALENT FIXATION OF JOINTS MAY BE USED. CONTINUOUS CLEATS MAY BE USED.

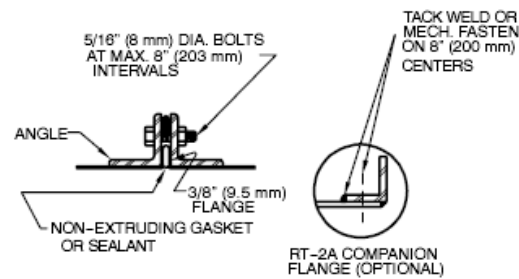
FIGURE 2-17 CORNER CLOSURES – FLANGES

Chapter 3

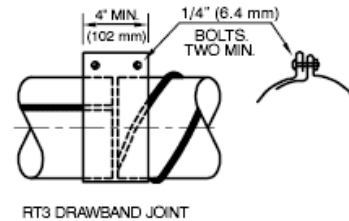
Round, Oval and Flexible Duct



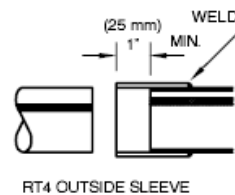
- Longitudinal or Spiral Seam
- Sleeve to be at least the same gage as duct
- Screws must be used at uniform intervals of at least 15 in. along the circumference
- Three screws minimum on 14 in. or less diameter



- Longitudinal or spiral seam
- Minimum Flange Sizes:
- 1 in. $\times$ 1 in. $\times$ 10 ga up to 14 in. Dia.
- 1 1/2 in. $\times$ 1 1/2 in. $\times$ 1/8 in. over 14 in. Dia.

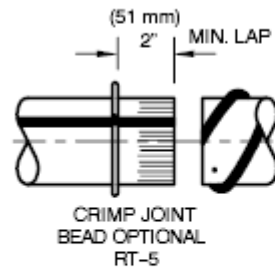


- Longitudinal or spiral seam
- Drawband to be at least same gage as duct

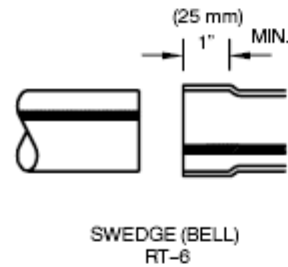


- Longitudinal seam only
- See RT-1 for screw requirements

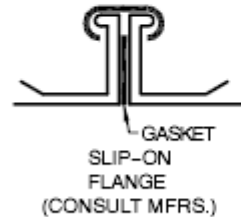
FIGURE 3-1 ROUND DUCT TRANSVERSE JOINTS



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



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



- Consult manufacturers for ratings established by performance documented to functional criteria in Chapter 11.

FIGURE 3-1 ROUND DUCT TRANSVERSE JOINTS (CONTINUED)

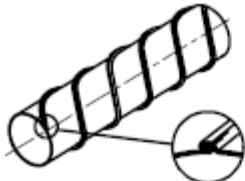
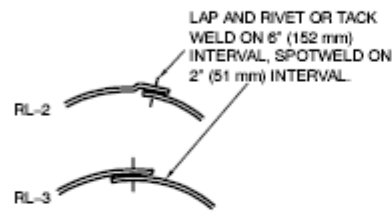
 SPIRAL SEAM RL-1	To ± 10 in. wg
 LAP AND RIVET OR TACK WELD ON 6" (152 mm) INTERVAL, SPOTWELD ON 2" (51 mm) INTERVAL. RL-2 RL-3	- To ± 4 in. wg - Acceptable to 10 in. wg if spot welded on 1 in. intervals or tack welded on 3 in. intervals
 RL-4 BUTT WELD (OR LAP & SEAM WELDED)	To ± 10 in. wg
 RL-5 GROOVED SEAM PIPE LOCK FLAT LOCK	- To ± 10 in. wg - To -3 in. wg
 RL-6A RL-6B RL-7 RL-8 SNAPLOCK SEAMS	- To $+2$ in. wg - To -1 in. wg

FIGURE 3-2 ROUND DUCT LONGITUDINAL SEAMS

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

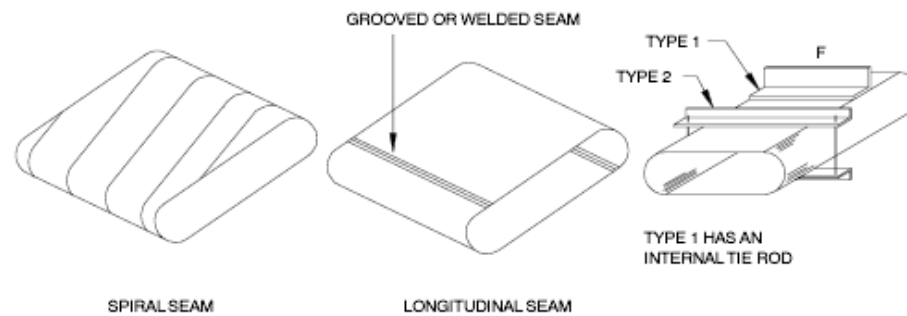
**Table 3-5 Round Duct Gage Unreinforced
Positive Pressure To 10 in. wg**

Neg. Pressure 2 in. wg	Stiffener Spacing											
	Unstiff.		20 ft		12 ft		10 ft		6 ft		5 ft	
Diameter, in.	GA	R	GA	R	GA	R	GA	R	GA	R	GA	R
4	28	NR	28	A	28	A	28	A	28	A	28	A
6	28	NR	28	A	28	A	28	A	28	A	28	A
8	28	NR	28	A	28	A	28	A	28	A	28	A
10	28	NR	28	A	28	A	28	A	28	A	28	A
12	26	NR	28	A	28	A	28	A	28	A	28	A
14	24	NR	28	A	28	A	28	A	28	A	28	A
16	24	NR	26	A	28	A	28	A	28	A	28	A
18	22	NR	26	A	28	A	28	A	28	A	28	A
20	22	NR	24	A	28	A	28	A	28	A	28	A
22	22	NR	24	A	26	A	28	A	28	A	28	A
24	20	NR	24	A	26	A	26	A	28	A	28	A
30	18	NR	22	A	24	A	26	A	28	A	28	A
36	16	NR	22	A	24	A	24	A	26	A	28	A
42	16	NR	22	A	22	A	24	A	26	A	26	A
48	N/A	NR	20	B	22	A	22	A	24	A	26	A
54	N/A	NR	20	B	22	B	22	A	24	A	24	A
60	N/A	NR	20	B	22	B	22	B	24	A	24	A
66	N/A	NR	18	C	20	B	22	B	24	B	24	A
72	N/A	NR	18	C	20	B	20	B	22	B	24	B
78	N/A	NR	18	D	20	C	20	C	22	B	22	B
84	N/A	NR	18	E	20	C	20	C	22	B	22	B
90	N/A	NR	18	E	18	D	20	C	22	B	22	B
96	N/A	NR	18	E	18	E	20	D	22	C	22	B

**Table 3-6 Min. Required Gage for Longitudinal Seam Duct
Under Neg. Pressure**

NOTES:

- a. N/A – Not Applicable
- b. NR – Not Required
- c. R – Reinforcement (stiffener) Class



JOINTS AND CONNECTIONS ARE SIMILAR TO ROUND DUCT SIZE
REINFORCEMENTS AS FOR RECTANGULAR DUCT OF F DIMENSION ATTACH
REINFORCEMENT TO DUCT AT ENDS AND 12" (305 MM) MAX. SPACING

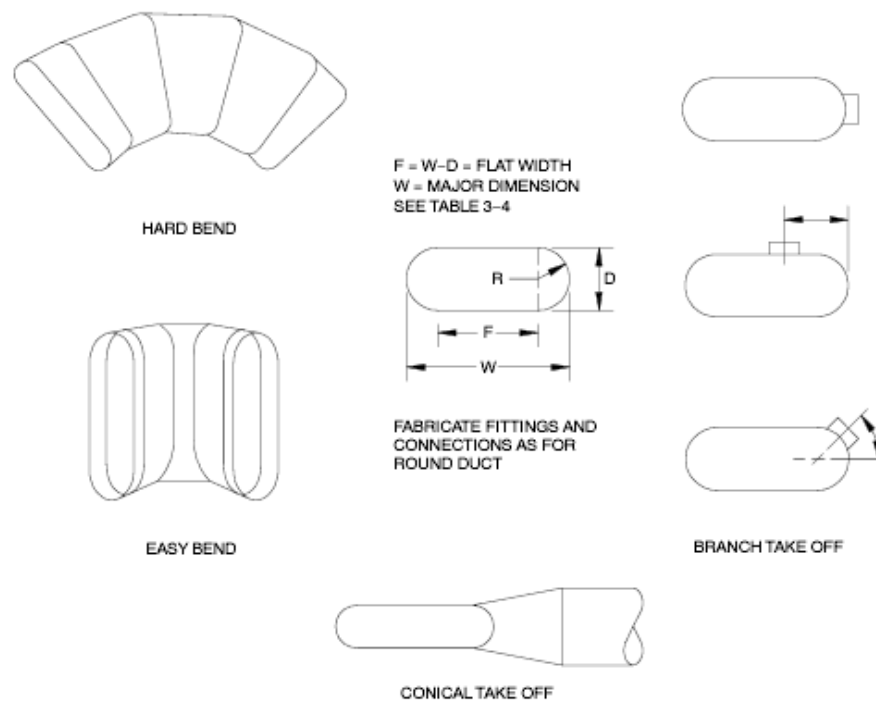


FIGURE 3-7 FLAT OVAL DUCTS

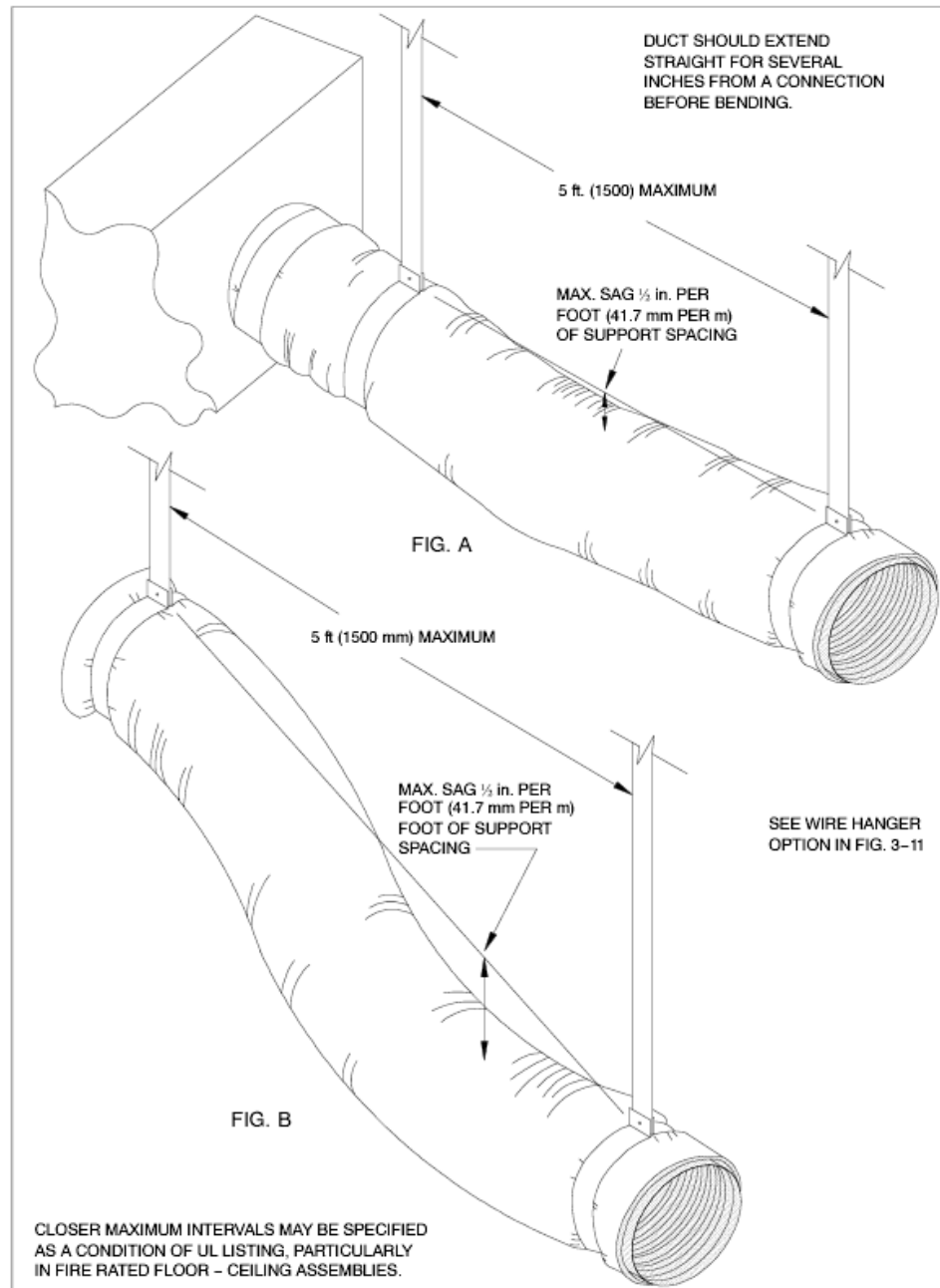
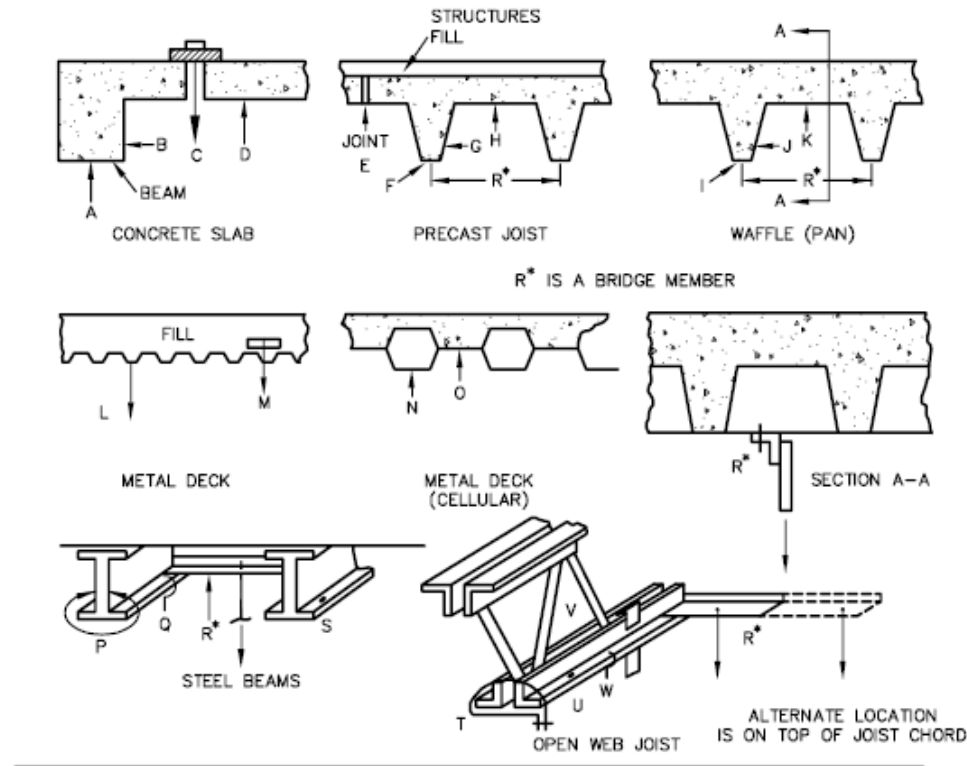


FIGURE 3-10 FLEXIBLE DUCT SUPPORTS

Chapter 5

Hangers and Supports

ALPHABET LETTER ONLY INDICATES AN ALTERNATIVE LOCATION OR SITUATION THAT MAY BE PERMITTED OR RESTRICTED BY DESIGN DOCUMENTS. ILLUSTRATIONS OF CONCRETE AND STEEL DO NOT PRECLUDE ATTACHMENTS TO WOOD.



CONVENTIONAL HANGER METHODS AND DEVICES

CONCRETE INSERTS, SINGLE
CONCRETE INSERTS, SLOTTED
POWDER ACTUATED FASTENERS
"C" CLAMPS
WELDED STUDS
FRICTION CLAMPS
STRAP
ROD, THREADED, UNTHREADED
BRIDGE
BEAM CLAMP, HALF FLANGE
BEAM CLAMP, FULL FLANGE
EYE BOLT (OR ROD)
TOGGLE BOLTS

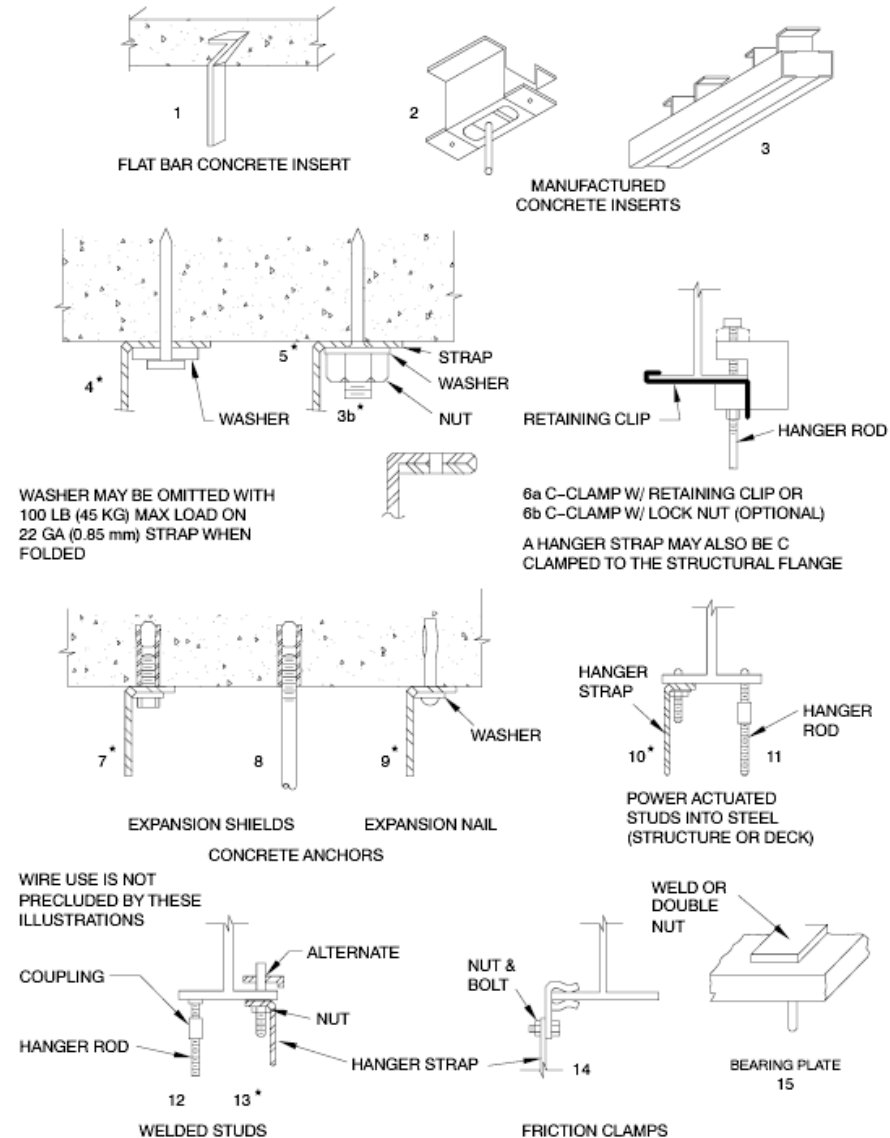
DRILLED HOLE AND BOLT
STANCHION
SELF TAPPING SCREWS PLUS STRAPS
DROP IN EXPANSION ANCHORS
KNEE BRACKET FROM WALL
LAG SCREW EXPANSION ANCHOR
NAILED PIN FASTENERS
RIVETS
SWAY BRACING
"FISH" PLATE OR WASHER AND ROD
HOOK OR LOOP
VIBRATION ISOLATOR
WIRE

SELECT HANGERS FOR TYPE OF STRUCTURE AND SUSPENSION.
DO NOT EXCEED ALLOWABLE OR SPECIFIED LOAD LIMITS.

ALLOWABLE LOAD ON UPPER ATTACHMENT IS 1/4 OF FAILURE LOAD

FIGURE 5-1 HANGER ATTACHMENTS TO STRUCTURES

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



* IMPORTANT! PREVENT BENDING OF
STRAP AT 90° BEND UNDER LOAD.

THE NUMBERS ASSOCIATED WITH THE ART ARE
ONLY FOR CONVENIENT REFERENCE.

FIGURE 5-2 UPPER ATTACHMENT DEVICES - TYPICAL

Maximum Half of Duct Perimeter	Pair at 10 ft Spacing		Pair at 8 ft Spacing		Pair at 5 ft Spacing		Pair at 14 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	3/8"	1" × 20 ga	1/4"	1" × 22 ga	1/4"	1" × 22 ga	1/4"
P/2 = 96"	1" × 16 ga	3/8"	1" × 18 ga	3/8"	1" × 20 ga	3/8"	1" × 22 ga	1/4"
P/2 = 120"	1 1/2" × 16 ga	1/2"	1" × 16 ga	3/8"	1" × 18 ga	3/8"	1" × 20 ga	1/4"
P/2 = 168"	1 1/2" × 16 ga	1/2"	1 1/2" × 16 ga	1/2"	1" × 16 ga	3/8"	1" × 18 ga	3/8"
P/2 = 192"	Not Given	1/2"	1 1/2" × 16 ga	1/2"	1" × 16 ga	3/8"	1" × 16 ga	3/8"
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 1/4" bolt 1" × 16 ga -two 1/4" dia. 1 1/2" × 16 ga -two 3/8" 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. 1 1/2" × 16 ga - 1100 lbs.		0.106" - 80 lbs. 0.135" - 120 lbs. 0.162" - 160 lbs. 1/4" - 270 lbs. 3/8" - 680 lbs. 1/2" - 1250 lbs. 5/8" - 2000 lbs. 3/4" - 3000 lbs.		

Table 5-1 Rectangular Duct Hangers Minimum Size

Dia.	Maximum Spacing	Wire Dia.	Rod	Strap
10 in. dn 250 mm dn	12 ft 3.7 m	One 12 ga One 2.75 mm	$\frac{1}{4}$ in. 6.4 mm	1 in. $\times$ 22 ga 25.4 $\times$ 0.85 mm
11-18 in. 460 mm	12 ft 3.7 m	Two 12 ga or One 8 ga One 4.27 mm	$\frac{1}{4}$ in. 6.4 mm	1 in. $\times$ 22 ga 25.4 $\times$ 0.85 mm
19-24 in. 610 mm	12 ft 3.7 m	Two 10 ga Two 3.51 mm	$\frac{1}{4}$ in. 6.4 mm	1 in. $\times$ 22 ga 25.4 $\times$ 0.85 mm
25-36 in. 900 mm	12 ft 3.7 m	Two 8 ga Two 2.7 mm	$\frac{3}{8}$ in. 9.5 mm	1 in. $\times$ 20 ga 25.4 $\times$ 1.00 mm
37-50 in. 1270 mm	12 ft 3.7 m		Two $\frac{3}{8}$ in. Two 9.5 mm	Two 1 in. $\times$ 20 ga (2) 25.4 $\times$ 1.00 mm
51-60 in. 1520 mm	12 ft 3.7 m		Two $\frac{3}{8}$ in. Two 9.5 mm	Two 1 in. $\times$ 18 ga (2) 25.4 $\times$ 1.31 mm
61-84 in. 2130 mm	12 ft 3.7 m		Two $\frac{3}{8}$ in. Two 9.5 mm	Two 1 in. $\times$ 16 ga (2) 25.4 $\times$ 1.61 mm
85-96 in. 2400 mm	12 ft 3.7 m		Two $\frac{1}{2}$ in. Two 12 mm	Two $1\frac{1}{2}$ in. $\times$ 16 ga (2) 38 $\times$ 1.61 mm

Table 5-2 Minimum Hanger Sizes for Round Duct

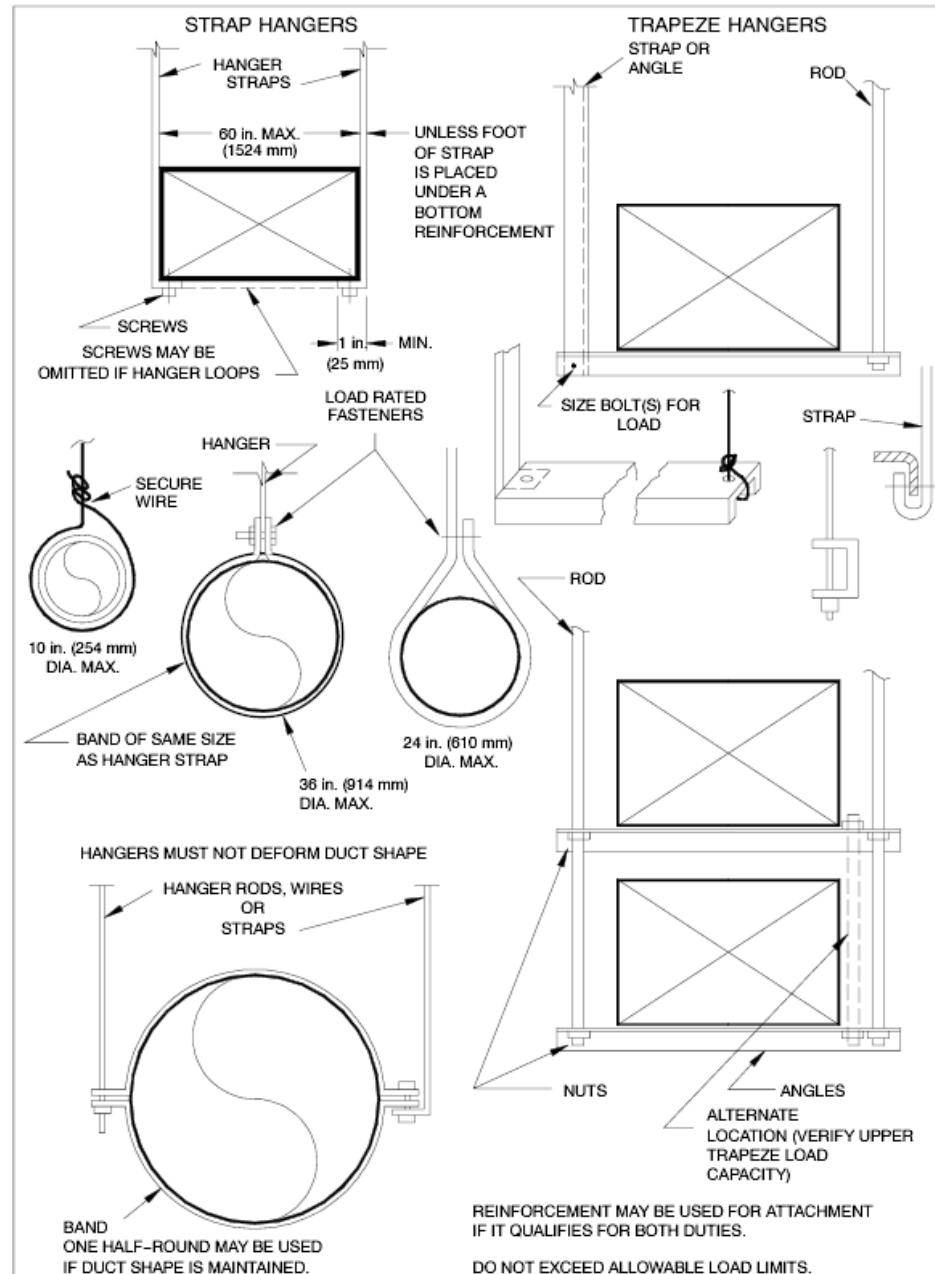


FIGURE 5-5 LOWER HANGER ATTACHMENTS

Trapeze		Angles												Channels			
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Length, in.		1-in. 16 ga	1-in. 1/8-in.	1-1/2-in. 16 ga	1-1/2-in. 1/8-in.	1-1/2-in. 1/4-in.	1-1/2-in. 3/16-in.	2-in. 1/8-in.	2-in. 3/16-in.	2-in. 1/4-in.	2-1/2-in. 3/16-in.	2-1/2-in. 1/4-in.	3-in. 1/4-in.	4-in. 1/4-in.	3-in. 4.1 lb/ft	3-in. 6.0 lb/ft	4-in. 5.4 lb/ft
18		80	150	180	350	510	650	650	940	1230	1500	1960	-	-	-	-	-
24		75	150	180	350	510	650	650	940	1230	1500	1960	-	-	-	-	-
30		70	150	180	350	510	650	650	940	1230	1500	1960	-	-	-	-	-
36		60	130	160	340	500	620	620	920	1200	1480	1940	-	-	-	-	-
42		40	110	140	320	480	610	610	900	1190	1470	1930	-	-	-	-	-
48		-	80	110	290	450	580	580	870	1160	1440	1900	-	-	-	-	-
54		-	-	-	250	400	540	540	840	1120	1400	1860	-	-	-	-	-
60		-	-	-	190	350	490	490	780	1060	1340	1800	-	-	-	-	-
66		-	-	-	100	270	400	400	700	980	1260	1720	-	-	-	-	-
72		-	-	-	-	190	320	320	620	900	1180	1640	-	-	-	-	-
78		-	-	-	-	-	210	210	500	790	1070	1530	-	-	-	-	-
84		-	-	-	-	-	-	-	380	660	940	1400	2310	4680	4650	5980	9080
96		-	-	-	-	-	-	-	-	320	600	1060	1970	4340	3870	4950	8740
108		-	-	-	-	-	-	-	-	-	-	-	2510	7240	5760	7780	15650
120		-	-	-	-	-	-	-	-	-	-	-	1220	5950	4120	5930	13200
132		-	-	-	-	-	-	-	-	-	-	-	-	4350	2540	3920	10820
144		-	-	-	-	-	-	-	-	-	-	-	-	2420	-	2000	8330
Section Properties	I _x	0.012	0.022	0.041	0.078	0.110	0.139	0.190	0.272	0.348	0.547	0.703	1.240	3.040	1.660	2.070	3.850
	Z	0.016	0.031	0.037	0.072	0.104	0.13	0.130	0.190	0.247	0.303	0.394	0.577	1.050	1.100	1.380	1.930
	A	0.120	0.234	0.180	0.359	0.527	0.688	0.484	0.715	0.938	0.902	1.190	1.440	1.940	1.210	1.760	1.590
	lb/ft	0.440	0.800	0.660	1.230	1.800	2.340	1.650	2.440	3.190	3.070	4.100	4.900	6.600	4.100	6.000	5.400

Table 5-3 Allowable Loads in Pounds for Trapeze Bars

Chapter 8

Double-Wall Duct Construction

FOR DUCTS UPTO 24" (610MM) X 24" (610 MM)

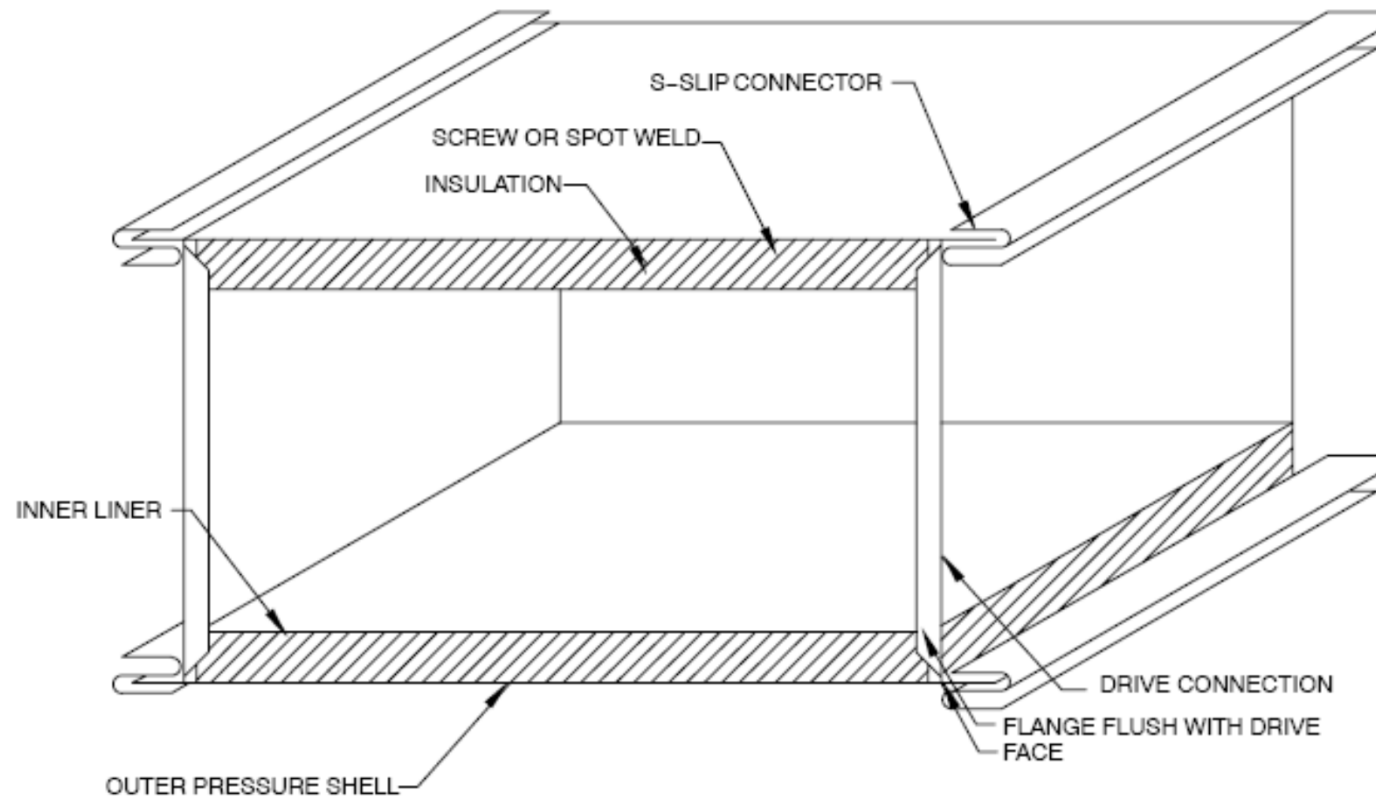
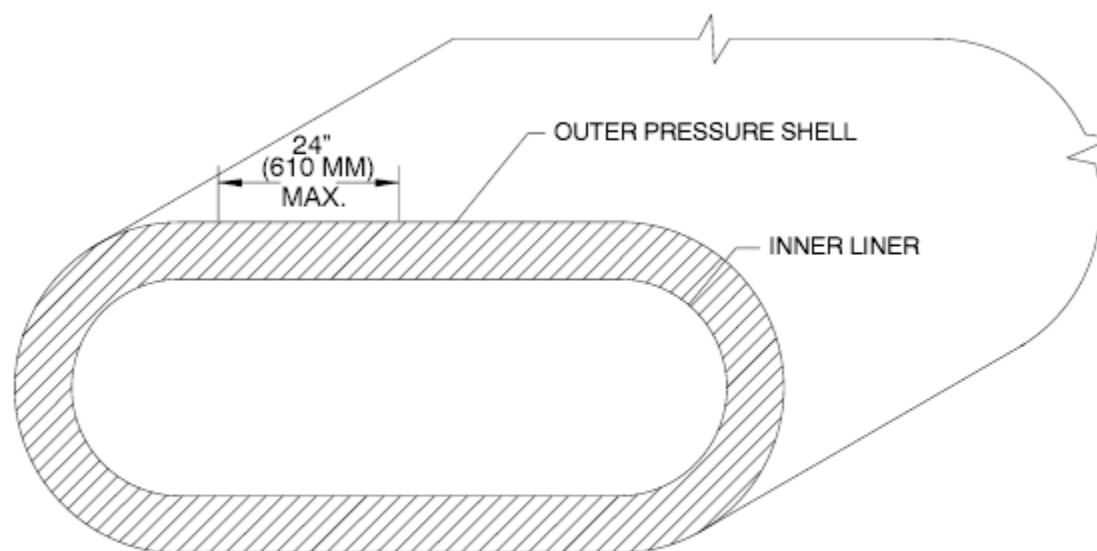


FIGURE 8-3 RECTANGULAR DOUBLE-WALL DUCT



F=W-D=FLAT WIDTH
W=MAJOR DIMENSION

FIGURE 8-4 FLAT OVAL DOUBLE-WALL DUCT

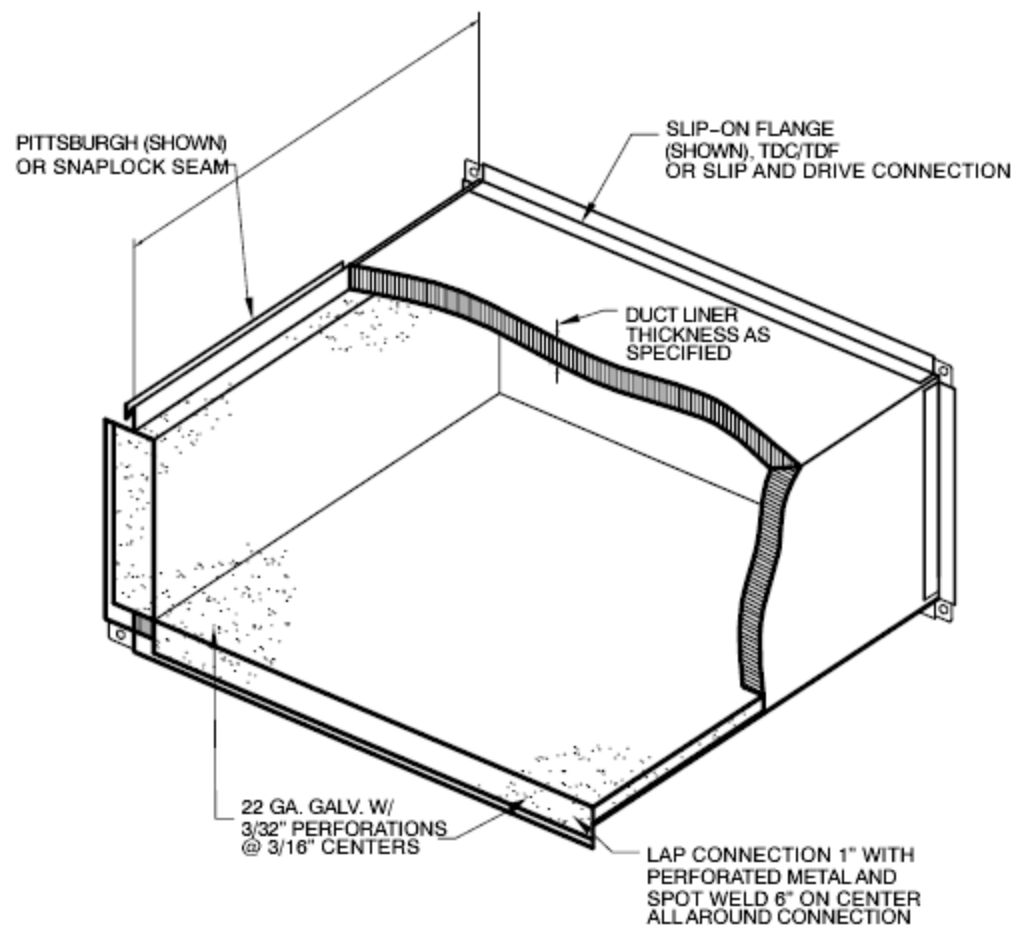
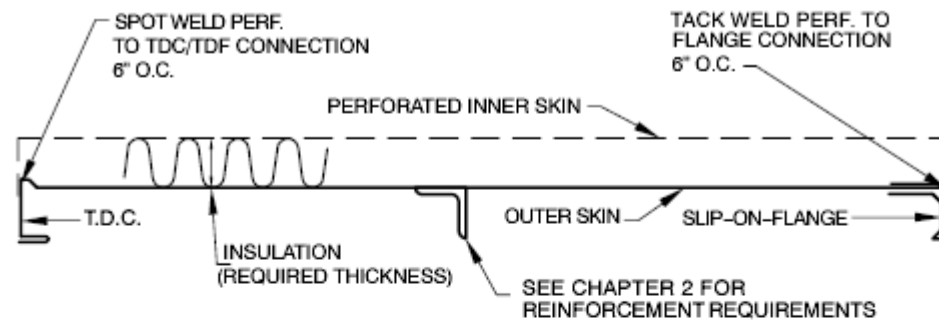


FIGURE 8-13 DOUBLE-WALL DUCT – FLANGE CONNECTION



DUCTS NOT REQUIRING TIE RODS

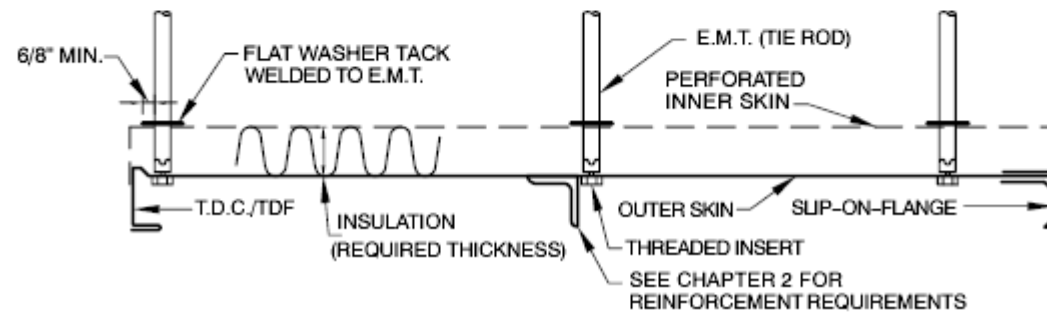


FIGURE 8-14 DOUBLE-WALL DUCT DETAILS

Chapter 10

Specialty Systems

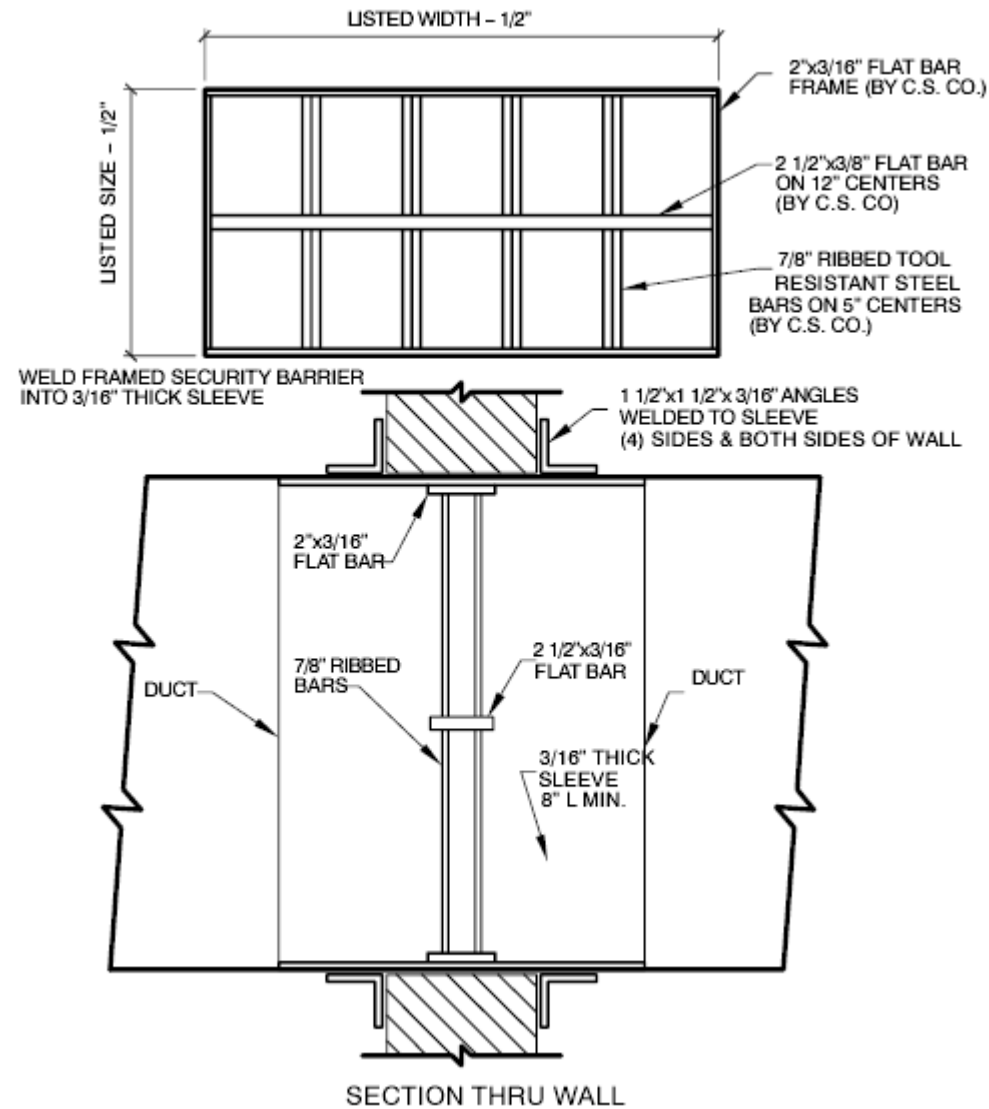


FIGURE 10-5 SECURITY DUCT BARRIER DETAIL

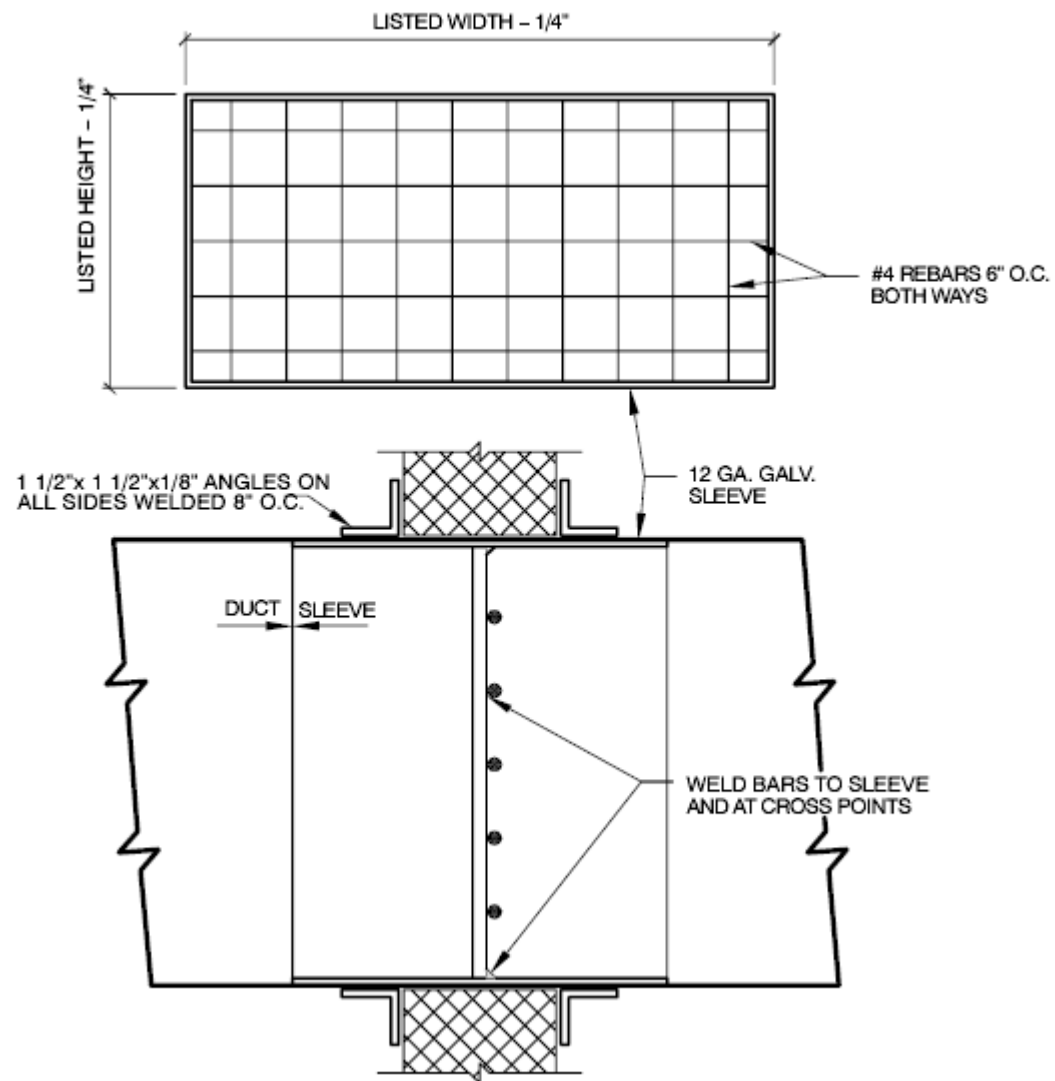


FIGURE 10-6 ALTERNATIVE SECURITY BARRIER DETAIL

Questions???

Comments???

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