



**Zen Industries, Inc. is a fabricator
of
HVAC ductwork and fittings
for
Commercial, Industrial, and Institutional
HVAC Projects**

Bringing Six Sigma & Lean Manufacturing to HVAC Products and Custom Manufacturing.

3rd Edition 2005 SMACNA STANDARDS

Sales & Estimating: Drew McCaffrey • Drew.McCaffrey@ZENIndustries.com • 877-600-0274 • Fax: 877-826-7952
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ZEN Industries, Inc. • 2340 East 69th Street, Unit #2 • P.O. Box 604394 • Cleveland, OH 44104



Table of Contents Submittals

Rectangular Ducts and Fittings Overview	Page 01
TDF - 1" W.G.	Page 02
TDF - 2" W.G.	Page 03
S&D - 1" W.G.	Page 04
S&D - 2" W.G.	Page 05
TDF - 3" W.G.	Page 06
TDF - 4" W.G.	Page 07
TDF - 6" W.G.	Page 08
TDF - 10" W.G.	Page 09
Standard NE-OHIO	Page 10
Standard Duct Sealing Requirements	Page 11
Un-reinforced Duct	Page 11
Seams and Connectors	Page 12
Tie Rods	Page 13
Liner Installation	Page 14
Liner Fasteners	Page 15
Duct Liner Interruption	Page 16
Optional Hat Section	Page 17
Rectangular Vanes	Page 18
Rectangular Duct & Fittings TDF Connection	Page 19
Rectangular Duct & Fittings Straight Duct	Page 19



Rectangular Duct & Fittings

304L Stainless Steel = ASTM-A-240

316L Stainless Steel = ASTM-A-240

Aluminum 3003H14 = ASTM-B-209

Galvanized Metal =ASTM-A653-96

Reference SMACNA tables 1" - 10" W.G. for construction standards and reinforcement schedule

ZEN Industries Inc. Rectangular Duct & Fittings are fabricated from galvanized steel in accordance with 3rd Edition 2005 SMACNA Duct Construction Standards

Zen Industries Standards based on 3rd Edition 2005 SMACNA standards:

Galvanized sheets	26 & 24 ga	G-60 LFQ	22 to 18ga	G-90 LFQ
All duct 12" and above will be beaded				
1/2"wg. to 2"wg	snaplock seam	(pittsburg available at an additional cost)		
3"wg up to 48"wide	snaplock seam	(duct over 48" wide-pittsburg)		
4"wg to 10"wg	pittsburg seam			(assembly available at an additional cost)
Fittings - assembled	straight duct - unassembled			
Duct sections width + height	up to 18"	wrapped		
	up to 70"	"L" shaped		
	71" & up	4 pc.		
FS/D = flat slip(24ga) & drive(24ga)	ST-S/D = standing slip(22ga) & drive			TDF =T-25b roll formed flange
MPT= midpoint tie-rod	JTR= joint tie-rods (both ends)			
2x2x1/8" angle =	midpoint reinforcement in lieu of tie-rods			
Duct liner available 1/2" or 1" 1.5" or 2" in stock				

ZEN Industries shop standards for rectangular duct

BASED ON 3rd Edition 2005 SMACNA STANDARDS

TDF - 1" W.G.

MAX. WIDTH	CONNECTOR	DUCT LENGTHS				
		60"	48"	36"	30"	24"
10" - DOWN	FS/D	26	26	26	26	26
11 - 12"	FS/D	26	26	26	26	26
13 - 14"	FS/D	26	26	26	26	26
15 - 16"	FS/D	26	26	26	26	26
17 - 18"	TDF	26	26	26	26	26
19 - 20"	TDF	26	26	26	26	26
21 - 22"	TDF	26	26	26	26	26
23 - 24"	TDF	26	26	26	26	26
25 - 26"	TDF	26	26	26	26	26
27 - 28"	TDF	26	26	26	26	26
29 - 30"	TDF	26	26	26	26	26
31 - 36"	TDF	26	26	26	26	26
37 - 42"	TDF	24	24	26	26	26
43 - 48"	TDF	22	24	24	24	26
49 - 54"	TDF	22	22	24	24	24
55 - 60"	TDF	24 MPT	22	22	24	24
61 - 72"	TDF	22 MPT	22 MPT	22	22	22
		20		20	20	
73 - 84"	TDF	MPT/JTR	20 MPT	MPT	MPT	22 MPT
				20	20	
85 - 96"	TDF	20 - 2MPT	20 - 2MPT	MPT	MPT	22 MPT
97 - 108"	WARD "J"	18 MPT	18 MPT	18	18	18
109 - 120"	WARD "J"	18 MPT	18 MPT	18	18	18

Zen Industries Standards based on the latest SMACNA standards:

galvanized sheets	26 & 24 ga	G-60 LFQ	22 to 18ga	G-90 LFQ
all duct 12" and above will be beaded				
1/2"wg. to 2"w.g	snaplock seam	(pittsburg available at an additional cost)		
3"wg up to 48"wide	snaplock seam	(duct over 48" wide-pittsburg)		
4"wg to 10"wg	pittsburg seam			
fittings - assembled	straight duct - unassembled	(assembly available at an additional cost)		
duct sections width + height	up to 18"	wrapped		
	up to 70"	"L" shaped		
	71" & up	4 pc.		
FS/D = flat slip(24ga) & drive(24ga)	ST-S/D = standing slip(22ga) & drive	TDF =T-25b roll formed flange		
MPT= midpoint tie-rod	JTR= joint tie-rods			
2x2x1/8" angle =	midpoint reinforcement in lieu of tie-rods			
Duct liner available 1/2" or 1"				

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ZEN Industries shop standards for rectangular duct

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TDF - 2" W.G.

DUCT LENGTHS

MAX. WIDTH	CONNECTOR	60"	48"	36"	30"	24"
10" - DOWN	FS/D	26	26	26	26	26
11 - 12"	FS/D	26	26	26	26	26
13 - 14"	ST-S/D	26	26	26	26	26
15 - 16"	ST-S/D	26	26	26	26	26
17 - 18"	TDF	26	26	26	26	26
19 - 20"	TDF	26	26	26	26	26
21 - 22"	TDF	26	26	26	26	26
23 - 24"	TDF	26	26	26	26	26
25 - 26"	TDF	26	26	26	26	26
27 - 28"	TDF	24	24	26	26	26
29 - 30"	TDF	24	24	26	26	26
31 - 36"	TDF	22	24	24	26	26
37 - 42"	TDF	24 MPT	22	24	24	24
43 - 48"	TDF	22 MPT	20	22	22	24
49 - 54"	TDF	22 MPT	22 MPT	20	22	22
55 - 60"	TDF	20 JTR	22 MPT	20	20	22
61 - 72"	TDF	20 MPT/JTR	20 JTR	20 MPT	22 JTR	22 JTR
73 - 84"	TDF	20 2MPT/JTR	20 JTR	20 MPT	20 JTR	20 JTR
85 - 96"	TDF	20 2MPT/JTR	20 2MPT/JTR	20 JTR	20 JTR	20 JTR
97 - 108"	WARD "J"	18 MPT/JTR	18 MPT/JTR	18 MPT/JTR	18	18
109 - 120"	WARD "J"	18 MPT/JTR	18 MPT/JTR	18 MPT/JTR	18 JTR	18

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galvanized sheets 26 & 24 ga G-60 LFQ 22 to 18ga G-90 LFQ

all duct 12" and above will be beaded

1/2"wg. to 2"w.g snaplock seam (pittsburg available at an additional cost)

3"wg up to 48"wide snaplock seam (duct over 48" wide-pittsburg)

4"wg to 10"wg pittsburg seam

fittings - assembled straight duct - unassembled (assembly available at an additional cost)

duct sections width + height up to 18" wrapped

up to 70" "L" shaped

71" & up 4 pc.

FS/D = flat slip(24ga) & drive(24ga) ST-S/D = standing slip(22ga) & drive

TDF =T-25b roll formed flange

MPT= midpoint tie-rod JTR= joint tie-rods

2x2x1/8" angle = midpoint reinforcement in lieu of tie-rods

Duct liner available 1/2" or 1"

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S&D - 1" W.G.

DUCT LENGTHS

MAX. WIDTH	CONNECTOR	60"	48"	36"	30"	24"
10" - DOWN	FS/D	26	26	26	26	26
11 - 12"	FS/D	26	26	26	26	26
13 - 14"	FS/D	26	26	26	26	26
15 - 16"	FS/D	26	26	26	26	26
17 - 18"	ST-S/D	26	26	26	26	26
19 - 20"	ST-S/D	26	26	26	26	26
21 - 22"	ST-S/D	26	26	26	26	26
23 - 24"	ST-S/D	26	26	26	26	26
25 - 26"	ST-S/D	26	26	26	26	26
27 - 28"	ST-S/D	26	26	26	26	26
29 - 30"	ST-S/D	26	26	26	26	26
31 - 36"	ST-S/D	24	26	26	26	26
37 - 42"	ST-S/D	24	24	26	26	26
43 - 48"	ST-S/D	22	24	24	26	26
49 - 54"	TDF	22	22	24	24	24
55 - 60"	TDF	24 MPT	22	22	24	24
61 - 72"	TDF	22 MPT	22 MPT	22	22	22
		20			20	
73 - 84"	TDF	MPT/JTR	20 MPT	20 MPT	MPT	22 MPT
					20	
85 - 96"	TDF	20 - 2MPT	20 - 2MPT	20 MPT	MPT	22 MPT
97 - 108"	WARD "J"	18 MPT	18 MPT	18	18	18
109 - 120"	WARD "J"	18 MPT	18 MPT	18	18	18

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3"wg up to 48"wide	snaplock seam	(duct over 48" wide-pittsburg)
4"wg to 10"wg	pittsburg seam	
fittings - assembled	straight duct - unassembled	(assembly available at an additional cost)
duct sections width + height	up to 18"	wrapped
	up to 70"	"L" shaped
	71" & up	4 pc.
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2x2x1/8" angle =	midpoint reinforcement in lieu of tie-rods	
Duct liner available 1/2" or 1"		

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10" - DOWN	ST-S/D	26	26	26	26	26
11 - 12"	ST-S/D	26	26	26	26	26
13 - 14"	ST-S/D	24	26	26	26	26
15 - 16"	TDF	24	26	26	26	26
17 - 18"	TDF	24	24	26	26	26
19 - 20"	TDF	24	24	26	26	26
21 - 22"	TDF	24	24	26	26	26
23 - 24"	TDF	24	24	26	26	26
25 - 26"	TDF	24	24	26	26	26
27 - 28"	TDF	22	24	24	26	26
29 - 30"	TDF	22	24	24	24	26
31 - 36"	TDF	20	22	22	24	24
37 - 42"	TDF	22 MPT	24 MPT	22	22	24
43 - 48"	TDF	22 MPT/JTR	22 MPT	20	20	22
49 - 54"	TDF	22 MPT/JTR	20 MPT	20 MPT	20	20
55 - 60"	TDF	20 MPT/JTR	20 MPT	20 MPT	22 JTR	20
61 - 72"	TDF	20 2MPT/JTR	20 MPT/JTR	20 MPT	20 JTR	20 MPT
73 - 84"	TDF	20 2MPT/JTR	20 2MPT/JTR	18 MPT	20 JTR	20 JTR
85 - 96"	TDF	18 2MPT/JTR	20 2MPT/JTR	18 MPT	20 JTR	20 JTR
97 - 108"	WARD "J"	18 MPT/JTR	18 MPT/JTR	18 MPT/JTR	18 JTR	18 JTR
109 - 120"	WARD "J"	18 MPT/JTR	18 MPT/JTR	18 MPT/JTR	18 JTR	18 JTR

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3"wg up to 48"wide	snaplock seam	(duct over 48" wide-pittsburg)	
4"wg to 10"wg	pittsburg seam		
fittings - assembled	straight duct - unassembled	(assembly available at an additional cost)	
duct sections width + height	up to 18"	wrapped	
	up to 70"	"L" shaped	
	71" & up	4 pc.	

FS/D = flat slip(24ga) & drive(24ga)

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MAX. WIDTH	CONNECTOR	DUCT LENGTHS				
		60"	48"	36"	30"	24"
10" - DOWN	ST-S/D	26	26	26	26	26
11 - 12"	ST-S/D	26	26	26	26	26
13 - 14"	TDF	24	26	26	26	26
15 - 16"	TDF	24	26	26	26	26
17 - 18"	TDF	24	24	26	26	26
19 - 20"	TDF	24	24	26	26	26
21 - 22"	TDF	24	24	26	26	26
23 - 24"	TDF	22	24	24	26	26
25 - 26"	TDF	22	22	24	24	26
27 - 28"	TDF	22	22	24	24	26
29 - 30"	TDF	20	22	24	24	24
31 - 36"	TDF	22 MPT	24 MPT	22	24	24
37 - 42"	TDF	20 MPT	22 MPT	20	20	22
43 - 48"	TDF	20 MPT/JTR	20 MPT	20 MPT	20 MPT	20
49 - 54"	TDF	20 MPT/JTR	20 MPT/JTR	20 MPT	20 MPT	20 MPT
55 - 60"	TDF	20 MPT/JTR	20 MPT/JTR	20 MPT	20 MPT	20 MPT
61 - 72"	TDF	20 2MPT/JTR	20 MPT/JTR	18 JTR	18 MPT	20 MPT
73 - 84"	TDF	18 2MPT/JTR	18 MPT/JTR	18 JTR	18 JTR	20 JTR
85 - 96"	TDF	18 2MPT/JTR	18 2MPT/JTR	18 JTR	18 JTR	20 JTR
97 - 108"	WARD "J"	18 MPT/JTR	18 MPT/JTR	18 MPT/JTR	18 JTR	18 JTR
109 - 120"	WARD "J"	18 MPT/JTR	18 MPT/JTR	18 MPT/JTR	18 JTR	18 JTR

Zen Industries Standards based on the latest SMACNA standards:

galvanized sheets	26 & 24 ga	G-60 LFQ	all duct 12" and above will be beaded
1/2"wg. to 2"w.g	snaplock seam	(pittsburg available at an additional cost)	
3"wg up to 48"wide	snaplock seam	(duct over 48" wide-pittsburg)	
4"wg to 10"wg	pittsburg seam		
fittings - assembled	straight duct - unassembled	(assembly available at an additional cost)	
duct sections width + height	up to 18"	wrapped	
	up to 70"	"L" shaped	
	71" & up	4 pc.	
FS/D = flat slip(24ga) & drive(24ga)	ST-S/D = standing slip(22ga) & drive	TDF =T-25b roll formed flange	
MPT= midpoint tie-rod	JTR= joint tie-rods		
2x2x1/8" angle =	midpoint reinforcement in lieu of tie-rods	Duct liner available 1/2" or 1"	

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		60"	48"	36"	30"	24"
10" - DOWN	ST-S/D	24	24	26	26	26
11 - 12"	ST-S/D	24	24	26	26	26
13 - 14"	TDF	22	24	26	26	26
15 - 16"	TDF	22	24	26	26	26
17 - 18"	TDF	22	24	26	26	26
19 - 20"	TDF	22	24	24	26	26
21 - 22"	TDF	22	22	24	24	26
23 - 24"	TDF	22	22	24	24	24
25 - 26"	TDF	20	22	22	24	24
27 - 28"	TDF	22 MPT	20	22	22	24
29 - 30"	TDF	22 MPT	20	22	22	24
31 - 36"	TDF	20 MPT	24 MPT	20 MPT	20	22
37 - 42"	TDF	20 MPT/JTR	22 MPT/JTR	20 MPT	20 MPT	20
43 - 48"	TDF	20 MPT/JTR	20 MPT/JTR	20 MPT	20 MPT	20 MPT
49 - 54"	TDF	20 MPT/JTR	20 MPT/JTR	20 MPT	20 MPT	20 MPT
55 - 60"	TDF	20 MPT/JTR	20 MPT/JTR	18 MPT	20 MPT	20 MPT
61 - 72"	TDF	18 MPT/JTR	18 MPT/JTR	18 MPT	18 MPT	18 MPT
73 - 84"	TDF	18 2MPT/JTR	18 2MPT/JTR	18 MPT	18 MPT	18 MPT
85 - 96"	WARD "J"	16 MPT/JTR	18 MPT/JTR	16 JTR	16 JTR	18 JTR
97 - 108"	WARD "J"	16 2MPT/JTR	18 MPT/JTR	16 JTR	16 JTR	18 JTR
109 - 120"	WARD "J"	16 2MPT/2JTR	16 2MPT/2JTR	2MPT/2JTR	16 JTR	18 JTR

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4"wg to 10"wg pittsburg seam

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TDF - 10" W.G.

MAX. WIDTH	CONNECTOR	DUCT LENGTHS				
		60"	48"	36"	30"	24"
8" - DOWN	ST-S/D	24	26	26	26	26
9 - 10"	ST-S/D	22	24			
11 - 12"	ST-S/D	22	24	26	26	26
13 - 14"	TDF	20	22	24	26	26
15 - 16"	TDF	20	20	24	24	26
17 - 18"	TDF	20	20	24	24	26
19 - 20"	TDF	18	20	22	24	26
21 - 22"	TDF	18	20	22	22	24
23 - 24"	TDF	18	20 JTR	20	22	22
25 - 26"	TDF	18	20 JTR	20	22	22
27 - 28"	TDF	18 JTR	20 JTR	20 JTR	20	22
29 - 30"	TDF	18 JTR	18 JTR	20 JTR	20 JTR	20
31 - 36"	WARD J	20 MPT	18	20	22	22
37 - 42"	WARD J	20 MPT	18	18	20	22
43 - 48"	WARD J	18 MPT	22 JTR	18 JTR	18	22
49 - 54"	WARD J	18 MPT/JTR	20 MPT/JTR	18 JTR	18	20
55 - 60"	WARD J	18 MPT/JTR	20 MPT/JTR	18 JTR	18 JTR	20
61 - 72"	WARD J	18 MPT/JTR	18 MPT/JTR	18 MPT/JTR	16 JTR	18 JTR
73 - 84"	WARD J	16 MPT/JTR	18 MPT/JTR	18 MPT/JTR	16 JTR	18 JTR
85 - 96"	WARD J		16 MPT/JTR	16 MPT/JTR	16 JTR	16 JTR
97 - 108"	WARD J		16 MPT/JTR	16 MPT/JTR	16 JTR	16 JTR
109 - 120"	WARD J		16 2MPT/2JTR	2MPT/2JTR	16 JTR	16 JTR

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4"wg to 10"wg	pittsburg seam			
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STANDARD NE-OHIO

DUCT LENGTHS

MAX. WIDTH	CONNECTOR	60"	48"	36"	30"	24"
10" - DOWN	FS/D	26	26	26	26	26
11 - 12"	FS/D	26	26	26	26	26
13 - 14"	FS/D	24	24	24	24	24
15 - 16"	FS/D	24	24	24	24	24
17 - 18"	FS/D	24	24	24	24	24
19 - 20"	FS/D	24	24	24	24	24
21 - 22"	FS/D	24	24	24	24	24
23 - 24"	ST-S/D	24	24	24	24	24
25 - 26"	ST-S/D	24	24	24	24	24
27 - 28"	ST-S/D	24	24	24	24	24
29 - 30"	ST-S/D	24	24	24	24	24
31 - 35"	ST-S/D	24	24	24	24	24
36 - 42"	ST-S/D	22	22	22	22	22
43 - 48"	ST-S/D	22	22	22	22	22
49 - 54"	ST-S/D	22	22	22	22	22
55 - 60"	ST-S/D	20	20	20	20	20
61 - 72"	ST-S/D	20	20	20	20	20
73 - 84"	ST-S/D	20	20	20	20	20
85 - 96"	ST-S/D	18	18	18	18	18
97 - 108"	ST-S/D	18	18	18	18	18
109 - 120"	ST-S/D	18	18	18	18	18

all snaplock seams

galvanized sheets

all duct 12" and above will be beaded

fittings - assembled

duct sections width + height

26 & 24 ga

G-60 LFQ

22 to 18ga

G-90 LFQ

straight duct - unassembled

(assembly available at an additional cost)

up to 18" wrapped

"L"

up to 70" shaped

71" & up 4 pc.

ST-S/D = standing slip(22ga)
& drive

FS/D = flat slip(24ga) & drive(24ga)

Duct liner available 1/2" or 1"

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Standard Duct Sealing Requirements

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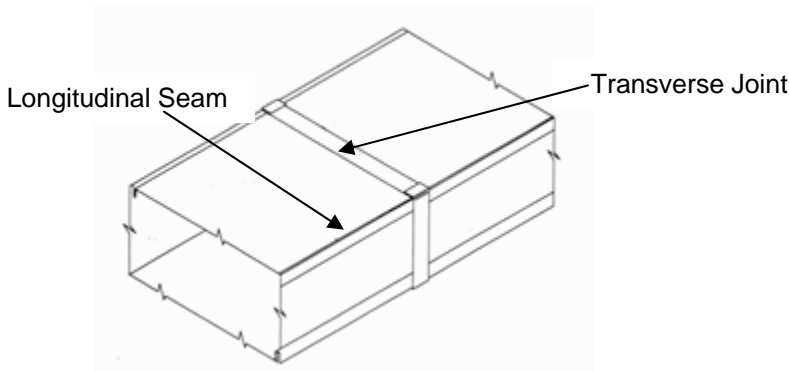
Seal Class	Sealing Requirements	Applicable Static Pressure Construction Class
A	Class A: All Transverse joints, longitudinal seams, and duct wall penetrations.	4" w.g. and up (1000 Pa)
B	Class B: All Transverse joints and longitudinal seams only.	3" w.g. (750 Pa)
C	Class C: Transverse joints only.	2" w.g. (500 Pa)

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

Unreinforced Duct

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Ducts with flat slip connectors and no reinforcement.



Joint Options





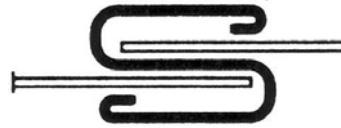
Seams and Connectors

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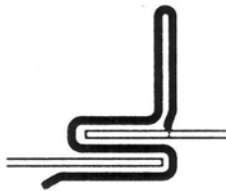
Connector Types



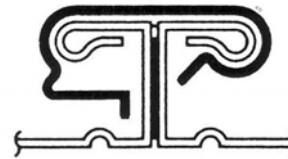
T-1 Drive



T-6 'S' Slip

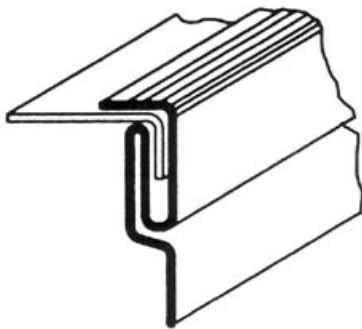


T-11 Standing 'S'

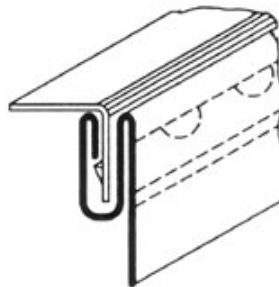


T-25b Flanged (TDF)

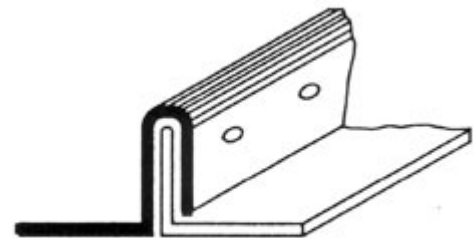
Seam Types



Pittsburgh Lock



Snap Lock

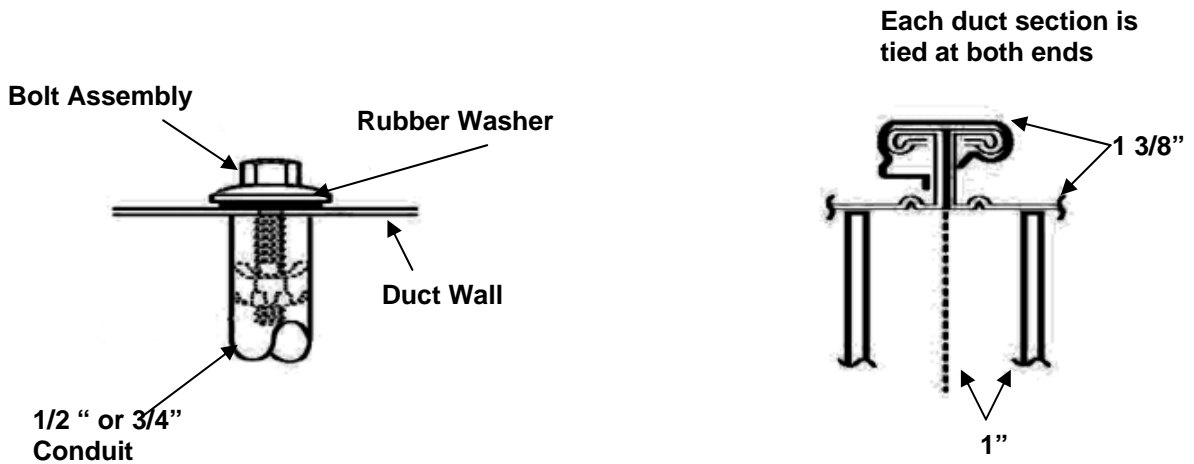
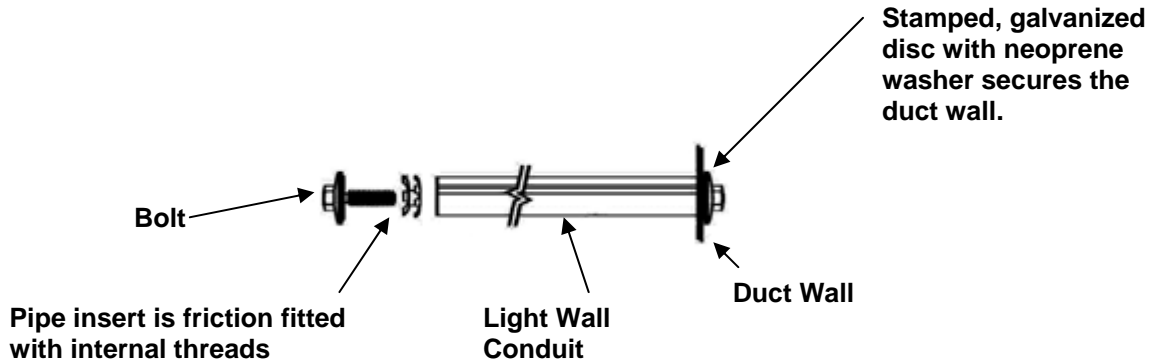


Standing Seam



Tie Rods

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Liner Installation

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1/2" - 2 lb. density liner

1"-1 1/2 lb. density liner

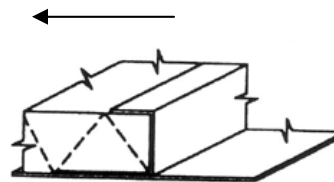
Other thicknesses and densities available upon request.

Notes: 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.

Interior width of 8" (200 mm) and less does not require pins.

The velocity rated side of liner must face the air flow.

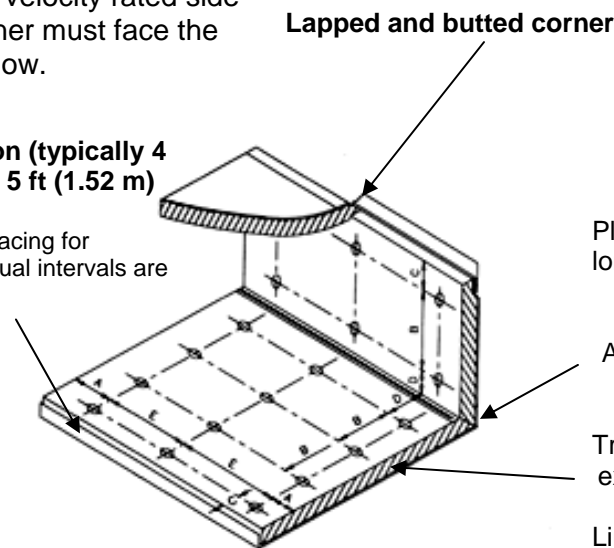
Air Flow



Detail – A
Metal Nosing Channel or Zee

Duct section (typically 4 ft (1.2m) or 5 ft (1.52 m))

Maximum spacing for fasteners actual intervals are approximate.



Place pins 3" (76 mm) along each side of a butted longitudinal liner seam that is away from a corner.

Alternate folded corner

Transverse edges to be coated with adhesive except when nosing is present.

Liner adhered to the duct with 90% min. area coverage of adhesive.

"A" pin row may be omitted when metal nosing is used. "E" then starts from nosing.

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)

*Unless a lower level is set by manufacturer or listing agency.

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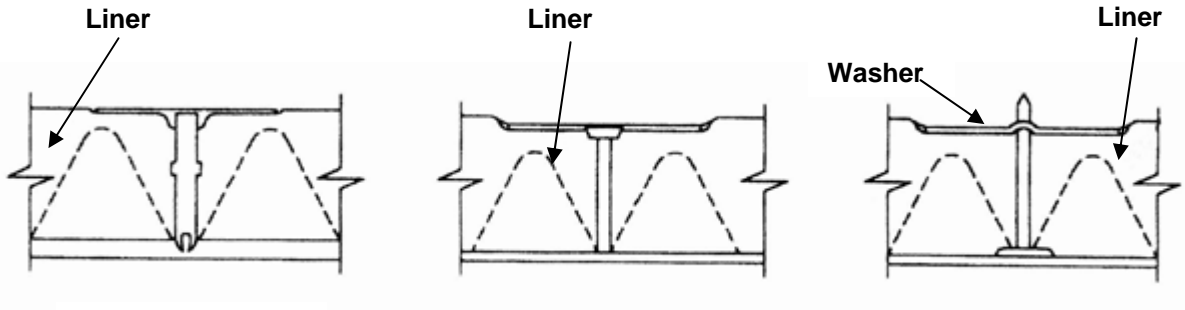
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Liner Fasteners

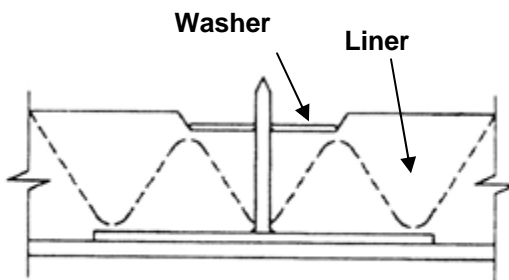
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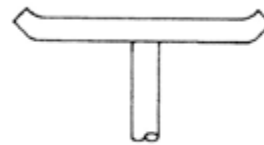
Type 1
Clinched Pin: Integral
Head-Impact Applied

Type 2
Welded Pin
Integral Head

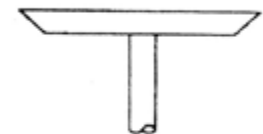
Type 3
Welded Pin
Press-On Head



Type 4
Adhered Pin
Press-On Head



Cupped



Beveled

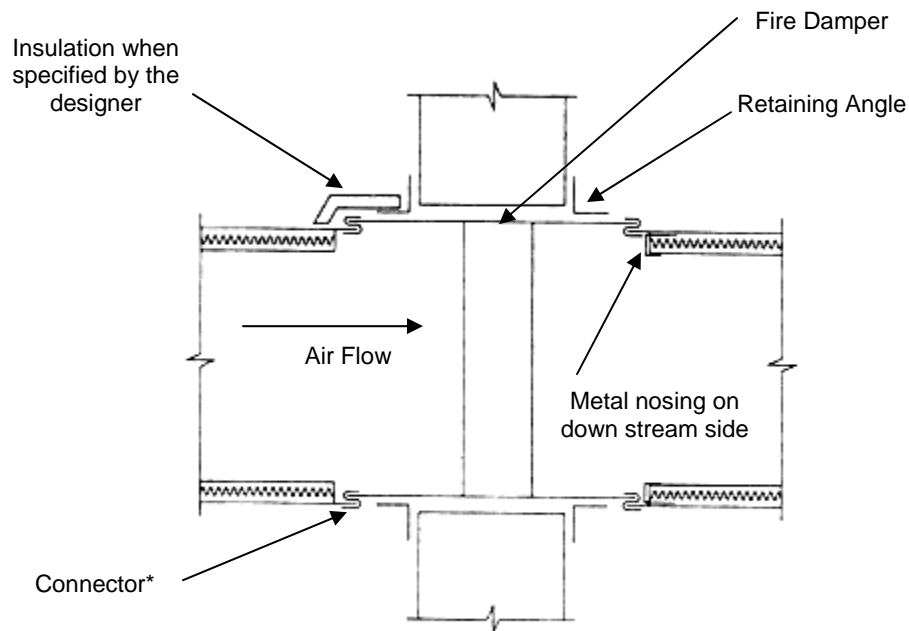
Head Types

Installed pins and washers shall not compress liner more than the correct length specified for the liner thickness used.



Duct Liner Interruption

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Interruption of duct liner at fire damper (to avoid impairing damper operation) is required by NFPA Standard 90A. Where 90A is applicable, installation may be made as shown and should otherwise conform to the Duct Liner Installation Standards.

The designer should consider the possibility and consequences of condensation occurring on unlined or uninsulated metal at penetrations and should specify control measures.

The illustration and text does not address features of fire damper installations unrelated to duct liner

* S Slip illustrated; see type of connections permitted as a condition of damper listing.

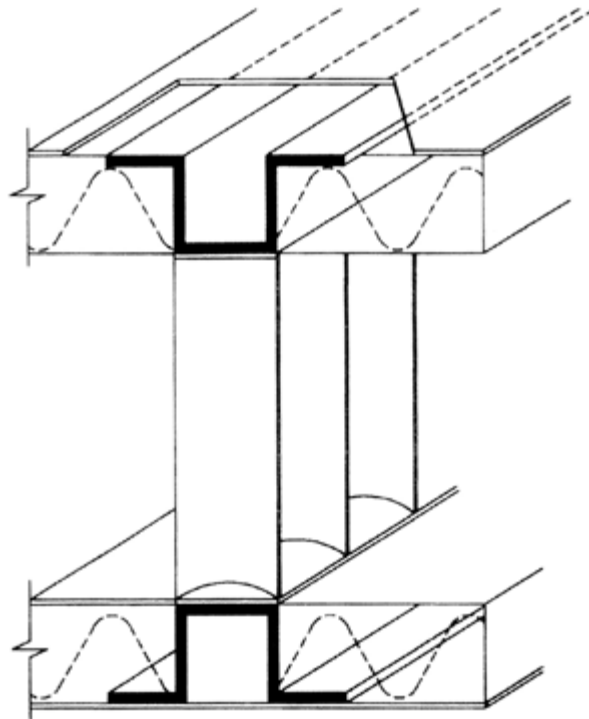
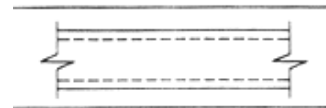


Optional Hat Section

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Standard symbols now reflect the proper designation for showing duct liner on drawings. Duct dimensions designate net free area.

Acoustical Lining Duct Dimensions
for NET Free Area



*HAT section used as insulated “Build Out.” Build Out is attached to duct with sheet metal screws, bolts, or welds.

*usage range 4001 FPM (20.3 mps) – 6000 FPM (30.5 mps)

Vanes and dampers must be insulated in a manner that will not disrupt liner, restrict damper operation, or increase friction loss.

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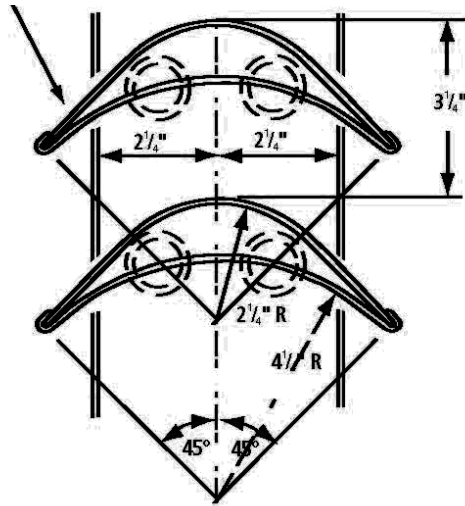


Rectangular Vanes

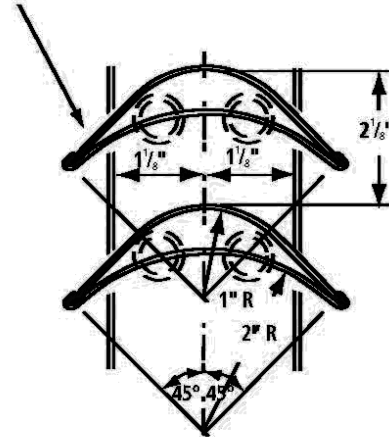
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Dual Wall Vanes

24 ga MIN.



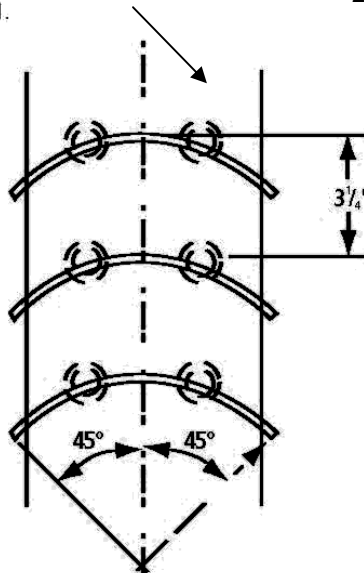
25 ga MIN.



Single Wall Vanes

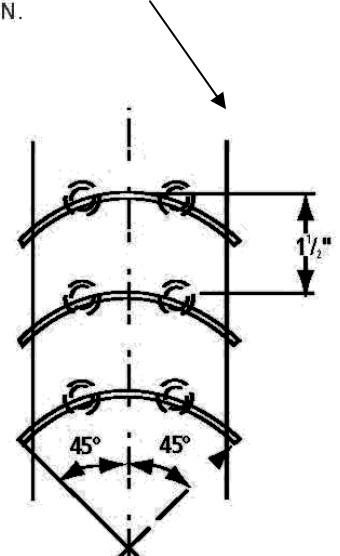
22 ga MIN.

22 ga MIN.



24 ga MIN.

24 ga MIN.

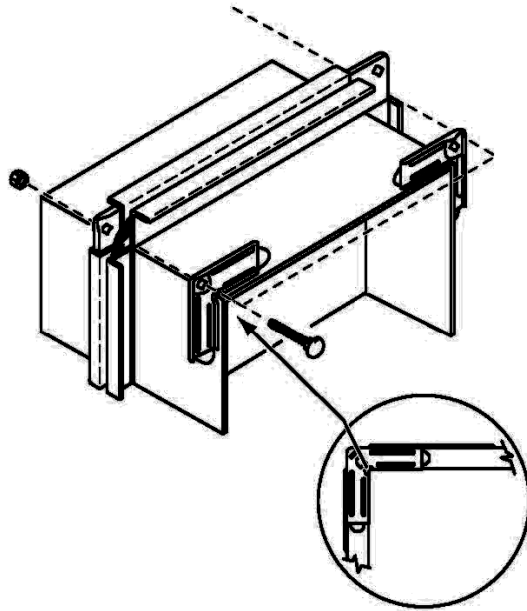




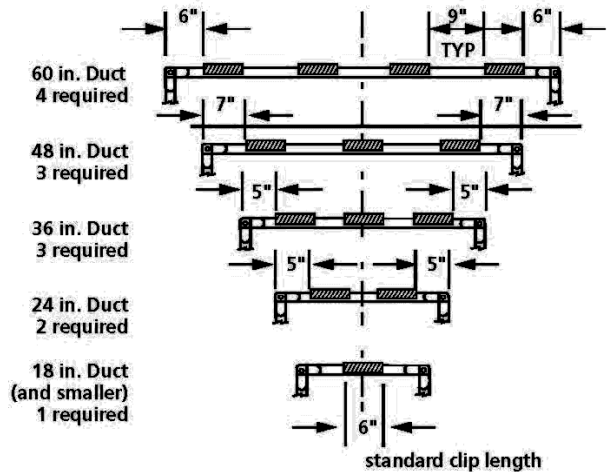
Rectangular Duct & Fittings

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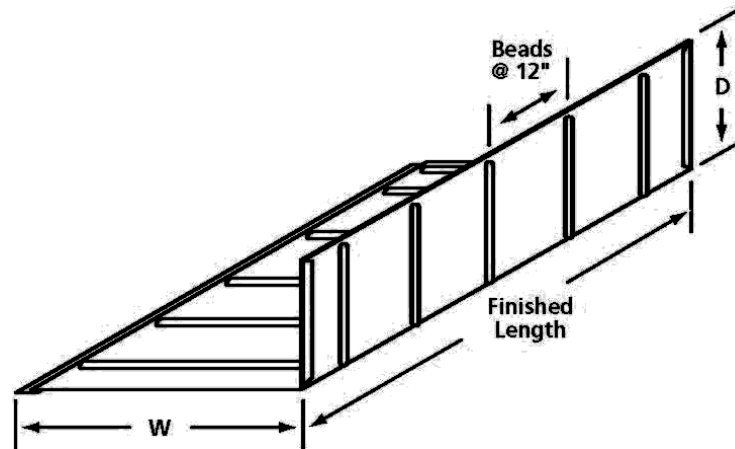
TDF Connection



Recommended Clip Spacing



Straight Duct



56" finished length with TDF 59" finished length with drive cleat edges 60" length with ends unfinished.