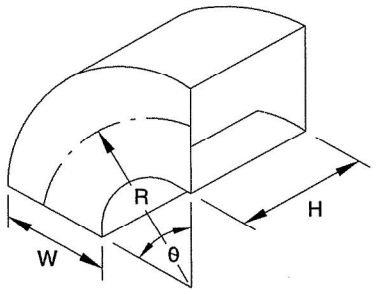
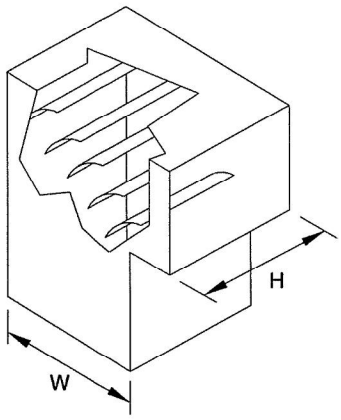
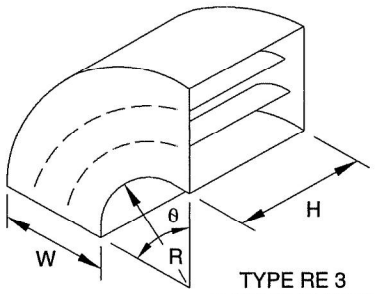


TYPE RE 1
RADIUS ELBOW

CENTERLINE R = $\frac{3W}{2}$ UNLESS OTHERWISE SPECIFIED θ IS NOT RESTRICTED TO 90°.
SQUARE THROAT, $\frac{R}{W}$ = 0.5, MAY BE USED, UP TO 1000 FPM (5 mps).

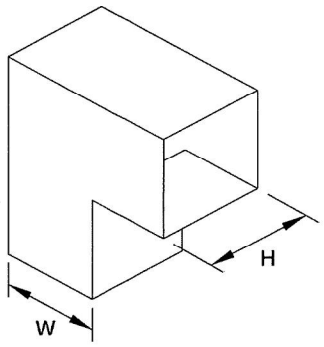


TYPE RE 2
SQUARE THROAT ELBOW
WITH VANES

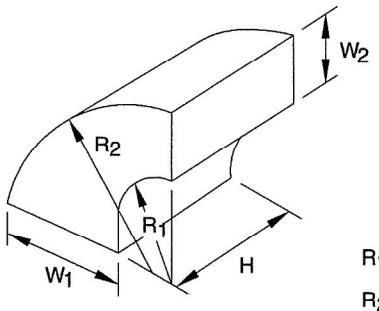


TYPE RE 3
RADIUS ELBOW
WITH VANES

NOTE: FOR RE 3 *SEE* PAGE A.41 AND CURVE RATIOS IN FIG. 5-12 IN THE SMACNA *DUCT DESIGN MANUAL*



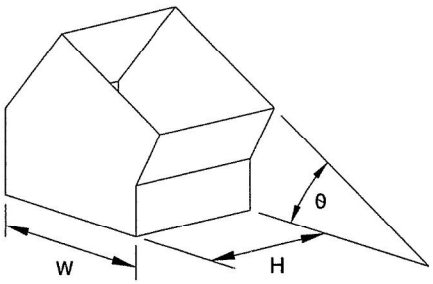
TYPE RE 4
SQUARE THROAT ELBOW
WITHOUT VANES
(1000 FPM (5 mps) MAXIMUM VELOCITY)



$R_1 = 3/4 \quad W_1$

$R_2 = R_1 + W_2$

TYPE RE 5
DUAL RADIUS ELBOW



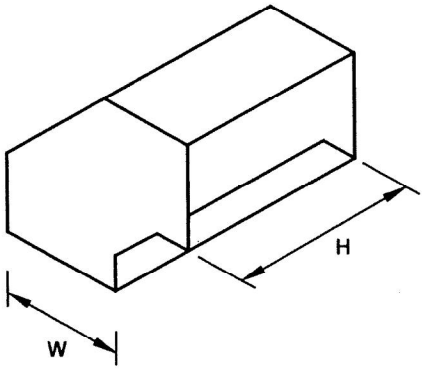
TYPE RE 6
MITERED ELBOW

BEAD, CROSSBREAK AND REINFORCE FLAT SURFACES AS IN STRAIGHT DUCT

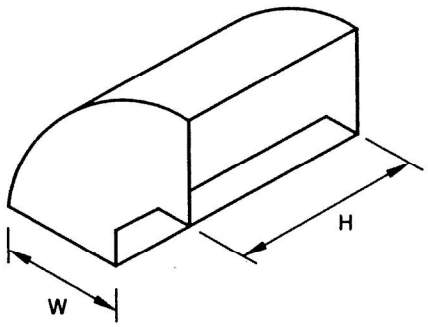
PAGE 1 OF 2

RECTANGULAR ELBOWS

FIG. 2-2

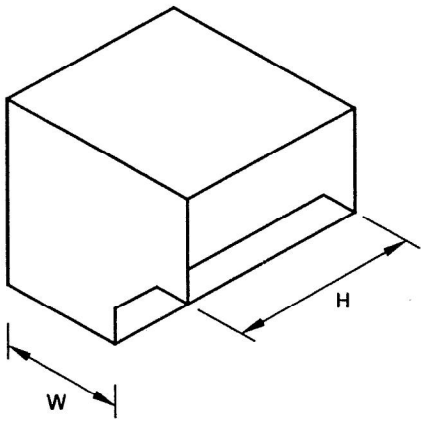


TYPE RE 7
45° THROAT
45° HEEL

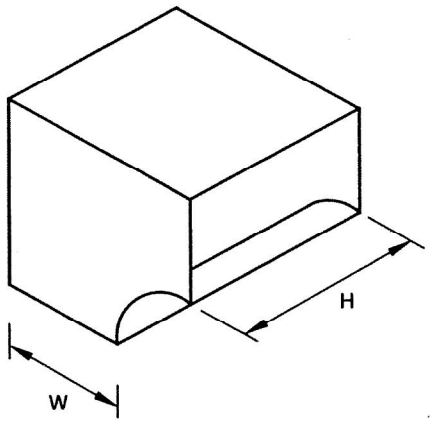


TYPE RE 8
45° THROAT
RADIUS HEEL

ALL 45° THROATS ARE 4" (100 mm) MINIMUM



TYPE RE 9
45° THROAT
90° HEEL



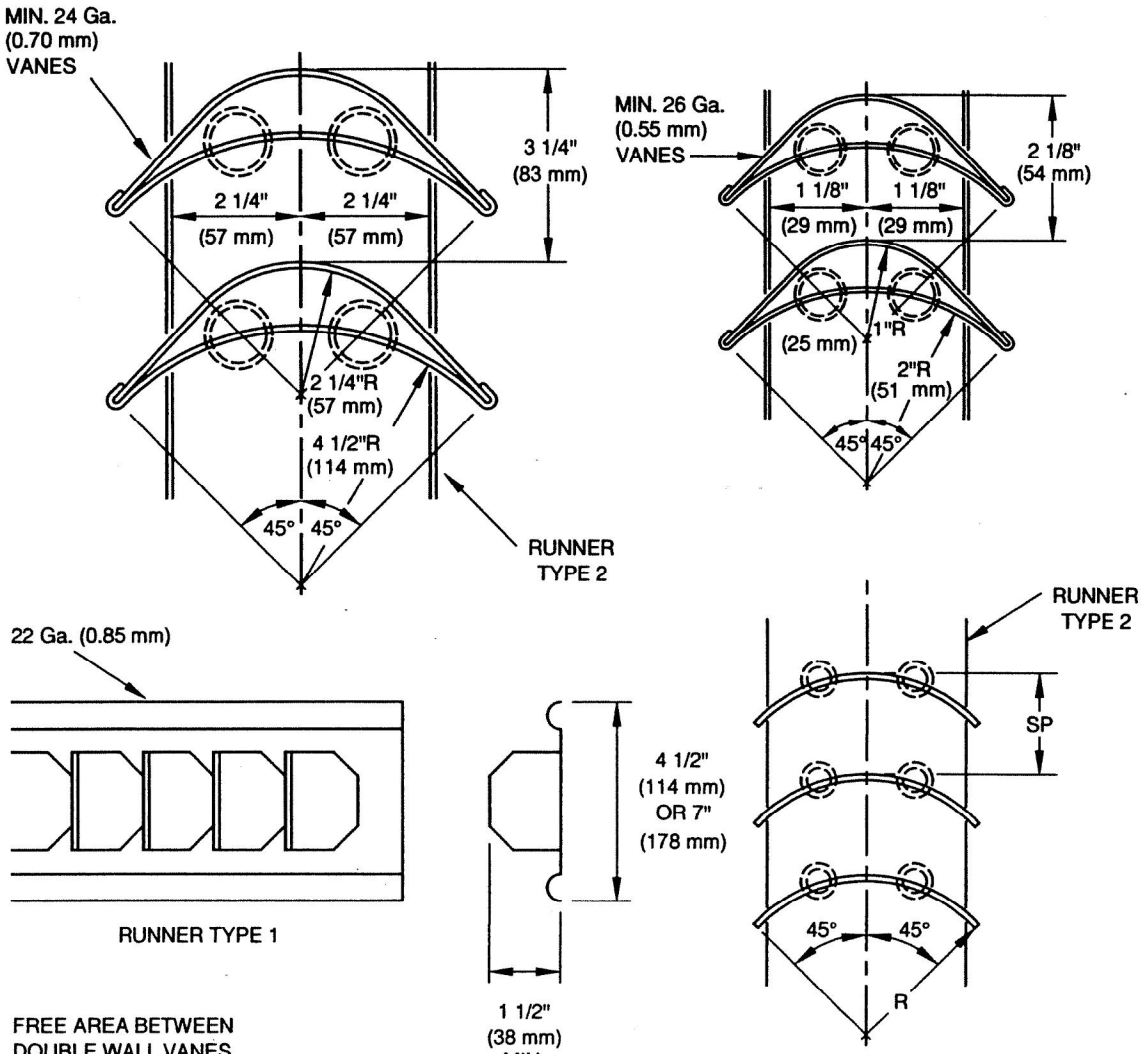
TYPE RE 10
RADIUS THROAT
90° HEEL

BEAD, CROSSBREAK AND REINFORCE FLAT SURFACES AS IN STRAIGHT DUCT

PAGE 2 OF 2

RECTANGULAR ELBOWS

FIG. 2-2

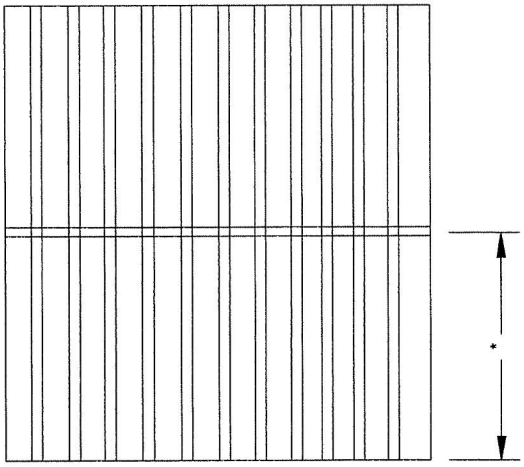


SINGLE VANE SCHEDULE			
	R	SP	GA
SMALL	2" (51 mm)	1 1/2" (38 mm)	24 (0.70 mm)
LARGE	4 1/2" (114 mm)	3 1/4" (83 mm)	22 (0.85 mm)

SEE NOTES ON FIG. 2-4. OTHER RUNNERS MAY BE USED AS APPROPRIATE. OTHER VANE SIZES, SPACINGS OR CONFIGURATIONS ARE ACCEPTABLE ON DESIGNER APPROVAL.

VANES & VANE RUNNERS

FIG. 2-3



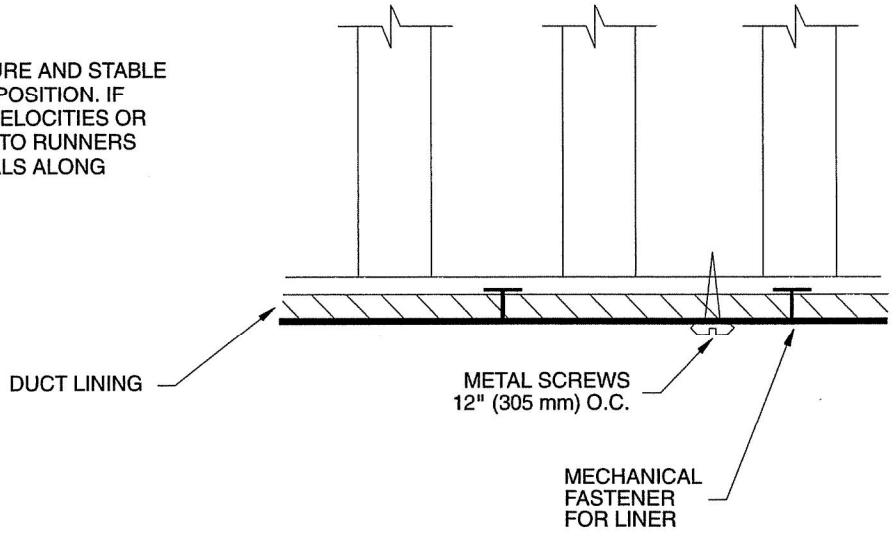
*MAXIMUM UNSUPPORTED VANE LENGTH

SMALL SINGLE VANE	36" (914 mm)
LARGE SINGLE VANE	36" (914 mm)
SMALL DOUBLE VANE	48" (1219 mm)
LARGE DOUBLE VANE	72" (1829 mm)

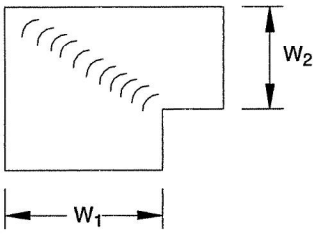
INSTALL VANES IN SECTIONS OR USE TIE RODS TO LIMIT THE UNBRACED VANE LENGTH.

VANES SHALL BE SECURELY FASTENED TO RUNNERS.

ALL VANES SHALL BE SECURE AND STABLE IN INSTALLED OPERATING POSITION. IF NECESSARY, AT CERTAIN VELOCITIES OR PRESSURES WELD VANES TO RUNNERS ON APPROPRIATE INTERVALS ALONG RUNNERS.



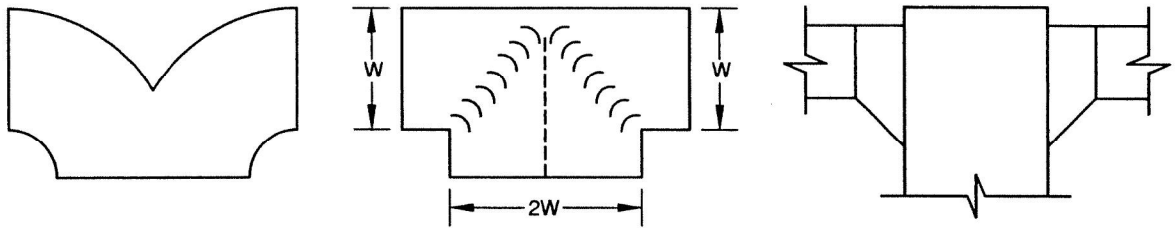
TO PREVENT LINER DAMAGE CARE MUST BE EXERCISED WHEN INSTALLING VANES IN LINED OR FIBROUS GLASS DUCT, SEE FIG. 2-21.



IF W_2 DOES NOT EQUAL W_1 SPECIAL PROVISIONS MUST BE MADE IN VANE SHAPE OR ANGLE OF ENTRY AND EXIT. APPLIES TO ALL TYPES OF VANES. CONSTRUCT VANE EDGES TO PROJECT TANGENTS PARALLEL TO DUCT SIDES. VANES AS USED WHEN $W_1 = W_2$ ARE NOT ACCEPTABLE ON SIZE CHANGE ELBOWS WITHOUT MODIFICATION.

SEE FIG. 2-3 FOR VANE DETAILS.

VANE SUPPORT IN ELBOWS — FIG. 2-4

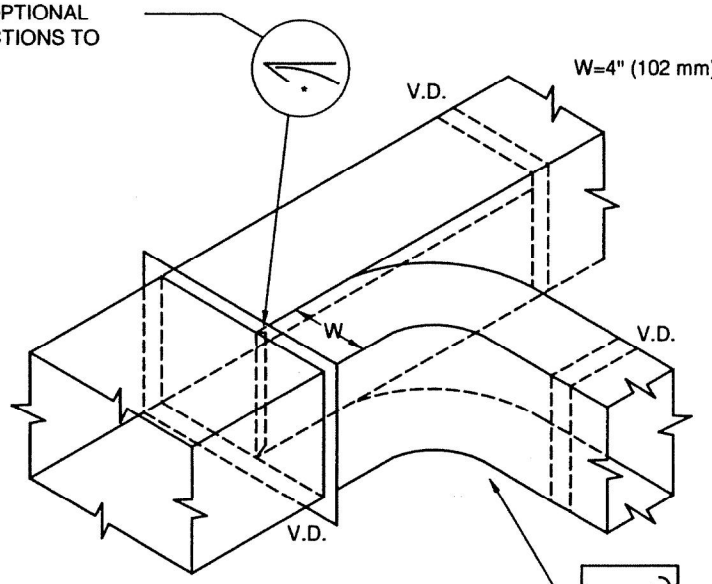


TYPE 1

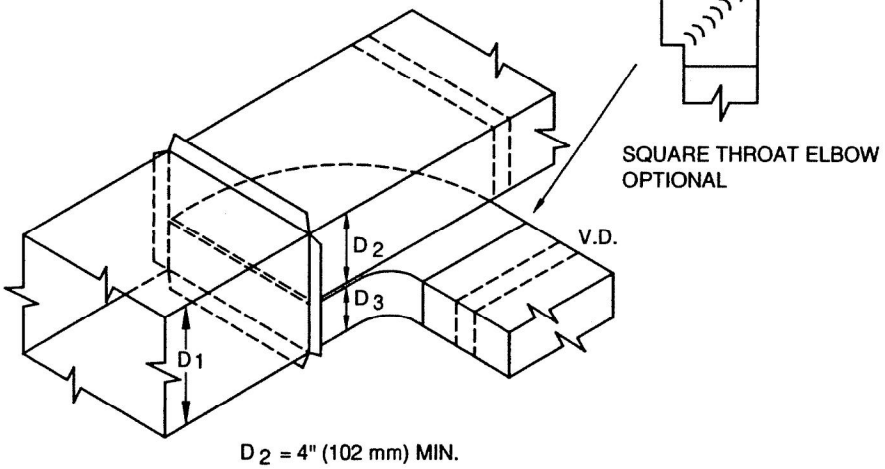
TYPE 2
STATIONARY SPLITTER
IS OPTIONAL

TYPE 3

* S SLIP OR U CLIP OPTIONAL
ALL SUCH CONNECTIONS TO
BE SEALED



TYPE 4A



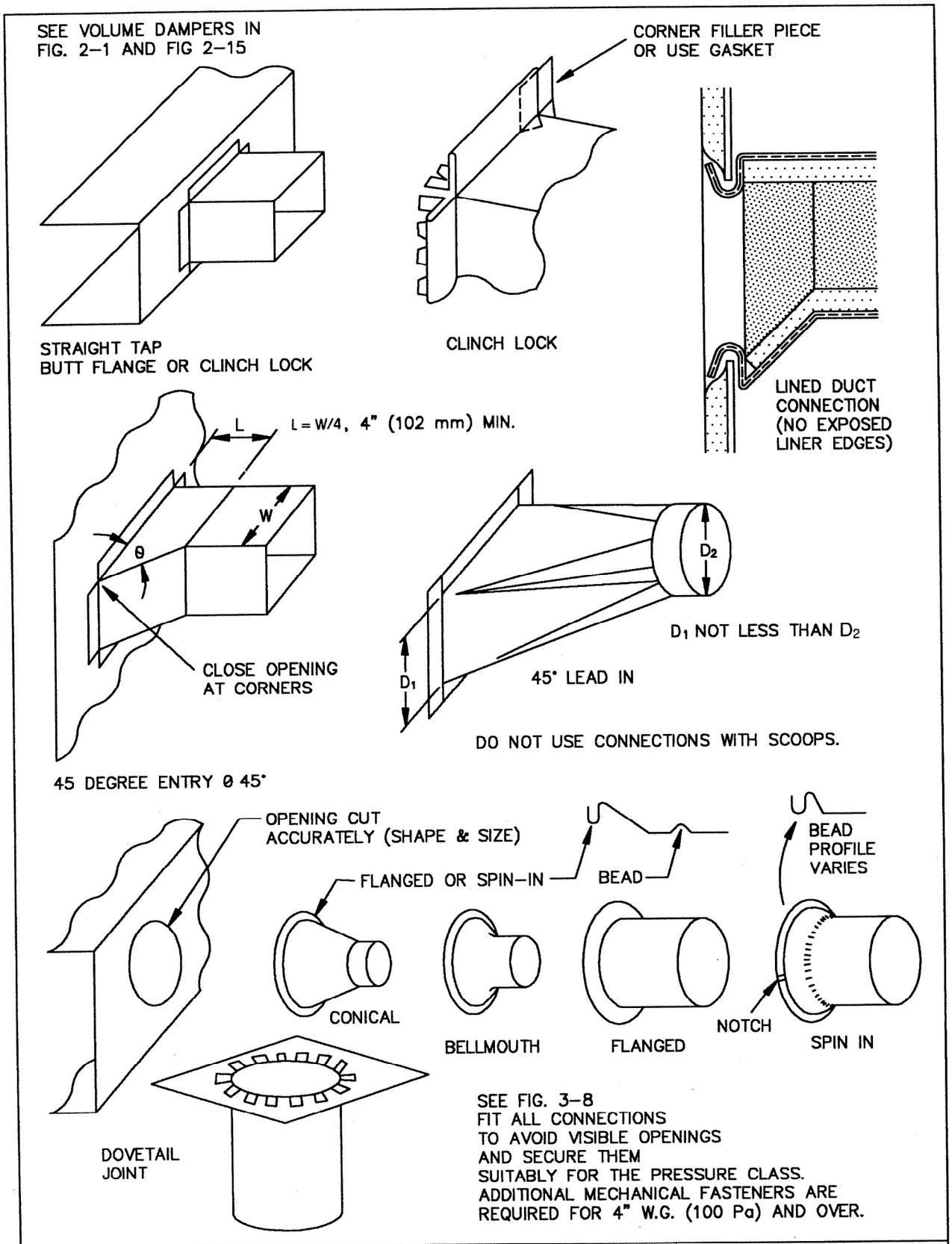
TYPE 4B

D_2 = 4" (102 mm) MIN.
D_3 = 4" (102 mm) MIN.

VOLUME CONTROL SHOULD BE BY BRANCH DAMPERS.
IF A SPLITTER IS SHOWN IN THE DESIGN ITS
LENGTH SHOULD BE 1.5 W OR 1.5 D_3.

DIVIDED FLOW BRANCHES

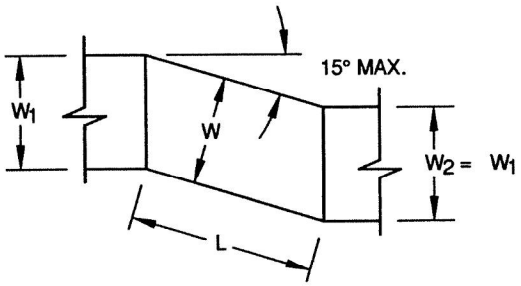
FIG. 2-5



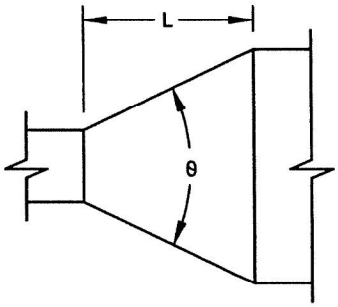
BRANCH CONNECTIONS

FIG. 2-6

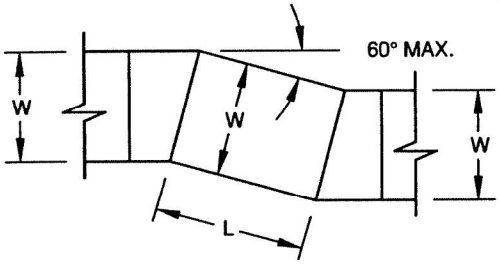
OFFSETS 2 AND 3 AND TRANSITIONS MAY HAVE EQUAL OR UNEQUAL INLET AND OUTLET AREAS. TRANSITIONS MAY CONVERT DUCT PROFILES TO ANY COMBINATION FOR RECTANGULAR, ROUND OR FLAT OVAL SHAPES.



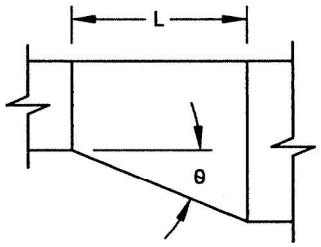
OFFSET TYPE 1
(ANGLED)



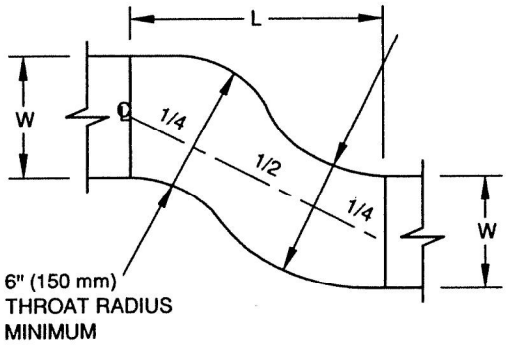
CONCENTRIC TRANSITION
θ MAX. 45° DIVERGING, 60° CONVERGING



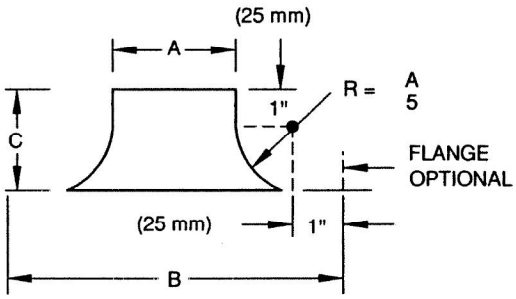
OFFSET TYPE 2
(MITERED)



ECCENTRIC TRANSITION
θ MAX. 30°
(EXCEPT 45° IS PERMITTED
AT ROUND TO FLAT OVAL)



OFFSET TYPE 3
(RADIUSSED
OR OGEE)



STANDARD BELLMOUTH
(ON SHORT PATTERN BELL
C = 3" (76 mm)
B = A + 4" (102 mm))

OFFSETS AND TRANSITIONS — FIG. 2-7

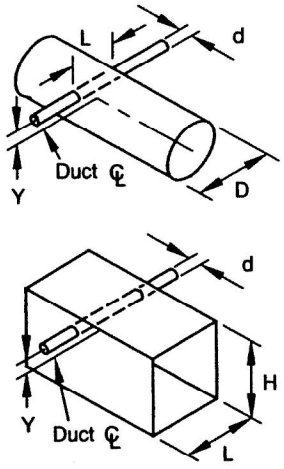


FIG. A

FIG. A IS APPLICABLE FOR UP TO 20% AREA OBSTRUCTION WITH ROUND SHAPED MEMBER AND 10% WITH FLAT PROFILE. Y IS THE DISTANCE FROM DUCT CENTER.

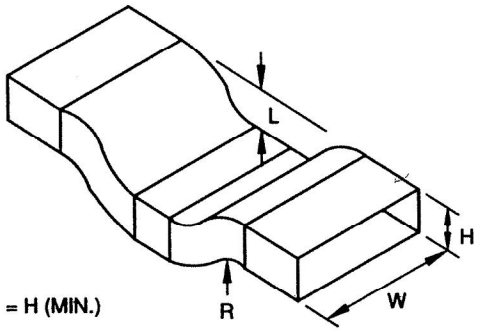


FIG. B

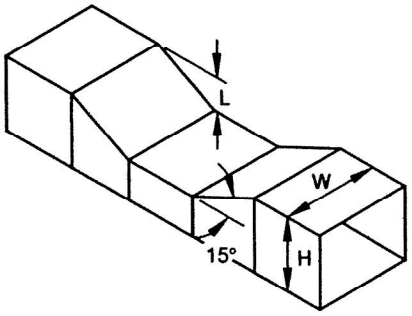


FIG. C

20% MAXIMUM AREA REDUCTION

L/H = 0.5 TO 2
B = 12" (300 mm) MIN.

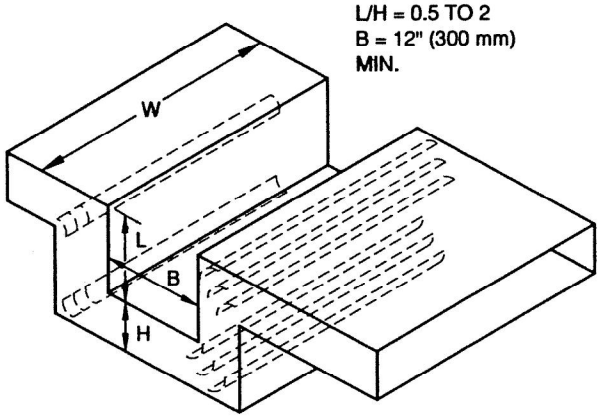
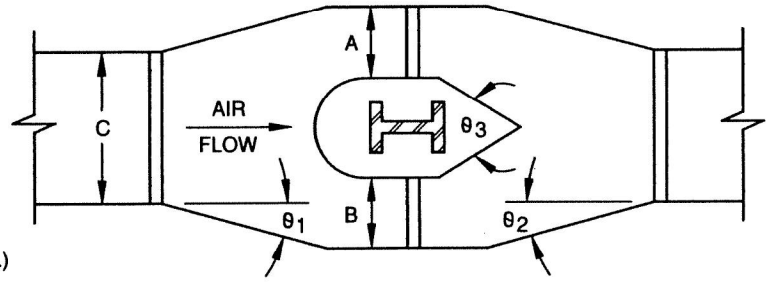


FIG. D

VANES MUST DIRECT FLOW PARALLEL TO DUCT WALL
CAUTION: HIGH LOSS COEFFICIENTS



A+B = 1.25C (MIN.) AT CONSTANT DEPTH.

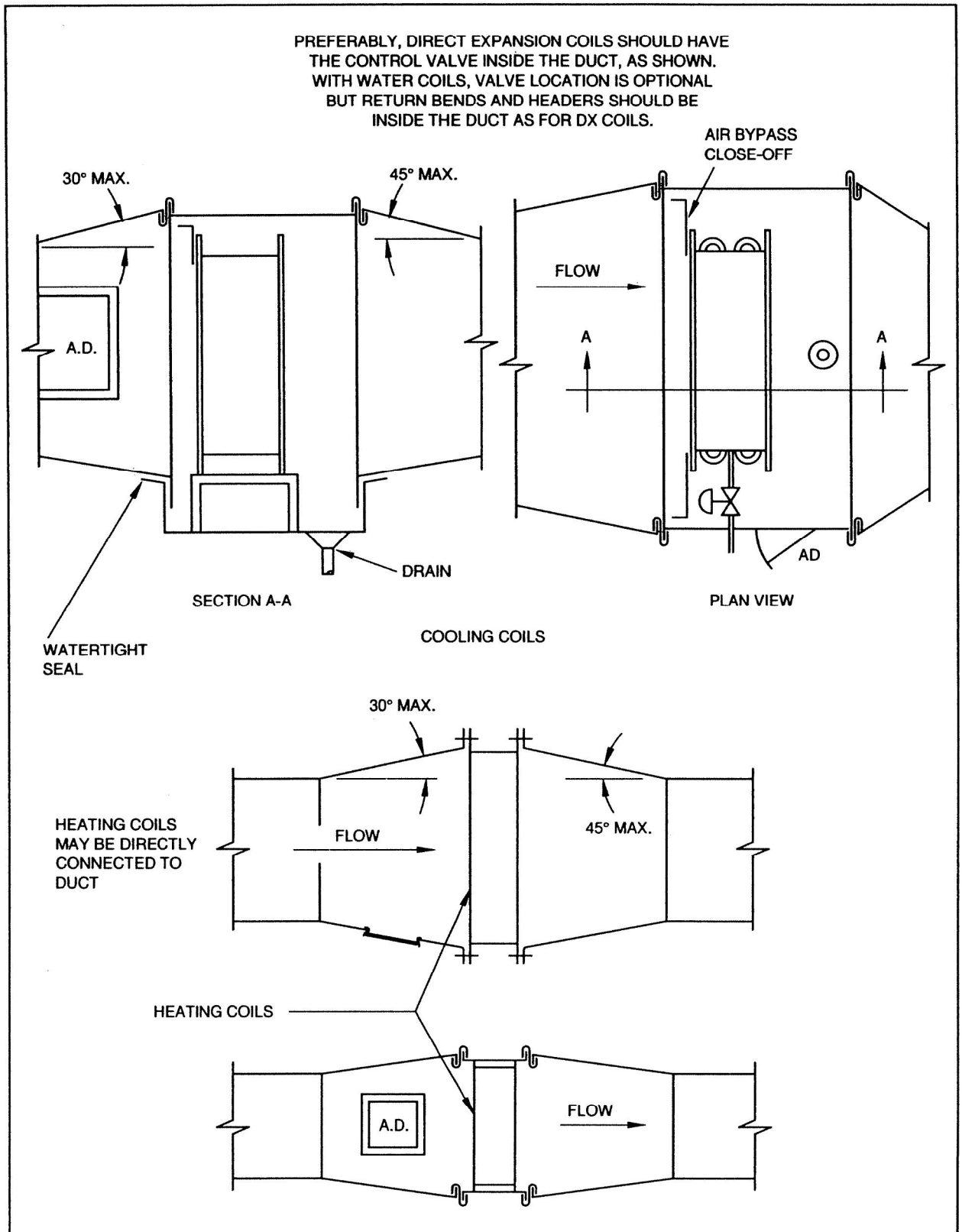
FIG. E

θ_1 = 20° MAX.
θ_2 = 30° MAX.
θ_3 = 60° MAX.

(USED WHEN OBSTRUCTION EXCEEDS 20% OF SECTION AREA AND OFFSETS AROUND ARE NOT POSSIBLE).

OBSTRUCTIONS

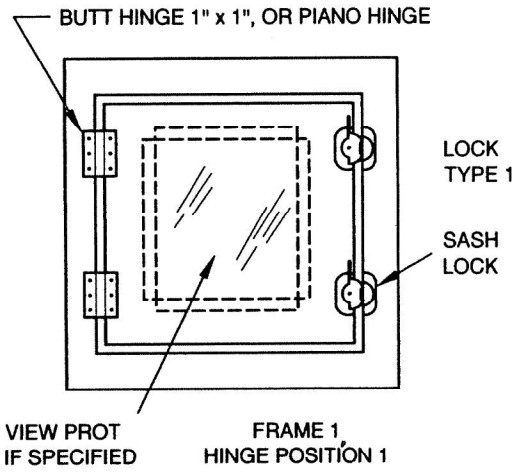
FIG. 2-8

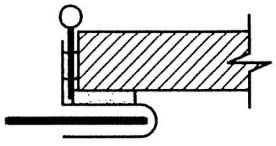


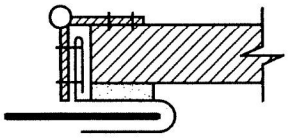
DESIGNERS SHOULD SPECIFY ACCEPTABLE COIL FRAME LEAKAGE OR PLACE THE COIL IN THE DUCT.

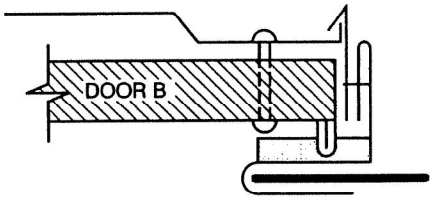
REMOTE HEATING AND COOLING COIL INSTALLATIONS

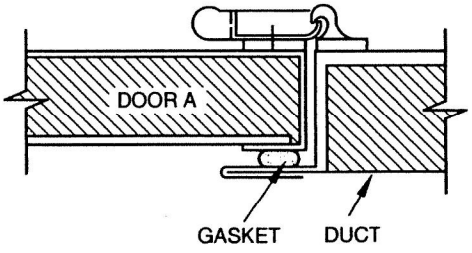
FIG. 2-9

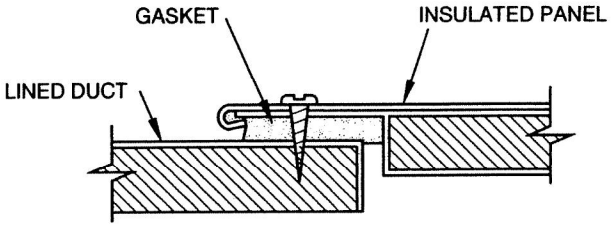


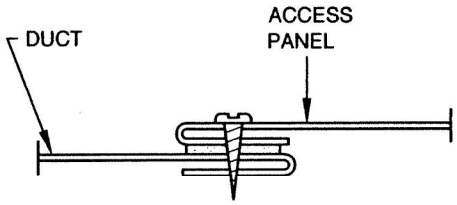










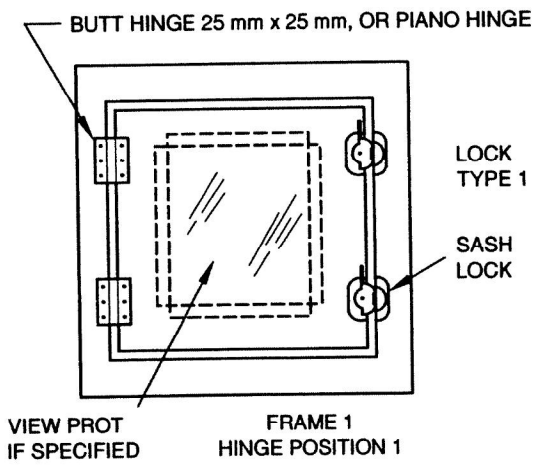


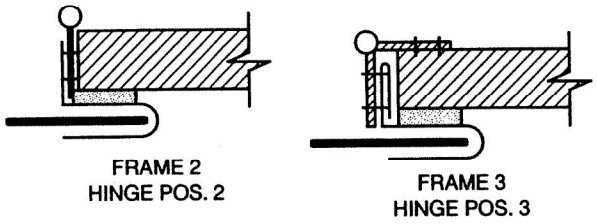
PANEL IS DUCT GAGE (MIN.)
WITH SCREWS AT 8" MAX. SPACING

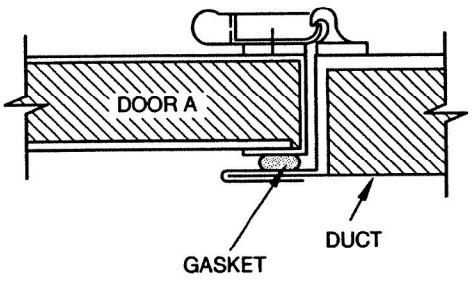
	Door Size	No. Hinges	No. Locks	Metal Gage		
				Frame	Door	Back
2" w.g. Static and Less	12" x 12" 16" x 20" 24" x 24"	2 2 3	1-S 2-S 2-S	24 22 22	26 24 22	26 26 26
3" w.g. Static	12" x 12" 16" x 20" 24" x 24"	2 2 3	1-S 1-S,1-T,1-B 2-S,1-T,1-B	22 20 20	22 20 20	26 26 24
4" w.g. to 10" w.g.	12" x 12" 16" x 20" 24" x 24"	2 3 3	1-S,1-T,1-B 2-S,1-T,1-B 2-S,2-T,2-B	20 20 18	20 18 18	26 24 24
S = Side opposite hinges, T = Top, B = Bottom						

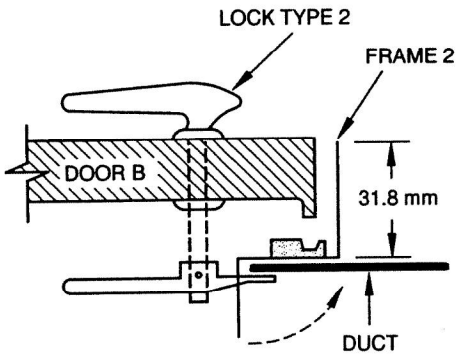
CONSTRUCTION AND AIRTIGHTNESS MUST BE SUITABLE FOR THE DUCT PRESSURE CLASS USED. THESE ILLUSTRATIONS DO NOT PRECLUDE THE USE OF OTHER METHODS AND HARDWARE.

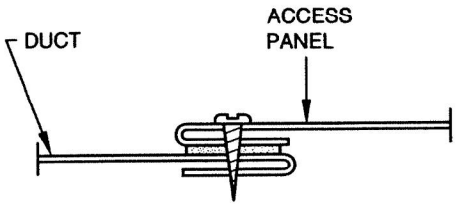
DUCT ACCESS DOORS AND PANELS FIG. 2-10











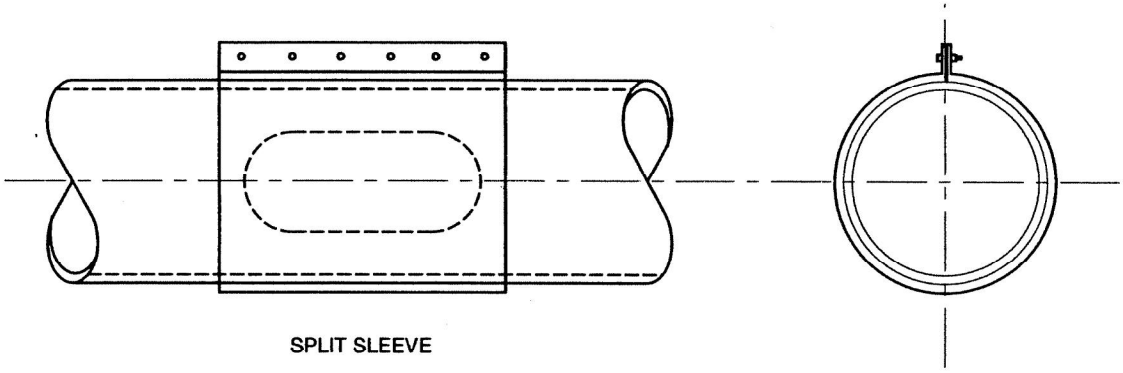
PANEL IS DUCT GAGE (MIN.)
WITH SCREWS AT 203 mm MAX. SPACING

	Door Size (mm)	No. Hinges	No. Locks	Metal Gage (mm)		
				Frame	Door	Back
500 Pa Static and Less	305 x 305	2	1-S	0.70	0.55	0.55
	406 x 508	2	2-S	0.85	0.70	0.55
	610 x 610	3	2-S	0.85	0.85	0.55
750 Pa Static	305 x 305	2	1-S	0.85	0.85	0.55
	406 x 508	2	1-S,1-T,1-B	1.00	1.00	0.55
	610 x 610	3	2-S,1-T,1-B	1.00	1.00	0.70
1000 Pa to 2500 Pa	305 x 305	2	1-S,1-T,1-B	1.00	1.00	0.55
	406 x 508	3	2-S,1-T,1-B	1.00	1.31	0.70
	610 x 610	3	2-S,2-T,2-B	1.31	1.31	0.70
S = Side opposite hinges, T = Top, B = Bottom						

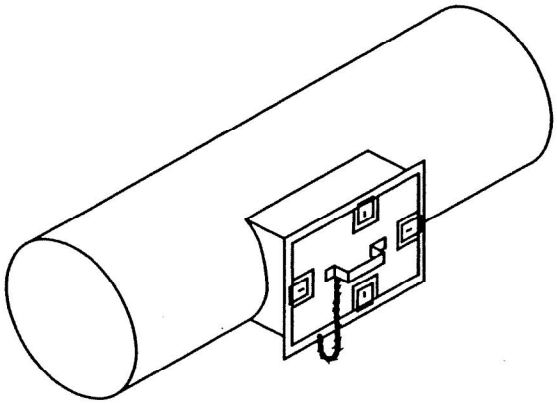
CONSTRUCTION AND AIRTIGHTNESS MUST BE SUITABLE FOR THE DUCT PRESSURE CLASS USED.

DUCT ACCESS DOORS AND PANELS

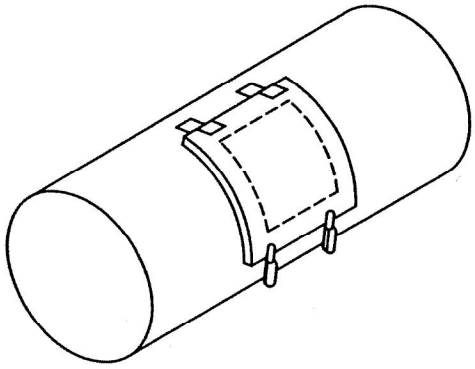
FIG. 2-10M



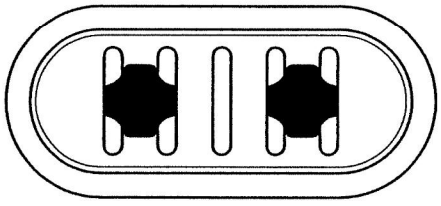
SPLIT SLEEVE



COMBINATION ACCESS
AND PRESSURE RELIEF
(MANUALLY OPERABLE
AND PRESSURE SENSITIVE
RELEASE LATCHES)



ROLLED HINGED
PLATE WITH
COMMERCIAL
CATCHES.



CLAMPING TYPE ACCESS DOOR

A CONTOURED PANEL
WITH SCREW FASTENING
AND GASKET IS
ALSO ACCEPTABLE

CONSTRUCTION AND AIRTIGHTNESS SHALL BE SUITABLE
FOR THE DUCT PRESSURE CLASS USED.

ACCESS DOORS - ROUND DUCT FIG. 2-11

2.2 VOLUME DAMPERS

2.3 NOTES FOR FIGURES 2-10 AND 2-11

1. Unless otherwise permitted, dampers shall be provided with the general configuration, materials, and application limits indicated in Figures 2-12 and 2-13 and in related notes.

2. Damper hardware must be durable and installed properly.

3. Dampers must be stable under operating conditions. Round and rectangular damper blades must be stiffened by forming or other method if required for the duty.

4. All single blade dampers must have a locking device to hold the dampers in a fixed position without vibration.

5. Damper component penetration of ducts must be closed, in keeping with the sealing classification applicable for the pressure class. End bearings or other seals are required on 3" w.g. (750 Pa) static pressure class.

6. The installation of a damper in a lined duct must not damage the liner or cause liner erosion.

2.4 COMMENTARY

Designers must show all required air volume control devices on the contract drawings. Nothing in this document implies an obligation to provide volume control devices that are not on the contract drawings.

The ASHRAE *Terminology Handbook* chapter on testing, adjusting, and balancing defines ducts as follows: a main duct serves the system's major or entire fluid flow; a submain serves two or more branch mains; a branch main serves two or more terminals; a branch serves a single terminal. Illustrating dampers on contract drawings relieves contractors from interpreting damper requirements.

The damper designs illustrated in Figures 2-12 and 2-13 are for reduced volume control, not for positive shut off. Modified versions can be constructed for tight shut off.

OBD (opposed blade damper) devices installed with grilles and diffusers should not be relied on to take more than ¼ to ½ closure without noise.

Single-blade or opposed-blade dampers are preferred over splitters.

Orifice plates or perforated metal with required pressure-drop characteristics may be used in lieu of dampers to set up permanent loss in duct runs.

Multiblade damper styles are normally parallel blade for two position operation; opposed blade for modulating position.

Dampers with blade lengths over 48" (1219 mm) are normally sectioned horizontally.

Motor operators for dampers should develop sufficient torque to operate properly. The motor supplier should select operators carefully. In certain cases, a fire damper may be used for flow rate control. if it serves a dual function, its operation as a fire damper must not be impaired. The installation must not develop noise or vibration.

Volume control devices that are capable of throttling flow over wide pressure differentials without generating noise are normally special procurement items. Low-pressure drop dampers should not be used for wide-pressure differentials.

Consult duct design texts and manufacturer's data for loss coefficients.

The designer must carefully evaluate pressure change in ducts and provide pressure relief measures where necessary. System status changes, as in smoke control mode or energy conservation use, impose different requirements for normally open, normally closed, and modulating dampers.

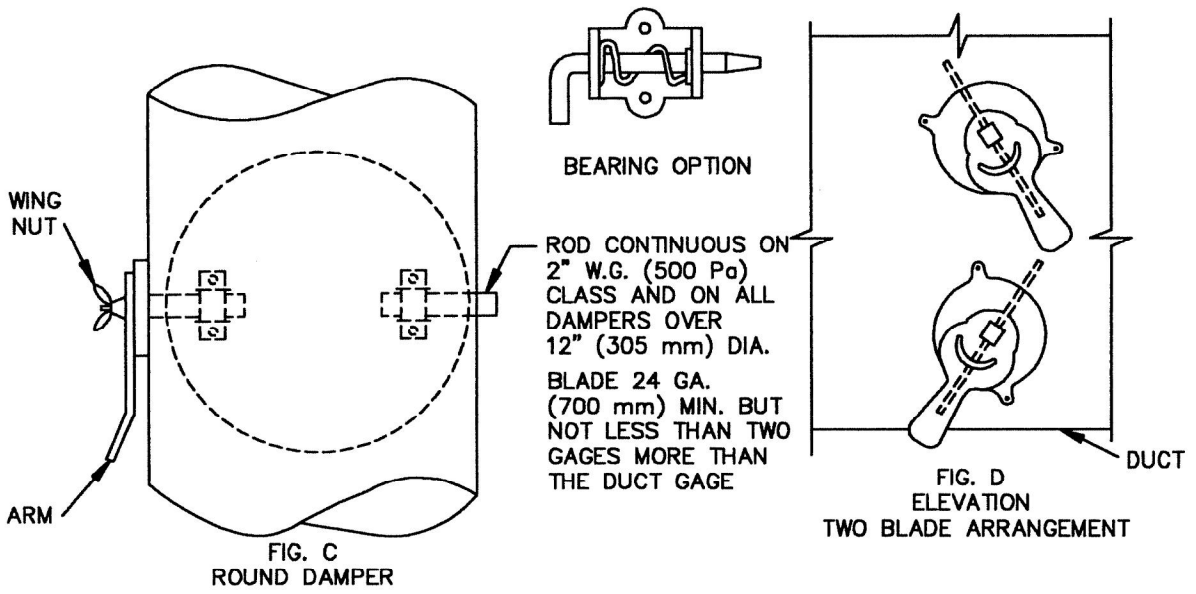


FIG. C
ROUND DAMPER

FIG. D
ELEVATION
TWO BLADE ARRANGEMENT

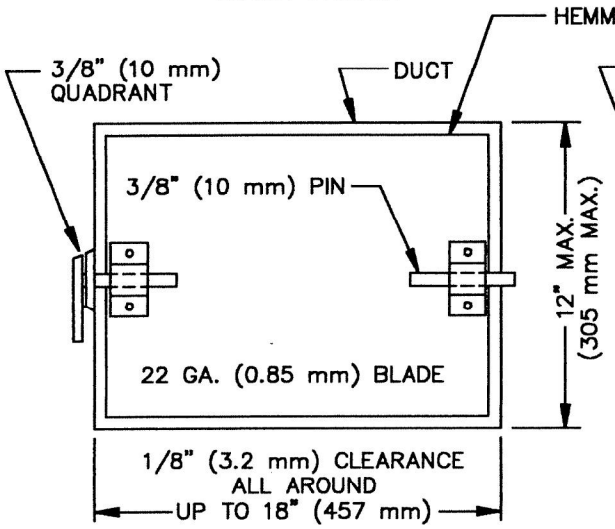


FIG. A

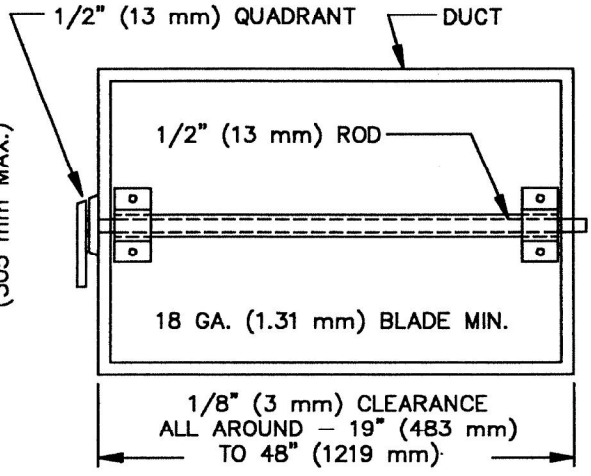


FIG. B

NOTE: OVER 12" (305 mm) HIGH USE MULTIPLE BLADES. SEE FIG. 2–13.

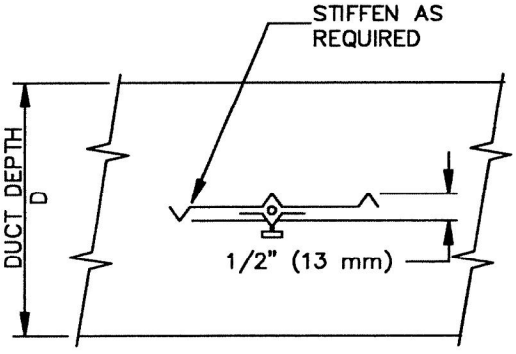
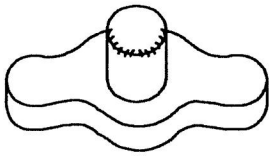
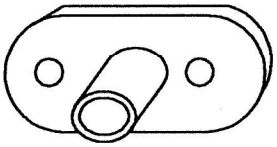


FIG. A OR B
SIDE ELEVATION



CLOSED OUTSIDE END BEARING

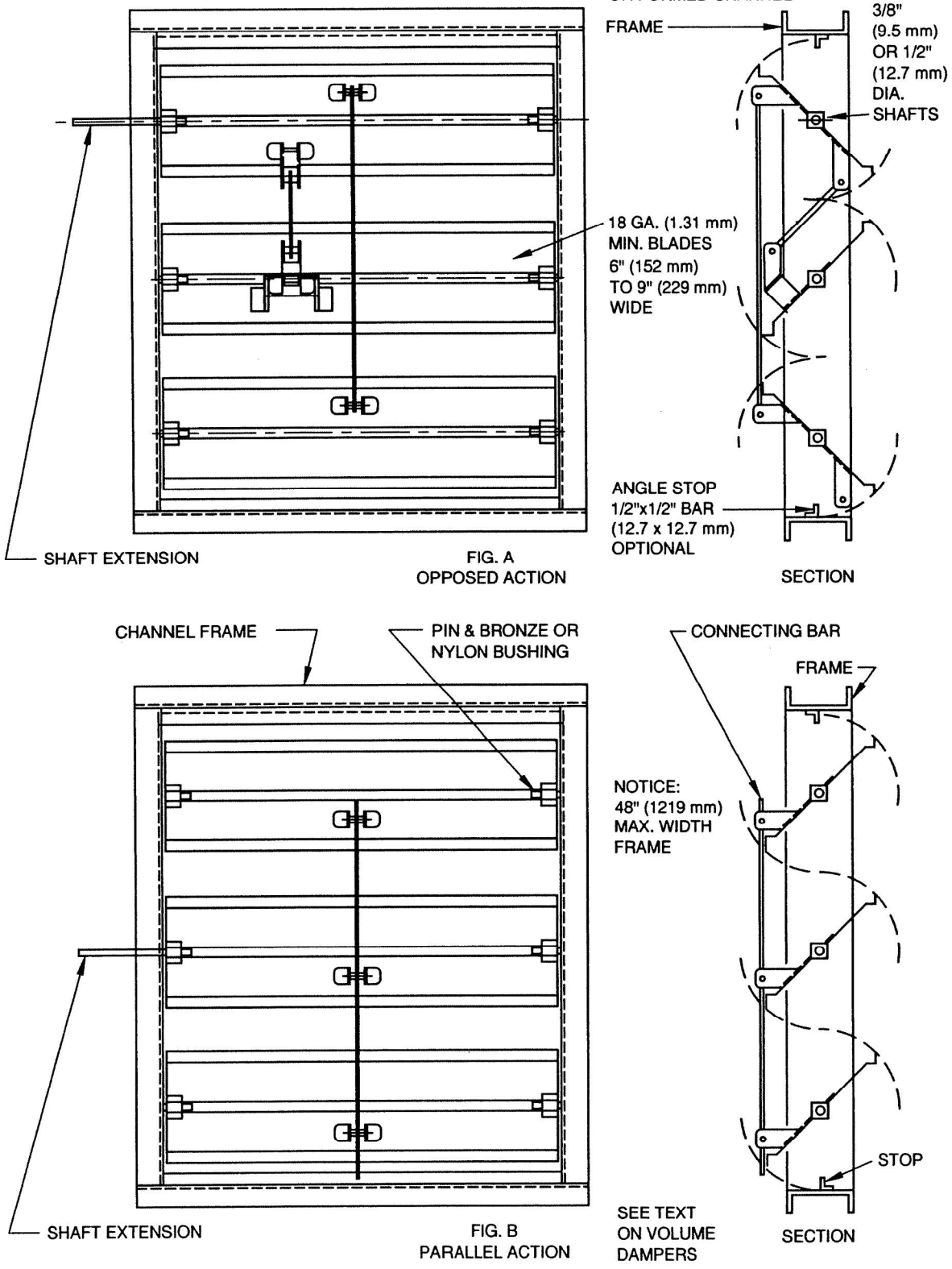


CLOSED INSIDE END BEARING

REQUIRED ON 3" W.G. (750 Pa) CLASS DUCT AND OVER. OPTIONAL FOR OTHERS

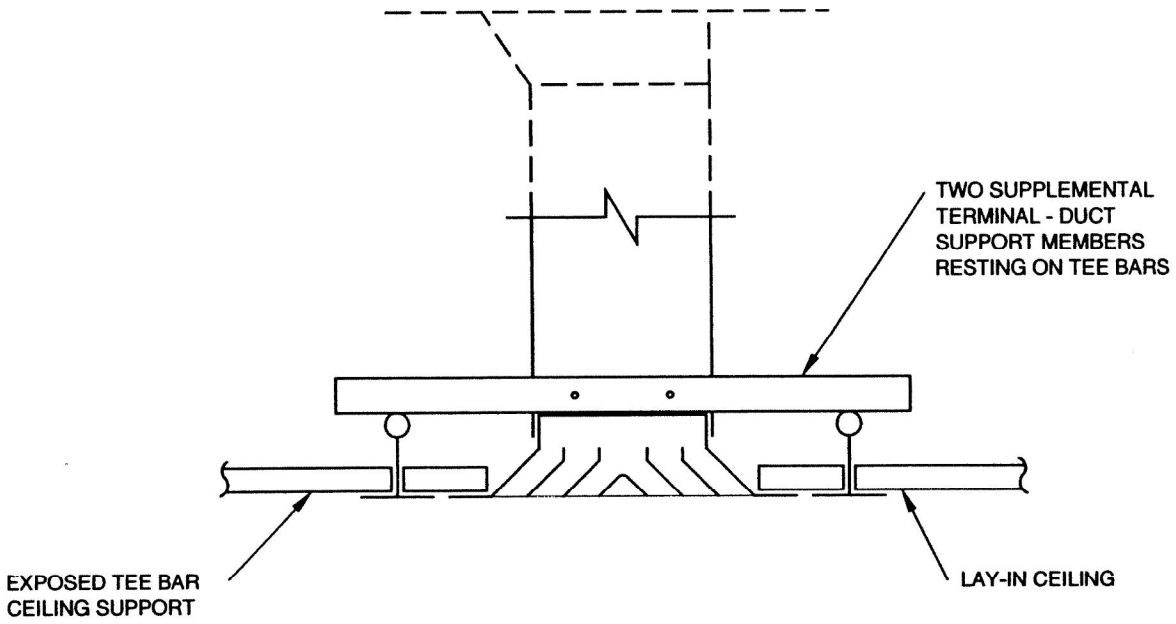
SEE TEXT ON VOLUME DAMPERS

VOLUME DAMPERS - SINGLE BLADE TYPE FIG. 2-12

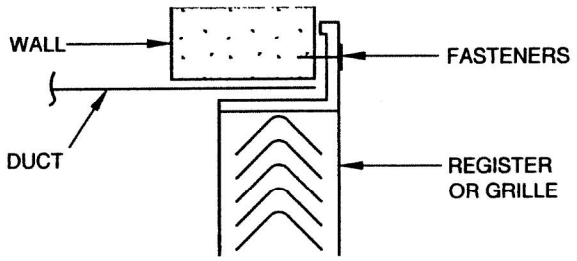


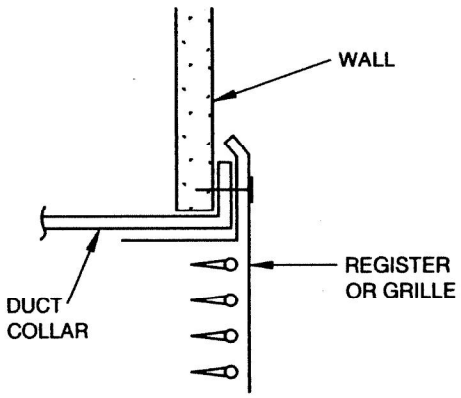
MULTIBLADE VOLUME DAMPERS

FIG. 2-13



SURFACE MOUNTED AIR TERMINAL



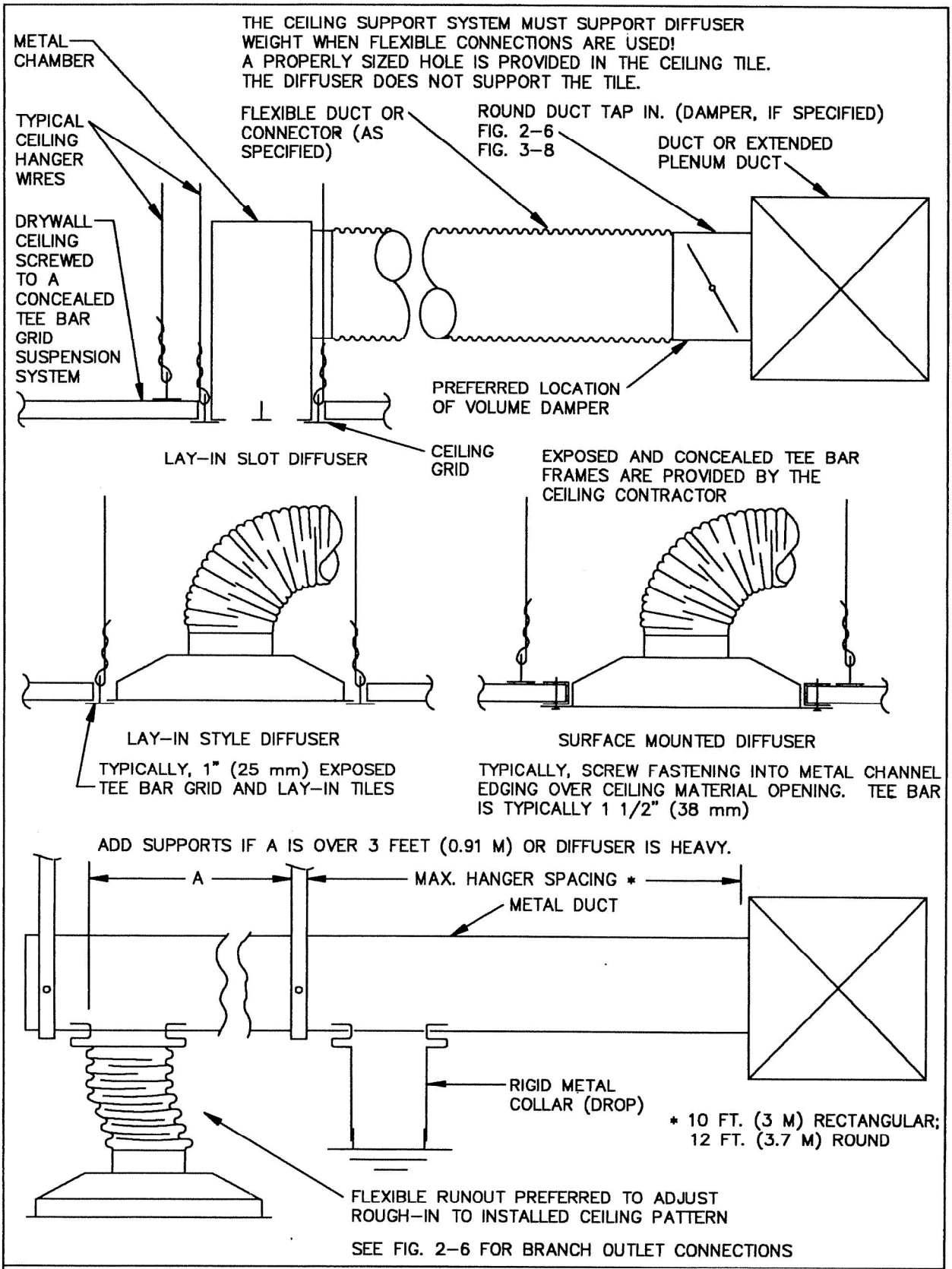


ALTERNATE DETAIL

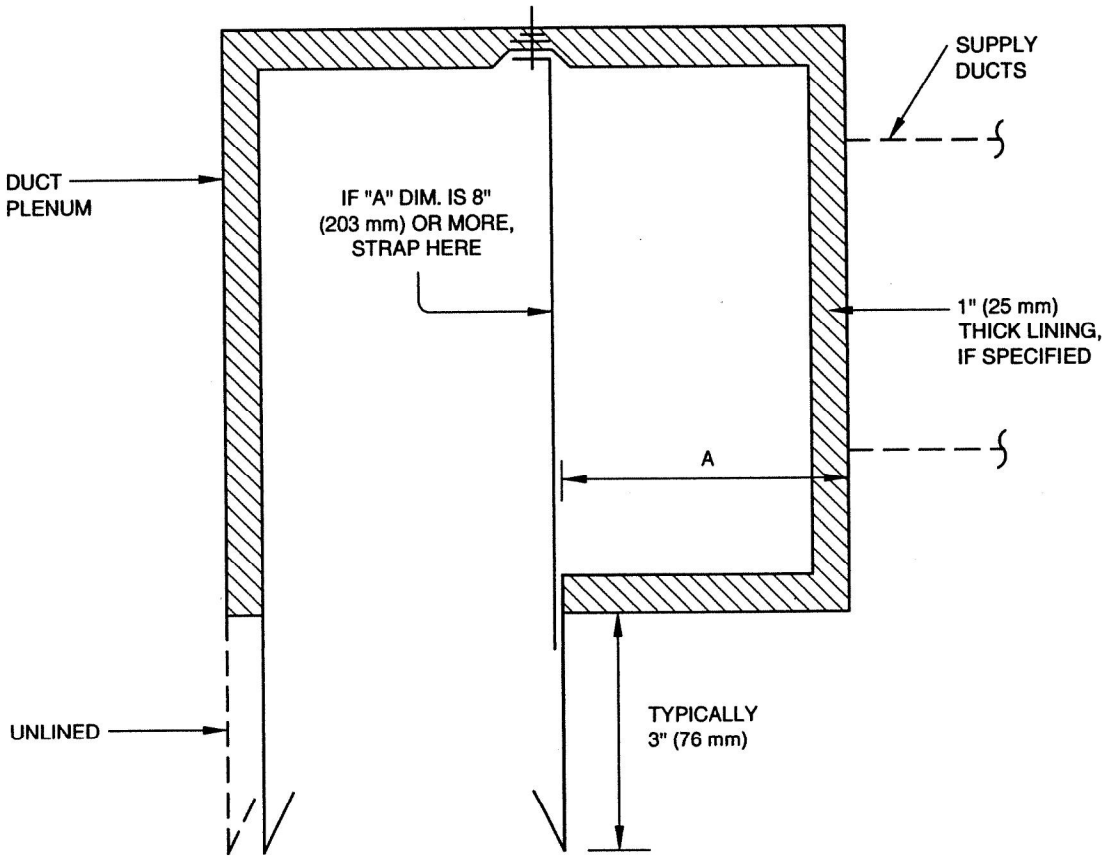
NOTE:
REGISTER CONTAINS VOLUME CONTROL AT GRILLE. GRILLE HAS NO VOLUME CONTROL.

GRILLE FLANGES MUST COVER DUCT FLANGES.

GRILLE AND REGISTER CONNECTIONS FIG. 2-14



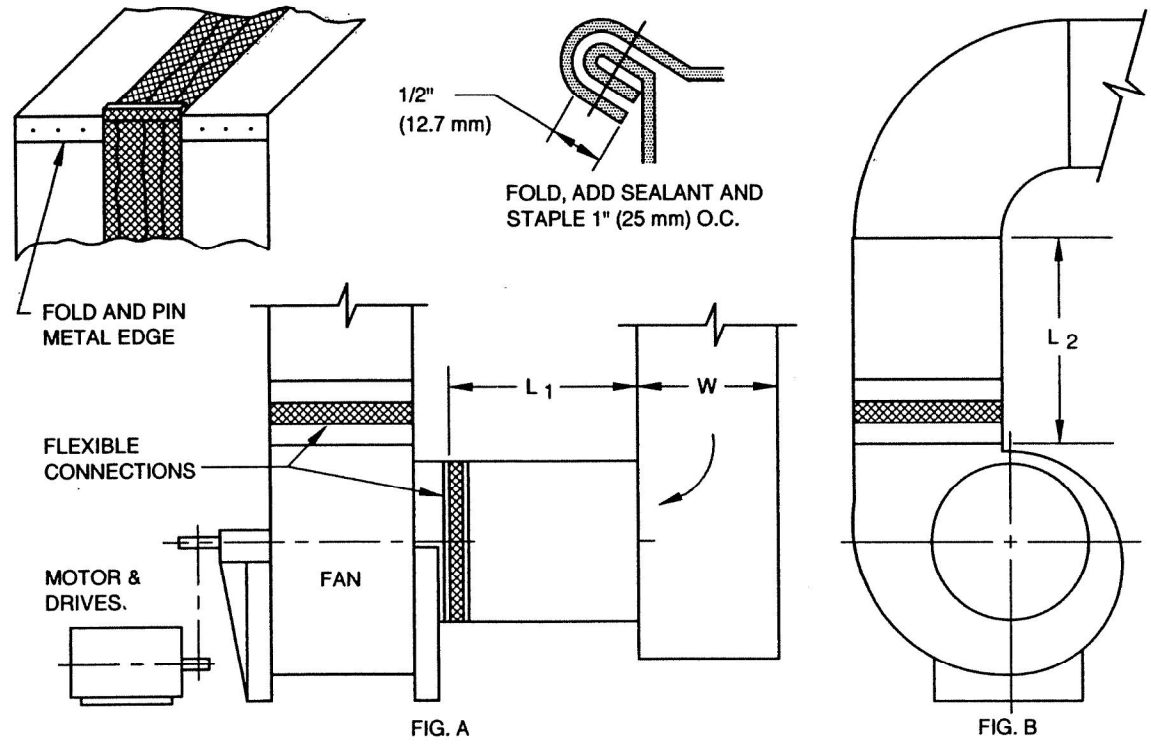
CEILING DIFFUSER BRANCH DUCTS FIG. 2-15



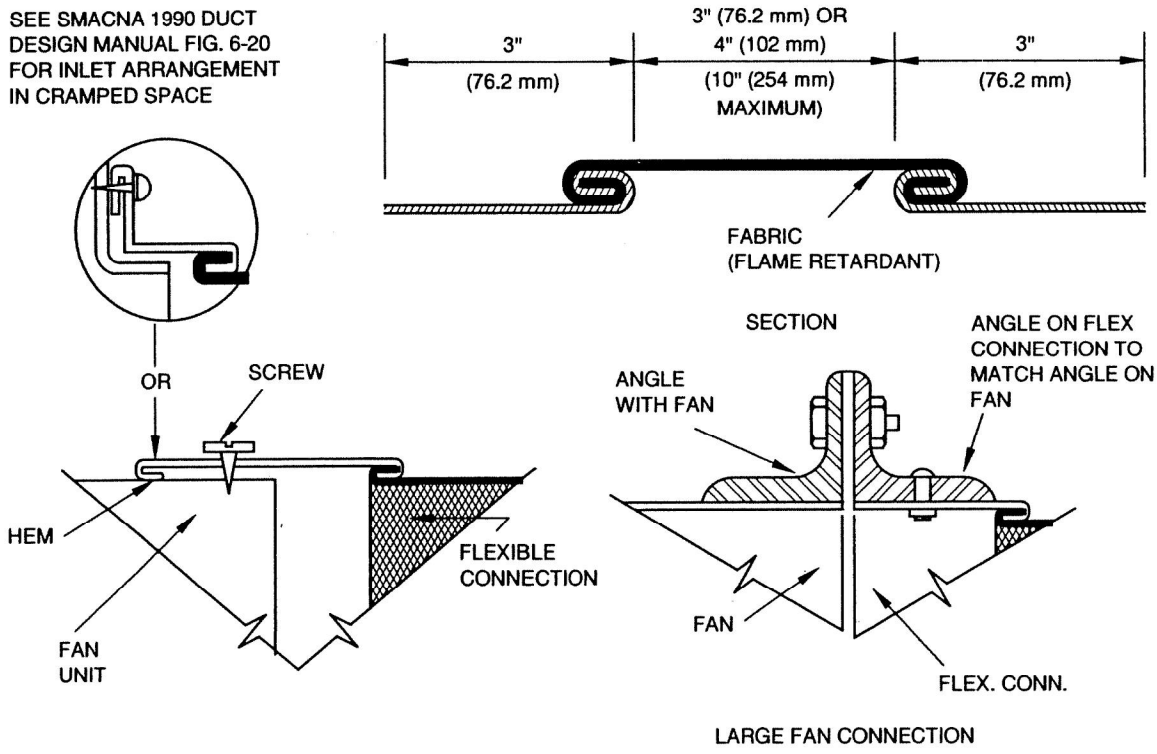
OTHER ARRANGEMENTS CAN SATISFY REQUIREMENTS
FOR ALIGNMENT AND SUPPORT.

LINEAR DIFFUSER PLENUM

FIG. 2-16

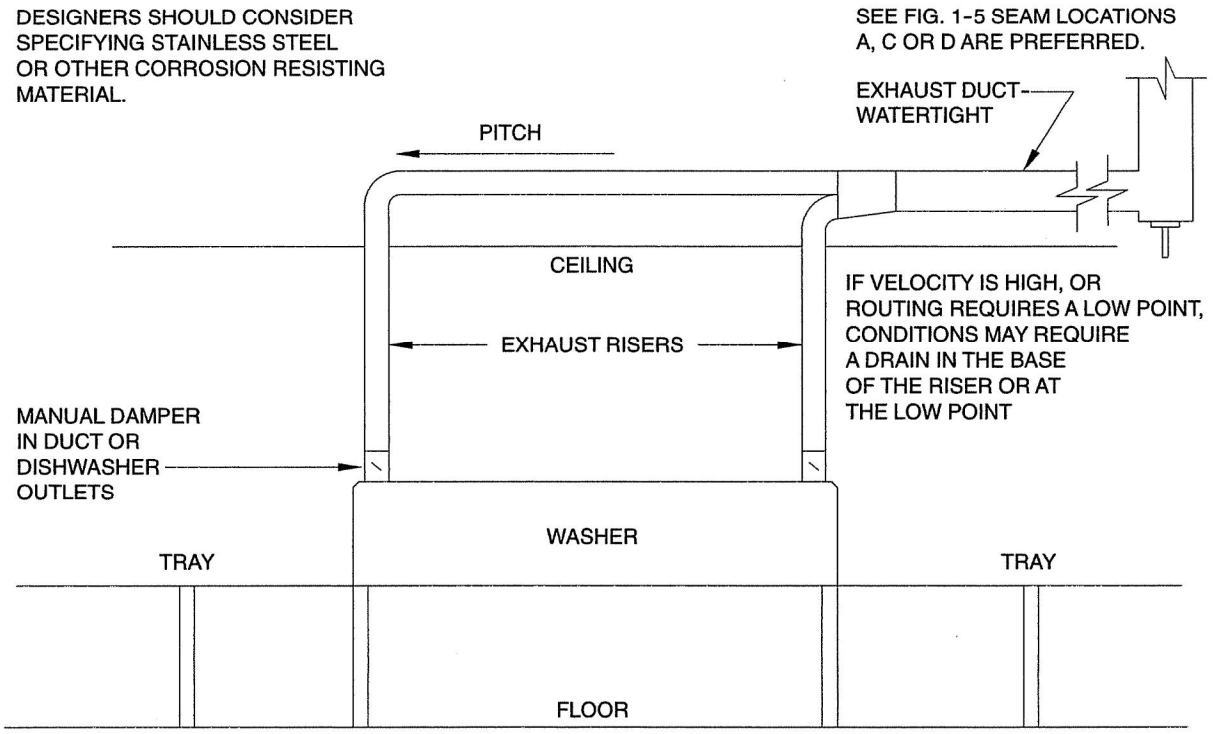


NOTE: SMACNA DUCT DESIGN MANUAL,
AND AMCA PUBLICATION 201 REVIEW PERFORMANCE OF VARIOUS
INLET AND OUTLET CONDITIONS (L_1, L_2, W DIMENSIONS, ETC.)



FLEXIBLE CONNECTIONS AT FAN

FIG. 2-17



WASHER ELEVATION
CONNECTIONS IN WASHER

FIG. A

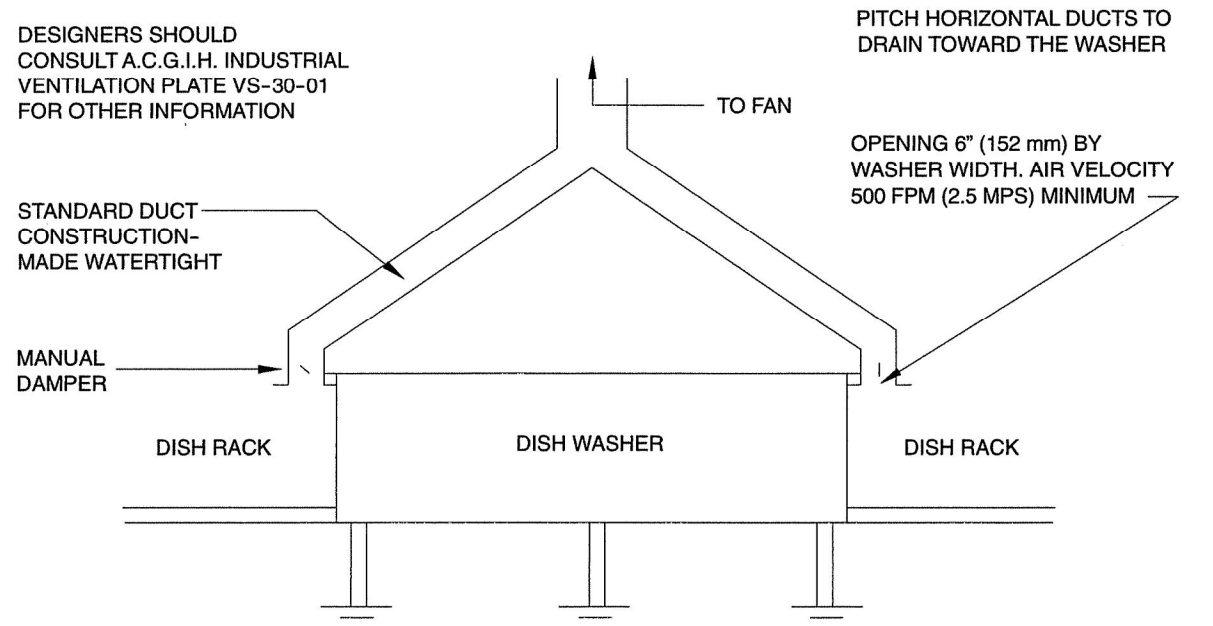


FIG. B

(ALTERNATIVE METHOD)

DISH WASHER VAPOR EXHAUST — FIG. 2-18

2.5 HOODS

In recent years, there has been a great increase in the extent of construction detail for dust, fume, and grease removal systems that appears in codes and code-invoked standards such as NFPA-91, "Blower and Exhaust Systems" and NFPA-96, "Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment". Such detail now sets forth material, wall thickness, and joint construction, among other features. Furthermore, much data on the shape, size, and location of kitchen range and other hoods is published in the book *Industrial Ventilation*, by the American Conference of Governmental Industrial Hygienists. Examples are Kitchen Range Hood Plates VS-910 and VS-911, Paint Spray Booth Plates VS-603 and 604, and Charcoal Broiler Hood Plate VS-913.

Chapter 4 is devoted to hood design data and Chapter 5 to specific operations involving hoods and ducts. Moreover, new emphasis on energy conservation has prompted the increased use of localized exhaust and makeup air.

These and similar industry changes have resulted in reliance on customized designs rather than standard designs such as those formerly published by SMACNA.

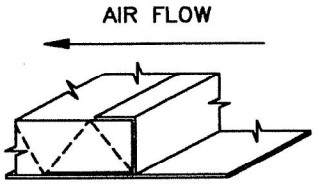
Designers should consult these references, illustrate the complete design on contract drawings, and make limited reference to the duct construction detail in this manual, if necessary.

"Hooded" air intakes and exhausts for the exterior of buildings are detailed in the Appendix.

NOTE:

SEE TYPICAL DUCT BRANCH ENTRY CONDITION IN FIG. 2–6.

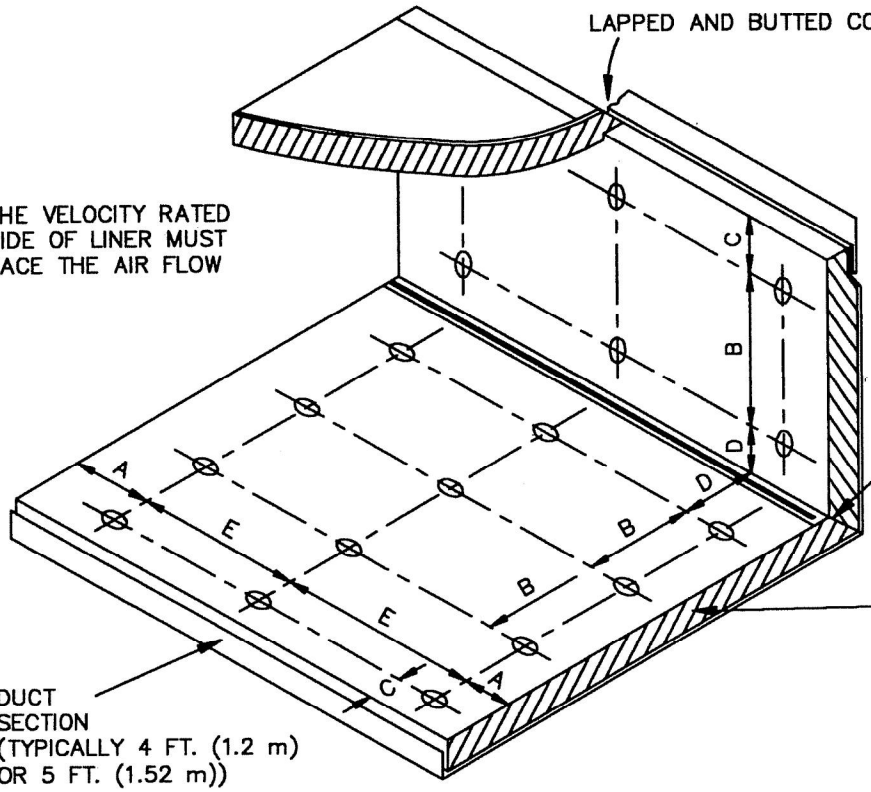
METAL NOSING MUST BE USED WHEREVER LINER IS PRECEDED BY UNLINED METAL; OTHERWISE WHEN VELOCITY EXCEEDS 4000 FPM (20.3 MPS) USE METAL NOSING ON EVERY LEADING EDGE. NOSING MAY BE FORMED ON DUCT OR BE CHANNEL OR ZEE ATTACHED BY SCREWS, RIVETS OR WELDS.



DETAIL – A

METAL NOSING
CHANNEL OR ZEE

INTERIOR WIDTH OF 8" (200 mm) AND LESS DOES NOT REQUIRE PINS.



MAXIMUM SPACING FOR FASTENERS. ACTUAL INTERVALS ARE APPROXIMATE.

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 THE 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

FLEXIBLE DUCT LINER INSTALLATION FIG. 2-19

2.6 INSTALLATION STANDARDS FOR RECTANGULAR DUCTS USING FLEXIBLE LINER

S2.0 Flexible duct liner of the specified material, thickness, and density shall be furnished and installed where shown on the contract drawings.

S2.1 Unless otherwise indicated, the net free area of the duct dimensions given on the contract drawings shall be maintained. The duct dimensions shall be increased as necessary to compensate for liner thickness.

S2.2 The liner surface designated to be exposed shall face the airstream.

S2.3 Each layer of duct liner shall be attached with 90% coverage of adhesive at the liner contact surface area.

S2.4 All transversely oriented edges of liner not receiving metal nosing shall be coated with adhesive. Liner shall be neatly butted without gaps at transverse joints and shall be coated with adhesive at such joints before butting.

S2.5 Liner shall be folded and compressed in the corners of rectangular duct sections or shall be cut and fit to ensure butted edge overlapping. Longitudinal joints in duct the liner shall not occur except at the corners of ducts, unless the size of the duct and standard liner product dimensions make them necessary.

S2.6 Ducts with interior widths of 8" (203 mm) or less do not require mechanical fasteners in addition to adhesive.

S2.7 Except as noted in paragraph S2.6, mechanical fasteners shall be located with respect to *interior* dimensions and regardless of airflow direction as in the accompanying table and in Figure 2-19.

Velocity	Transversely Around Perimeter	Longitudinally
2500 fpm (12.7 mps) and less	At 4" (102 mm) from longitudinal liner edges, at 6" (152 mm) from folded corners and at intervals not exceeding 12" (305 mm)	At 3" (76 mm) from transverse joints and at intervals not exceeding 18" (457 mm)
2501 fpm (12.7 mps) to 6000 fpm (30.5 mps)	At 4" (102 mm) from longitudinal liner edges, at 6" (152 mm) from folded corners and at intervals not exceeding 6" (152 mm)	At 3" (76 mm) from transverse joints and at intervals not exceeding 16" (406 mm)

S2.8 Longitudinal joints in liners shall be coated with adhesive when velocities over 2500 fpm (12.7 mps) are anticipated.

S2.9 Metal nosings that are either channel or zee profile or are integrally formed from the duct wall shall be securely installed over transversely oriented liner edges facing the airstream, at fan discharge and at any interval of lined duct preceded by unlined duct. In addition, where velocities exceed 4000 fpm (20.3 mps), metal nosing shall be used on upstream edges of liner at every transverse joint.

S2.10 Where dampers, turning vane assemblies, or other devices are placed inside lined ducts or fittings, the installation must not damage the liner or cause erosion of the liner. The use of metal hat sections or other buildout means is optional; when used, buildouts shall be secured to the duct wall with bolts, screws, rivets, or welds.

S2.11 Liners shall also be installed with mechanical fastening devices that:

a) are spaced in accordance with Figure 2-21,
b) when installed, are as corrosion resistant as G60 coated galvanized steel,
c) will not adversely affect the fire resistance classification of liner and adhesives,
d) do not damage the liner when applied as recommended by the manufacturer,

e) do not cause leakage in the duct,
f) do not project more than nominally into the airstream,
g) will indefinitely sustain a 50 lb (22.7 Kg) tensile dead load test perpendicular to the duct wall,
h) are the correct length specified for the liner thickness used, and
i) are installed with pins perpendicular to the duct wall.

2.7 COMMENTARY

These standards assume that the designer of a duct system has:

a) examined the liner reference texts listed in the front of this document;

b) clearly designated on the contract drawings the amount of ductwork to receive lining;

c) specified the type of liner, the thickness and density of liner and the type of liner, adhesive to be used (see page x references);

d) determined that the specified liner materials have the acoustical, friction loss, and other performance characteristics required for the application; and

e) provided for condensation control where the interruption of the liner would cause a problem.

Typically, duct liner is of flexible fibrous glass material of 1" (25 mm) thickness and 1-1/2 pounds per cubic foot (24 Kg/m^3) density. It is primarily used for its sound absorption characteristics, although it may have some thermal resistance value. Molded round liner is available. Metal wall inner lining is available for all conventional duct shapes; typically it is of 22 gage (0.85 mm) galvanized steel with 3/32" (2.4 mm) diameter holes on 3/16" (4.8 mm) or 1/4" (6.4 mm) centers. The double-wall style of lined duct is used where increased resistance to damage is desired or where erosion of the inner surface might occur.

Standard flexible liner is normally shop-installed. Minor damage to the liner surface may occur in transportation and handling. Small cuts, tears, or abrasions may be repaired with fire retardant adhesive. Material that has significant damage cannot be considered to be in new condition.

Liner is normally prequalified for a certain resistance to moisture absorption, mold growth, and degradation from high humidity. Occasional exposure to wet weather during transportation or to prebuilding enclosure conditions in new construction does not necessarily impair the liner's performance. In such cases, drying or other corrective measures recommended by the material manufacturer should be followed.

Installing two layers of material to meet a minimum liner thickness is not recommended. For special circumstances, when it must be done, 90% minimum adhesive coverage of each layer should make the two layers act as one. In addition, pay special attention to the leading edge conditions.

Normally, duct linings must be interrupted at fire dampers (to avoid adverse effects on damper operation) and at heat sources (to meet minimum clearances specified in an equipment listing). Note: Some appliances are rated for a zero clearance to combustible material.

Liner adhesives are usually water-based or solvent-based, and they may be flammable in wet or dry states. Designers should select adhesives that meet construction and code requirements. So-called safety standards may involve tests that report various characteristics but do not meet up to a hazard classification under installed conditions. Contractors are invited to follow ventilation, storage, and other precautions published by the adhesive manufacturers.

2.7.1 Liner Fastener Commentary

Three types of fasteners are commonly used with duct liners. For each type of fastener, a specific pin length is appropriate for each type and thickness of liners. It is important that the proper pin length be used, otherwise a faulty installation will result.

Fasteners designed to be secured with adhesives have a large base on which to apply the adhesive. After waiting enough time to achieve adequate bond strength which will vary, depending on the air temperature-impale the duct liner on the pin and add the spring clip or washer.

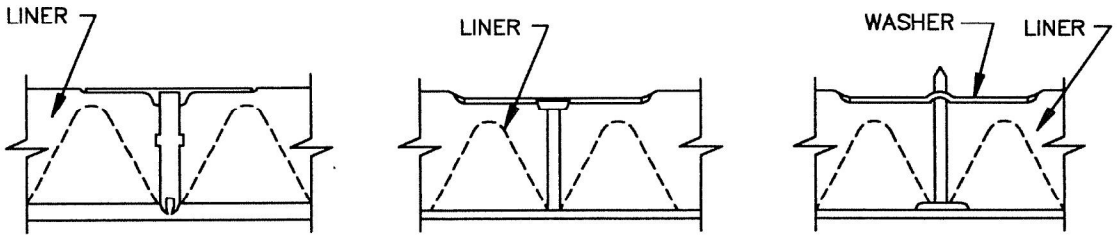
Mechanically secured fasteners form a positive attachment to the sheet metal. Typically, they are impact-applied, hardened steel fasteners which bite into the sheet metal.

Weld-secured fasteners are attached by two techniques: resistance welding and capacitance discharge welding. Correct adjustment of the timing devices is necessary to obtain a solid weld without burn-through.

The type of pin that is applied before duct liner installation takes a spring-clip or washer. Pins with pre-attached

caps are pressed through the insulation and attached to the duct in a single operation.

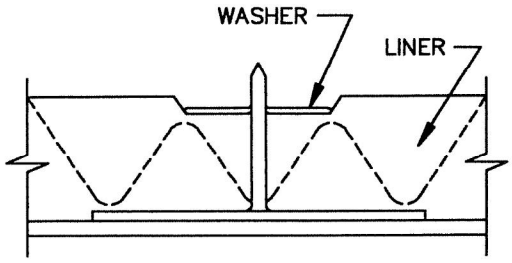
Depending on the type of fastener, discoloration or dimpling may be evident when fasteners are properly attached to the sheet metal. This does not affect the serviceability of the fastener or of the sheet metal.



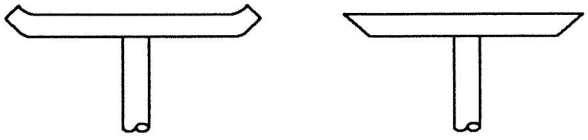
TYPE 1
CLINCHED PIN: INTEGRAL HEAD–IMPACT APPLIED

TYPE 2
WELDED PIN
INTEGRAL HEAD

TYPE 3
WELDED PIN
PRESS–ON HEAD



TYPE 4
ADHERED PIN
PRESS–ON HEAD



CUPPED BEVELED

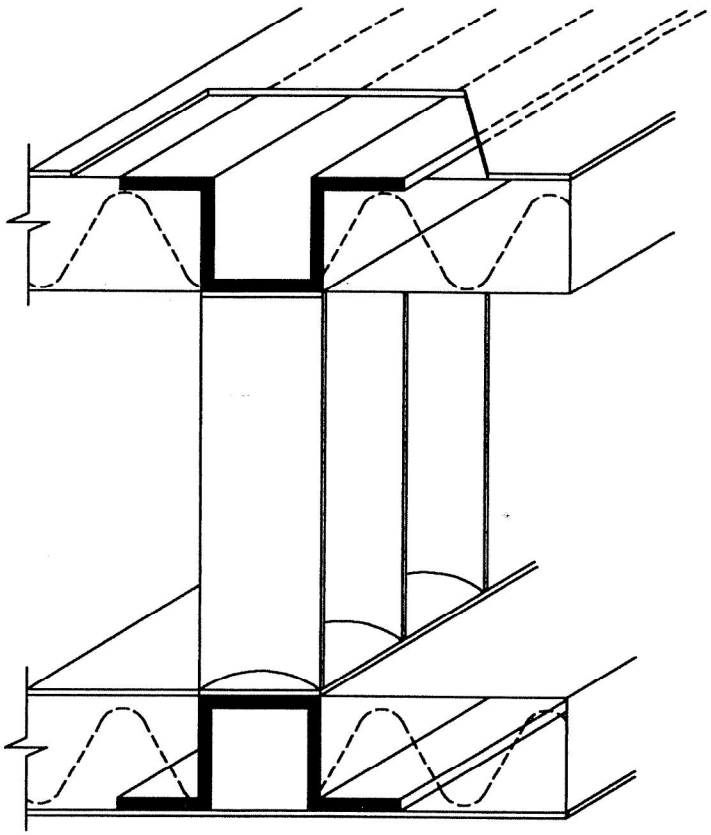
HEAD TYPES

INSTALLED PINS AND WASHERS SHALL NOT COMPRESS LINER MORE THAN THE CORRECT LENGTH SPECIFIED FOR THE LINER THICKNESS USED.

LINER FASTENERS FIG. 2-20

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	



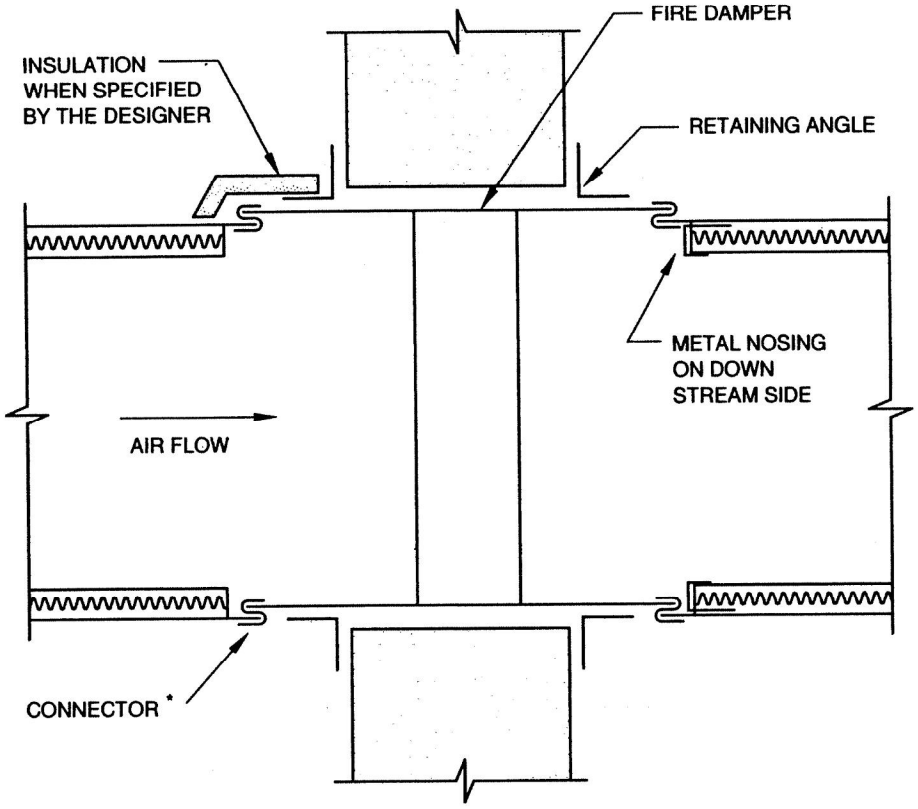
* HAT SECTION USED AS INSULATED "BUILD OUT". BUILD OUT IS ATTACHED TO DUCT WITH SHEET METAL SCREWS, BOLTS OR WELDS.
* usage range 4001 FPM (20.3 mps) – 6000 FPM (30.5 mps)

SEE FIG. 2–3 and 2–4.

VANES AND DAMPERS MUST BE INSULATED IN A MANNER THAT WILL NOT DISRUPT LINER, RESTRICT DAMPER OPERATION OR INCREASE FRICTION LOSS.

OPTIONAL HAT SECTION

FIG. 2-21



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 occuring on unlined or uninsulated metal at penetrations and should specify control measures.

This 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.

DUCT LINER INTERRUPTION

FIG. 2-22