FIBROUS GLASS
DUCT CONSTRUCTION STANDARDS

SMACNA

SHEET METAL AND AIR CONDITIONING CONTRACTORS
NATIONAL ASSOCIATION, INC.
FIBROUS GLASS
DUCT CONSTRUCTION STANDARDS

Sixth Edition-1992

SHEET METAL AND AIR CONDITIONING CONTRACTORS
NATIONAL ASSOCIATION INC.
4201 Chantilly Center Drive
Chantilly, VA. 22021
TO:        SMACNA Members
FROM:      John H. Stratton
            Director of Technical Services
SUBJECT:   Fibrous Glass
            Health & Safety Information
            Resource List

Enclosed is a list of selected resources of information on health and safety issues associated with fibrous glass, including organizations which have or are engaged in studies and a brief review of the regulatory status of fibrous glass use.

Material Safety Data Sheets (MSDS) should be consulted when fibrous products are being used.

Enclosure
SELECTED RESOURCES OF INFORMATION
ON HEALTH AND SAFETY ASPECTS
OF FIBROUS GLASS AND INDOOR AIR QUALITY

A. HEALTH AND SAFETY ISSUES

1. Skin or Eye Irritation
2. Respiratory Irritation
3. Respiratory Disease
4. Combustibility
5. Mold Growth
6. Particle Erosion and Circulation
7. Biological Contaminant Release
8. Biological Contaminant Collection
9. Volatile Organic Compound Off-Gassing
10. Moisture Collection/Retention
11. Dirt Collection
12. Cleanability and Sanitization
13. Odor
14. Corrosiveness
15. Allergens
16. Carcinogen Potential

This list covers subjects that have been addressed by numerous investigators for manufacturing facilities, fabrication and installation practices, end user exposures or in test laboratories. It is beyond the purpose of SMACNA to summarize the results of former and ongoing medical and scientific research or to describe the extent to which fibrous glass material is judged a risk or risk free. These materials are widely accepted in the nation's mechanical codes and building codes.

B. RESOURCES (A partial list)

1. Underwriters Laboratories, 33 Pfingsten Road, Northbrook, IL 60062
   * Standard 181, Factory-made Air Ducts and Connectors

2. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269
   * NFPA Standards 90A and 90B

3. American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1791 Tullie Circle, NE, Atlanta, GA 30329
   * Standard 62-1989, Ventilation for Acceptable Indoor Air Quality
* Proceedings of the ASHRAE Indoor Air Quality Conferences

* Air Contaminants Chapter, ASHRAE Fundamentals Handbook

* Building Systems: Room Air and Air Contaminant Distribution, 1989 (51 Papers)


4. American Conference of Governmental Industrial Hygienists, ACGIH, 6500 Glenway Avenue, Bldg. D-7, Cincinnati, OH 54221

* Threshold Limit Values (TLV) for Chemical Substances in the Work Environment Adopted by ACGIH

* Industrial Ventilation Manual

5. U. S. Environmental Protection Agency (EPA), 410 M Street, Washington, DC 20462

* Health Hazard Assessment of Non-Asbestos Fibers, December 30, 1988

* Carcinogenic Risk Assessment (Inquire about current research)

* Durable Fiber Exposure Assessment, 1986, 347 pages


* Indoor Air Quality Selected References (NIOSH report of 527 indoor air quality and sick building syndrome investigations plus a list of 27 IAQ references published more recently than 1980)


* Minimum Requirements of Construction and Equipment for Hospital and Medical Facilities. DHEW (HRA) 79-14500

* Occupational Exposure to Fibrous Glass (1974 symposium proceedings published in 1976 by NIOSH)
NIOSH Criteria for a Recommended Standard on Occupational Exposure to Fibrous Glass (1977)

7. National Institute for Occupational Safety and Health (NIOSH), 4676 Columbia Parkway, Cincinnati, OH 45226

* Recommended Exposure Limits (REL)

* Airborne Fiber Concentration Measurement Methods

8. National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709

* Office of Occupational Health and Technical Services (Information)

9. Occupational Safety and Health Administration (OSHA), 200 Constitution Avenue, Washington, DC 20210

* Permissible Exposure Limits (PEL) for Air Contaminants


10. State of California, Department of Health Services, 714/744 P Street, P. O. Box 942732, Sacramento, CA 9423407320

* California Safe Drinking Water and Toxic Enforcement Act of 1986, (Proposition 65)

11. World Health Organization, WHO Publications Center, USA, 49 Sheridan Avenue, Albany, NY 12210

* Environmental Health Criteria 77, Man-Made Mineral Fibers, 1988, ISBN 92-4-154277-2; (271 references are listed in this)

* Monographs on Evaluation of the Carcinogenic Risk of Chemicals (Man-made Chemical Fibers) to Humans

* Biological Effects of Man-made Mineral Fibers, WHO/AARC Proceedings

12. American Industrial Hygiene Association, 475 Wolf Ledges Parkway, Akron, OH 44311

* Journal articles

13. Heldref Publications, 4000 Albermarle Street, NE, Washington, DC

* Archives of Environmental Health: An International Journal


* American Journal of Industrial Medicine, Articles 20

15. Finnish Institute of Occupational Health, Topeliuksenkatu 41a, SF-0.0250, Helsinki, Finland

* Scandinavian Journal of Work, Environment and Health


* British Journal of Industrial Medicine

17. George Washington University, 2300 K street, NW, Washington, DC 20037

* Division of Occupational and Environmental Medicine (Inquire about current research)

18. John Hopkins University, Department of Environmental Sciences, 615 N. Wolfe Street, Baltimore, MD 21287 (Inquire about current research)

* School of Hygiene and Public Health

19. University of California, Berkley, CA 94720 (Inquire about current research)

* Environmental Health Sciences School of Public Health

20. University of Nevada, Las Vegas, NV (Inquire about current research)

* Environmental Monitoring Systems Laboratory
21. University of Pittsburgh, Pittsburgh, PA 15261
   (Inquire about current research)
   * Department of Biostatistics, Graduate School of Public Health

22. Fibrous Glass Product Manufacturers
   * Material Safety Data Sheets (MSDS) (Used to comply with OHSA's Hazard Communication Standard)

23. North American Insulation Manufacturers Association, NAIMA (Formerly known as TIMA) 44 Canal Center Plaza, Suite 310, Alexandria, VA 2235, 703-684-0084
   * Health and Safety Aspects of Fibrous Glass
   * Fact About Man-made Vitreous Fiber (mold growth, airborne fiber, filter particle erosion, duct cleaning, etc.)

24. SMACNA, 4201 Lafayette Center Drive, Chantilly, VA 22031
   * Indoor Air Quality Manual

C. REGULATION

Currently fibrous glass is still classified as a possible carcinogen (based on animal studies) by the World Health Organization but appeals by industry are being made for "not classifiable" status or "probably not carcinogenic to humans" status. However, OSHA has just proposed that it be given a permissible exposure limit of one fiber per cubic centimeter. This level is recommended by board manufacturers as prudent. Formerly OSHA only regulated the material as nuisance dust.

OSHA believes that sufficient evidence of non-malignant respiratory disease exists and states that a current 8-hour time weighted average (TWA) exposure limit of 1.0 f/cc is applied in four countries. Three countries have -higher limits; one has a lower level.

ASHRAE Standard 62-1989, Ventilation for Indoor Air Quality (IAQ) Control, a document developed with the assistance of engineers, scientists and medical professionals does not identify fibrous glass as a specific hazard to be controlled
in hvac systems or in occupied, ventilated spaces. As an alternative to providing ventilation air of specified quality and quantity it permits IAQ control by "controlling known specifiable contaminants." Standard 62 is adopted by many regulatory agencies. The 1989 edition requires that "ventilation ducts and plenums shall be constructed and maintained to minimize the opportunity for growth and dissemination of microorganisms through the ventilation system."

Currently there are no nationally imposed or recognized standards for duct cleaning or duct cleanliness (other than those pertaining to clean room conditions). ASHRAE has initiated research (TRP-759) on identification and effectiveness of current methods and criteria applied in non-routine cleaning and decontaminating of ducts and other HVAC components.

SMACNA specifically disclaims any responsibility for conclusions reached by researchers on the subject of health and safety. It is SMACNA's sole purpose to place before the user of this manual a variety of resource materials on the subject from well regarded private and public organizations. Conclusions not confirmed by any independent evaluation by SMACNA or any agent of SMACNA.
The sixth edition of this standard reflects significant changes from former editions. SMACNA has discontinued the pressure sensitive tape standards AFTS 100 and 101. Underwriters Laboratories Standard 181A supersedes them. The omission of rigid round duct and ten-sided duct and 1400 EI board construction details is solely due to infrequent use and is not intended to discourage their use.

Many new provisions for fitting reinforcement are included. They, along with other details and the inspection list, are adapted from research and documentation made available from the Thermal Insulation Manufacturers Association (TIMA). After a merger the North American Insulation Manufacturers Association (NAIMA) replaced TIMA. All references to TIMA in this publication shall mean NAIMA. NAIMA currently maintains an office in Alexandria, Virginia. The acronym TIMA is used only because it is more familiar. Differences in this standard and the 1989 TIMA Fibrous Glass Duct Construction Standards are mainly distinguished by TIMA’s inclusion of detailed fabrication instructions. Some technical content differences occur out of preference. They should not be construed as disapproval of methodology.

SMACNA gratefully acknowledges the contributions of its own committees, of TIMA, and of those who reviewed drafts of the sixth edition. Former contributors are acknowledged in the appendix.
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REFERENCES

The following should be used as reference material when working with the information contained in this Standard.

ASHRAE Handbook and Product Directory—
Fundamentals, Systems and Equipment Volumes
American Society of Heating, Refrigerating and Air-
Conditioning Engineers

NFPA Standard 90A—Installation of Air
Conditioning and Ventilating Systems

NFPA Standard 90B—Installation of Residence
Type Warm Air Heating and
Air Conditioning Systems
National Fire Protection Association

Standard for Safety—Factory-Made Air Duct
Materials and Air Duct Connectors UL 181
Underwriters' Laboratories, Inc.

Test Methods for Pressure Sensitive Tapes
Pressure Sensitive Tape Council.

HVAC Duct Construction Standards, Metal and
Flexible, 1st Edition, 1985—SMACNA

HVAC Air Duct Leakage Test Manual, 1st Edition,
1985—SMACNA

Health and Safety Aspects of Fiber Glass—
Thermal Insulation Manufacturers Association
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MODEL PROJECT SPECIFICATION

Fibrous glass duct shall be of type (475) (600) and shall be of (1" (25.4 mm)) (1½" (38.1mm)) thickness conform to the SMACNA Fibrous Glass Duct Construction Standards, 6th Edition, 1992 (FGDS-9) or the TIMA Fibrous Glass Duct Construction Standards, 1st Edition, 1989 (TFGDS-89). The fabricator shall submit for the approval of owner's representative or the approval of local mechanical code official the following:

1. The title of the standard the fabricator chooses to comply with;

2. A list of any deviations from the selected standard and the reason(s) therefor;

3. The name and product rating of manufacturer of the duct board;

4. The type of closures systems selected, along with confirmation that they are acceptable to the board manufacturer and are listed by U.L.

5. A schedule of duct pressure classifications and the air handling systems for which they are selected.

6. The type and spacing interval of supports selected;

Zinc coating weight for all galvanized steel sheet shall be (G 60) (G 90).

Notice to Specifiers: The separate SMACNA and TIMA standards were produced with different objectives. Although much of the construction detail is similar in the two manuals, there are significant differences. In some instances SMACNA has featured only methods that contractors would consider to be the most economical. In others a conservative approach was taken to limit the number of alternatives in order to have fewer nuances to be concerned with. Otherwise, having other qualified training resources precludes the need for comprehensive fabrication instructions. Discrediting the TIMA approach to the scope of standards was not an objective. For fabrication with type 1400 board, see TIMA standards noted above.
CHAPTER 1
PERFORMANCE CRITERIA

FIBROUS GLASS DUCT CHARACTERISTICS AND LIMITATIONS

1. Flexural Rigidity (EI)
Average in the board, not less than rating of 475,800 or 1400 lb./sq. in. per inch of width when tested in accordance with TIMA Test Method HS-100-74. Consult TIMA or board manufacturers for 1400 Ei board construction schedules; they are not in this edition due to infrequent use.

2. Maximum static pressure in duct
2" W. G. (498 Pa), positive or negative

3. Maximum air velocity in duct
2,400 feet per minute (13.92 m/s)

4. Maximum allowable deflection
Duct width/100 (for rectangular duct wall).

5. Maximum allowable stress in steel members used for reinforcement or support
22,000 pounds per square inch (152 MPa) with 30,000 psi (207 MPa) yield strength minimum.

6. Board fatigue
No significant deformation or deficiency of duct sections after 50,000 cycles at 3 to 4 cycles per minute from natural sag to 1½ times operating pressure.

7. Moisture adsorption
Moisture adsorption of the board will not exceed 5% by weight under conditions of 120 deg. F. (49 deg. C.) dry bulb at 95% R.H. for 96 hours duration, when tested in accordance with ASTM C 553.

8. Temperature
250 deg. F (121 deg. C.) maximum inside the duct, continuous operation. 150 deg. F. (66 deg. C.) maximum duct surface temperature.

9. Corrosiveness
Non-corrosiveness on contact with galvanized steel, copper or aluminum when compared to control specimen in contact with clean, sterile cotton when tested in accordance with ASTM C 665.

10. Closure
Closure conforms to: Underwriters’ Standard UL 181, (or UL 181A) installed in accordance with the manufacturer's Class 1 Air Duct listing.

11. Safety Standards
NFPA Standard 90A, 90B

12. Reinforcement testing
Test programs have demonstrated that fibrous glass duct systems, including fittings such as offsets, tees, elbows, branches, transitions, and accessory items are capable of maintaining their structural integrity through 50,000 cycles at one and one half times system design pressurization. While this testing demonstrates the reliability of properly constructed systems, it does not imply that systems should be operated at pressures above their reinforcement rating.

13. Restrictions
Fibrous glass duct systems should not be used in the following applications:

  a. Kitchen exhaust or fume exhaust ducts, or to convey solids or corrosive gases.
  b. Installation in concrete or buried below grade.
  c. Outdoors
  d. As casings and/or housings of built-up equipment.
  e. Immediately adjacent to high temperature electric heating coils without radiation protection. Refer to NFPA Standard 90A.
  f. In more than two stories of riser.
  g. With equipment of any type which does not include automatic maximum temperature controls.
  h. With coal or wood fueled equipment.
  i. Where normal operating pressure or occasional over pressure would exceed product rating.
j. As penetrations in construction where fire dampers are required.

k. Where moisture would collect in the duct.

l. Where clean room condition is needed in the duct.

m. Where condensation would occur on the duct exterior, unless the duct exterior was a vapor barrier (impermeable).

14. Mounting of accessories
When mounting equipment, dampers, damper operators, control motors, etc., the duct system must be adequately reinforced and support to accommodate the additional weight of the material and equipment without damage to the duct material. Particularly important is the mounting of both dampers and their operators on the same sleeve or mounting plate.

15. Class 1 Air Duct Rating
When ducts must conform to NFPA Standard 90A and/or model codes, fibrous glass ducts are required to conform to the following requirements:

a. They shall be constructed of Class 1 duct materials as tested in accordance with Underwriters' Laboratories Standard for Factory-Made Duct Materials and Air Duct Connectors, UL 181.

b. Such ducts shall be installed in accordance with conditions of their listing.

c. They may not be used in air duct systems which operate continuously with an air temperature higher than 250 deg. F. (121 deg. C.) entering the ducts. (Test data on Class 1 rigid ducts exposed to 350 deg. F. (177 deg. C.) for 24 hours show no visible deterioration).

d. They shall not be used as vertical risers of more than two stories.

e. They may be directly attached to listed heating and cooling equipment designed to operate at temperatures not exceeding 250 deg. F. (121 deg. C.).

f. Under UL Standard 181 Class 1 air duct materials have Flame Spread rating not exceeding 25 without evidence of continued progressive combustion and a Smoke Developed rating not exceeding 50. Furthermore, the following portions of UL 181 are applicable to rigid fibrous glass ducts in new material condition:

   (1) Fire hazard classification
   (2) Flame penetration
   (3) Burning
   (4) Temperature
   (5) Puncture
   (6) Static load
   (7) Impact
   (8) Erosion
   (9) Pressure and collapse
   (10) Leakage
   (11) Corrosion, mold growth and humidity.

Pressure sensitive tapes that pass UL Standard 181A tests are imprinted with the producers name (or symbol), date of manufacture, product code and the wording "UL Listed 181A-P". Heat activated tapes, coded 181A-H, have similar imprinting.

16. Use in Medical Facilities
The United States Department of Health, Education and Welfare requirements for construction of hospitals and medical facilities (including outpatient surgical facilities) prohibit use of duct linings in systems supplying operating rooms, nurseries, isolation rooms and intensive care units unless terminal filters of at least 90% efficiency are installed downstream of linings.

17. Other Performance Characteristics
Consult design handbooks and board manufacturers for friction loss coefficients and thermal and acoustical performance. Duct leakage is not expected to exceed SMACNA Class 6. The applicable rates in CFM per 100 S.F. of duct surface area at various inches water gage static pressure levels are: 2.4 (a 0.25"; 3.8 (a 0.5"; 5.0 (a 0.75"; 6.0 (a 1.0"; 7.8 (a 1.5" and 9.4 (a 2.0".

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CHAPTER 2

SPECIFICATIONS AND CLOSURE

GENERAL SPECIFICATION REQUIREMENTS

2.0 All ducts required to meet Class 1 Air Duct rating shall comply with Underwriters Laboratories (U.L.) Standard 181. All closure systems shall meet U.L. 181 or U.L. 181A. Pressure sensitive tapes shall be, imprinted with the coding 181 A-R, the manufacturers name and a date code. Heat-sealable tape shall have similar imprinting but carry the coding 181A-H.

2.1 All fibrous glass duct shall be of (475) (800) E I flexural rigidity rating as determined by TIMA Test Number AHS-100 and shall be constructed so that the duct wall deflection does not exceed one one-hundredth of the span when pressurized at or below the rated pressure classification. The EI rating shall be imprinted on the facing.

2.2 Construction detail not otherwise required to conform to a condition of listing or a superimposed requirement in these standards shall conform to the recommendations of the board manufacturer.

2.3 Sheet metal items shall be fabricated as specified in the HVAC Duct Construction Standards, Metal and Flexible 1985 Edition, (hereinafter referred to as the HVAC-DCS) except as necessarily altered for incorporation in fibrous glass duct. Metal items shall be installed in a manner that does not cut or damage the duct surface. Metal sleeves and collars of undesignated thickness shall be of duct wall gauge prescribed in the HVAC-DCS.

2.4 All fastenings not otherwise identified shall be #10 sheet metal screws with 2½" (63.5 mm) square washers 0.020" (0.51 mm) minimum thickness. All screws penetrating duct board shall be ½" (12.7 mm) longer than board thickness. Washers shall be used under screw heads wherever the head does not rest on channel, sleeve or other metal bearings and shall be used as retainers on duct interiors wherever metal sleeves, equipment flanges, vane rails or other suitable retainers are not present.

2.5 All horizontal branches and runouts to air terminals shall be supported independent of the main duct.

2.6 Extractor installations, if required by the designer's contract drawings, shall not be installed without metal sleeves on the duct interior.

2.7 Metal dovetail tabs that have less than ¾" (19.1 mm) length on duct interiors shall have 22 gauge (0.8534 mm) 3" (76.2 mm) wide bearing plates between the tabs and the duct wall.

2.8 Provision shall be made for locking dampers in position after flow adjustment. Quadrant damper operators shall not be used for controls without metal mounting plates to prevent damage or erosion.

2.9 All 90 degree square throat, square heel elbows other than those in transfer air ducts shall be vaned. Elbows with molded fibrous glass vanes must have tie rod or channel reinforcement on cheeks to prevent wall deflection.

2.10 Grille clips shall not be used for attachment or support of air terminals.

2.12 Metal turning vane and runner assemblies shall be fabricated in accordance with the 1985 HVAC-DCS requirements. Runners shall be fastened, two minimum, to the duct wall at 12" (305 mm) maximum intervals.

2.13 Metal access doors shall conform to the construction detail in the 1985 HVAC-DCS. Frames to receive the doors shall conform to these standards.

2.14 Access doors shall be located at least 4" (102 mm) from the end of duct joints and connections.

2.15 Ducts shall be made as indicated in these standards. They shall be secured and reinforced as specified.

2.16 All heat seal tape shall be 3" (76.2 mm) wide minimum. All pressure sensitive tape shall be 2½" (63.5 mm) minimum width.

2.17 Tapes shall be adhered to at least a 1" (25.4 mm) wide strip of each contact surface being closed. The application of tape over staples shall not result in staples puncturing the tape. Crumpled staples should be recovered and replaced with good staples prior to application of closure tape.
2.18 Staple spacing is indicated to be 2" (50.8 mm); a tolerance of plus 2" is permitted provided that the maximum distance across any 3 staples in series is 6" (152 mm).

2.19 The depth and thickness of shiplaps and all other grooving shall be that appropriate for the specific board thickness of 1" (25.4 mm) or 1 1/2" (38.1 mm).

2.20 Shiplaps may be premolded by the duct board manufacturer or be shop made. Damaged shiplaps shall be removed properly relaced prior to assembly of joints or seams.

2.21 Shiplap joints, except at tee or branch connections, shall be oriented so that the air flow direction is from the male end to the female end.

2.22 All fibrous glass duct branches that connect to mains shall use male shiplap ends on the branch at the connection or they shall have 3" (76.2 mm) x 3" (76.2 mm) x 22 gauge (0.8534 mm) metal angle brackets on the duct interior held in place with screws and washers, angles or channels on the exterior. Openings in mains and sub mains that do not have internal metal brackets shall have female shiplap forming to receive male ship. Exception: a 45 degree sloped entry should be straight cut beveled at 45 degrees.

2.23 On horizontal duct walls of less than 48" (1.22 m) width channel reinforcement extending completely around and contacting all the duct perimeter does not require attachment to the duct on positive pressure application. For 48" (1.22 m) or more width in top horizontal position the channel must be fastened to the duct with a screw and washer to control sag.

2.24 All straight duct sections and all direction change and size change fittings in positive pressure systems shall be reinforced as required herein by channel or tie rod method. Only channel reinforcement for negative pressure straight duct sections is provided in this standard.

2.25 Illustrations of tie rod end fastenings on isometric drawings are not intended to restrict alternatives to the style shown unless the associated text limits the style.

2.26 Channel reinforcements may run in either direction across end caps as is necessary to comply with the reinforcement interval and to limit end panel deflection to 1/100 of the greater span.

2.27 Tie rod reinforcements shall not be used where they will be subject to fan vibration.

2.28 The 16" (0.41 m) nominal spacing of tie rods is subject to a 2" (50.8 mm) tolerance on occasional rod location deviation. No row of tie rods is allowed on 20" (0.46 m) spacing.

2.29 Only volcano hole washers are permitted with loop terminated tie rods. Flat types may be used under the heads of metal screws and cap or rivet termination techniques.

2.30 Riser length shall not be more than two story heights.

2.31 Flexible ducts and flexible connectors shall be of the type and ratings set forth by the designer. Where the manufacturer or a testing and listing authority does not prescribe otherwise they shall be connected and supported as required by the HVAC-DCS.

2.32 Installed ducts must be free of visible damage, debris, moisture, sag and significant misalignment.

2.33 Joints without staple flaps are permitted only on gored elbows and offsets.

2.34 The omission of reinforcements and complete closure details in drawings herein that are illustrating particular features shall not be used as grounds for omitting requirements that are elsewhere and otherwise specified. Some fittings may require reinforcement even though schedules for straight ducts of the same span may show reinforcement is not required.

NOTICE Although molded round fibrous glass ducts and ten-sided ducts are not covered in this set of standards, such exclusion is not intended to discourage consideration of their use based on TIMA recommendations and conditions of listing or classifying by a testing authority.
Closures

General

Closures systems are a vital element in the proper assembly of fibrous glass duct systems, providing both the structural connection and sealing of seams and joints. Only those closure systems that comply with UL 181 or UL 181A are suitable for use with rigid fibrous glass duct systems. Listed closures include:

1. Pressure-sensitive aluminum foil tapes.

Model codes and project specifications require that non-metallic duct construction, which includes fibrous glass ducts, conform to UL 81, Class 1 requirements. Under UL 181A listing procedures, an individual closure system may be qualified for use on all manufacturers’ boards which meet the UL 181 requirement. UL 181A tapes are imprinted for identification.

Joint and Seam Preparation

Longitudinal seams are prepared as described in Figure 2-3. Transverse joints between two duct sections are prepared by joining two duct sections, pulling the staple flap over the adjoining section and stapling as shown in the illustrations.

Seams and Joints Without Staple Flaps

When staple flaps are not present, cross tabs are used to hold seams and joints in position prior to application of the closure system. Cross tabs, made from 6” minimum lengths of closure tape, are to be equally spaced on each side of the joint and on 12” (maximum) centers with at least one cross tab per duct side (Fig. 2-2). Cross tabs may be placed either under or over the closure tape.

Surface Preparation

In order to obtain satisfactory adhesion and bonding, the surface on which closures will be applied must be clean and dry. Dust, dirt, oil, grease, moisture and similar substances may result in adhesion and bonding failure when present. In many cases, wiping the application surface with an oil-free lint-free rag or paper towel would be sufficient. However, for the best results on contaminated surfaces, the cleaning recommendations of the tape manufacturer should be consulted.

Shelf Life

Tapes and mastics often have storage requirements and shelf life limitations. The installer should verify that these conditions have not been exceeded prior to use.

Notes

1. Manufacturers closure application instructions must be followed.
2. Heat activated tapes have color change dots to indicate satisfactory bond.
3. Glass fabric closure requires mastic application before and after fabric placement and has a prescribed set up time.
4. See mechanical reinforcement requirements at seams and joints in the reinforcement provisions.
1. Corner seams are closed with $\frac{1}{2}''$ (12.7 mm) minimum outward clinching staples approximately 2'' (50.8 mm) o.c.
2. With machine applied heat-sealable tape staples may be omitted.
3. Tape is centered over the edge of the flap so that a minimum of 1'' (25.4 mm) overlap occurs on adjacent surfaces.
4. Tape must be essentially free of wrinkles, uniformly adhered, free of staple punctures and pressed sufficiently to show duct facing reinforcement impressions in the tape.
5. Assembly of corners with two square cut butt edges is not permitted.
6. Cross tabs are 8'' (203 mm) long tape strips 12'' (305 mm) o.c. maximum; not fewer than one shall be used. They may go on before or after the closure tape.
ONE WAY TRANSITION, CHANGING HEIGHT

\[ Y = H_1 - H_2 \]

Figure 2-4

NOTE
Maximum Slope: for expanding flow 22\( \frac{1}{2} \) degrees; for contracting flow 30 degrees.

ONE-WAY TRANSITION, CHANGING WIDTH

\[ X = \text{Dimension change} \]
\[ W_2 = W_1 - X \]

Figure 2-5

NOTE
If the sloping panel is short of end by more than \( \frac{3}{8} \)" (9.52 mm), a shiplapped filler panel [minimum of 6" (152 mm) long] is used at either end of sloped panel or the slope is equally divided on two opposite sides to meet the \( \frac{3}{8} \)" (9.52 mm) limit.

NOTE: SEE COMPLETE CLOSURE SPECIFICATIONS
TWO WAY TRANSITION, CHANGING WIDTH AND DEPTH

\[ W_2 = W_1 - 2X \]
\[ H_2 = H_1 - Y \]

NOTES
1. Maximum Slope: for expanding flow 22\frac{1}{2} degrees; for contracting flow 30 degrees.
2. If sloping panel is short of end by more than \frac{3}{8}" (9.52 mm) a shiplapped filler panel (minimum 6" (152 mm) long) is used at either end of sloping panel, or the slope is equally divided on two opposite sides to meet a \frac{3}{8}" (9.52 mm) limit.

TWO WAY TRANSITION, ALTERNATE

NOTE: SEE COMPLETE CLOSURE SPECIFICATIONS
MULTIGORE ELBOW

Figure 2-7

ELBOWS OF LESS THAN 45 DEGREES

Figure 2-8

NOTE: SEE COMPLETE CLOSURE SPECIFICATIONS
OFFSET

L = 4" (102 mm) minimum

NOTE
Slope of offset is 30 degrees maximum.

Figure 2-9

NOTE: SEE COMPLETE CLOSURE SPECIFICATIONS
TEE WITH EQUAL LEGS AND SPLITTER

NOTE
Reinforcement, two sets of vanes are used in this type of tee.

END PANEL SEE FIGURE 2-18

Figure 2-10

BRANCH TAKE-OFF WITH SPLITTER

NOTE
Stationary metal splitters for both figures have hemmed leading edges and 1\(\frac{1}{2}\)" (38 mm) min. Flanges fastened with two screws and washers each side, minimum.

END PANEL SEE FIGURE 2-18

Figure 2-11

NOTE: SEE COMPLETE CLOSURE SPECIFICATIONS
90 DEGREE ELBOW WITH SHEET METAL TURNING VANES

Runners fastened with \#10 × 1 ¼" (32 mm) sheet metal screws and 2½" (64 mm) square washers, min. 2 per side or 12" (305 mm) (max.) O.C.

VANES ARE TYPICALLY ¾" (19 MM) THICK WITH 4" (102 mm) RADIUS AND 3" (76 mm) SPACING

VANE SEATING DETAIL: CONTOURED HOLES MUST NOT PENETRATE THE FOIL CASING. VANES ARE GLUED IN ON SPACINGS THAT SUIT LOSS COEFFICIENTS

90 DEGREE ELBOW WITH FIBROUS GLASS TURNING VANES

NOTE: SEE COMPLETE CLOSURE SPECIFICATIONS

NOTE
Fibrous glass turning vanes are limited to specific lengths. See manufacturers' instructions.
45 DEGREE ENTRY BRANCH

Figure 2-15

L = \frac{1}{4} W, 6" MIN. (152 mm)

H_2 = H_1

T = Broad thickness
Branch depth is less than main depth

Figure 2-16

ANGLED ENTRY DETAIL

ADJUSTABLE SPLITTER DAMPER (Used on supply duct only)

Figure 2-17

LOCKING BALL JOINT MOUNTED ON MAIN DUCT

22 GA. (0.7534 mm) MIN. TAPERED BLADE MORE RODS ARE ADDED TO STABILIZE LARGE BLADES.

NOTE: SEE COMPLETE CLOSURE SPECIFICATIONS
END CAPS

NOTE
See figure 3-31

Figure 2-18
12" MAX. (305 MM)
ONE MIN.

Figure 2-19

Figure 2-20

NOTE: SEE COMPLETE CLOSURE SPECIFICATIONS
ACCESS DOORS

ACCESS DOOR, FLANGE ON OPENING

NOTE
See Figure 3-29

<p>| PRESSURE RANGE, | ACCESS DOOR SIZE |</p>
<table>
<thead>
<tr>
<th>INCHES W.G.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0” to 1”</td>
<td>24” x 24” MAX.</td>
</tr>
<tr>
<td>1” to 2”</td>
<td>16” x 16” MAX.</td>
</tr>
</tbody>
</table>

Reinforcement is provided as necessary to maintain duct pressure classification.

**Figure 2-21**

FRAMING ACCESS DOOR OPENING:

1" X 1" X 1", 22 GAUGE Z-FRAMING AROUND OPENING

3", 22 GAUGE SHEET METAL FRAMING INSIDE DUCT

#10 X 1¼" SHEET METAL SCREWS, 6" (MAX) O.C.

FRAMING ACCESS DOOR:

1" X 1" X 1", 22 GAUGE U-CHANNEL AROUND DOOR. FASTEN CORNERS AS REQ'D.

FIBROUS GLASS DUCT BOARD

STEEL BUTT HINGES AND/OR WINDOW TYPE SASH LOCKS

**Figure 2-22**

**NOTE:** SEE COMPLETE CLOSURE SPECIFICATIONS
NOTE
Sheet metal connections must be made using glass fabric and mastic (GFM).

EXCEPTION:
When construction pressure class is 1" W.G. or less and sheet metal surfaces are cleaned carefully UL listed pressure-sensitive aluminum tape may be used.
All connections of fibrous glass duct to equipment and metal duct must be mechanically attached 12" (max.) on centers.

NOTE: SEE COMPLETE CLOSURE SPECIFICATIONS
NOTE
Sheet metal connections must be made using glass fabric and mastic (GFM).

EXCEPTION:
When construction pressure class is 1” W.G. or less and sheet metal surfaces are cleaned carefully UL listed pressure-sensitive aluminum tape may be used.
All connections of fibrous glass duct to equipment and metal duct must be mechanically attached 12” (max.) on centers.

NOTE: SEE COMPLETE CLOSURE SPECIFICATIONS
ACCESSORY INSTALLATION (REGISTER AND GRILLE)

NOTE: Some ducts containing registers and grilles may require reinforcement even though schedules for straight ducts of the same size may show reinforcement is not required.

Sheet metal tap connection requires use of bearing plate inside duct. Sleeve and bearing plate sheet metal gauge are shown in table below.

<table>
<thead>
<tr>
<th>DUCT SPAN, INCHES</th>
<th>SHEET METAL GAUGE (MM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12&quot; or less (305 m)</td>
<td>26 (.012)</td>
</tr>
<tr>
<td>13&quot; to 30&quot; (.33–.76 m)</td>
<td>24 (.010)</td>
</tr>
<tr>
<td>31&quot; to 54&quot; (.79–1.4m)</td>
<td>22 (.534)</td>
</tr>
</tbody>
</table>

Connection may be made with glass fabric and mastic or with pressure-sensitive aluminum foil tape. See CLOSURES.

NOTE: SEE COMPLETE CLOSURE SPECIFICATIONS
ACCESSORY INSTALLATION (Continued)

DIFFUSER CONNECTIONS

NOTE: Some ducts containing diffuser drops may require reinforcement even though schedules for straight ducts of the same span may show reinforcement is not required.

Construction as shown in Figure 2-34 is for use when the entire drop assembly weighs less than 15 pounds. When weight exceeds 15 pounds,* diffuser must be separately supported.

*Confirm local code allowance; if any.

---

**Table:**

<table>
<thead>
<tr>
<th>Conversion</th>
<th>Metric Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1¼&quot;</td>
<td>32 mm</td>
</tr>
<tr>
<td>2½&quot;</td>
<td>64 mm</td>
</tr>
<tr>
<td>3&quot;</td>
<td>76 mm</td>
</tr>
<tr>
<td>12&quot;</td>
<td>305 mm</td>
</tr>
<tr>
<td>22 GA.</td>
<td>0.7534 mm</td>
</tr>
<tr>
<td>15 lbs</td>
<td>6.8 Kgm.</td>
</tr>
</tbody>
</table>

---

**Figure 2-34**

- Two-22 ga. 3" x 3" angles
- Dovetail collar with backup plate or spin-in collar for flexible or rigid duct
- Hangs to support weight other than diffuser

**Figure 2-35**

- Trapeze support both sides
- Diffuser support from S.M.
- Tape tap before placing fasteners
- Screws (with washers) into sheet metal collar
- Support diffuser from S.M.

**Figure 2-36** INSTALLATION WITH STAPLING FLAP

- Male shiplap on drop staple and tape to trunk
- Drop fibrous glass duct board
- Screws supporting wires
- Diffuser or grille
- Hangers installed to support weight of drop and trunk
- #10 x 1¼" sheet metal screws and 2½" square steel washers min. 2 per side, 12" (max.) O.C.

**NOTE:** See complete closure specifications
1. Tie rods and washers must be no more than 16" on centers across duct dimension.
2. Ducts of 48" width and over require use of anti-sag devices.
3. If dimensions require, tie rods run in both horizontal and vertical directions.
4. Some fittings may require reinforcement even though the schedule for straight duct does not require it.
# TIE ROD REINFORCEMENT (METRIC)

### Figure 3-1M

**TABLE 3-1M. TIE ROD SYSTEM REINFORCEMENT SCHEDULE**

<table>
<thead>
<tr>
<th>W.G. Positive Static Pressure</th>
<th>Maximum Inside Duct Dimension (m)</th>
<th>TYPE 475 BOARD</th>
<th>TYPE 800 BOARD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. Rods Across Dimension</td>
<td>Maximum Longitudinal Spacing</td>
<td>No. Rods Per 1.2 m Section</td>
</tr>
<tr>
<td>0 thru 12.7 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.94–1.06</td>
<td>2</td>
<td>.600 m</td>
<td>4</td>
</tr>
<tr>
<td>1.09–1.22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.24–1.52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.55–1.63</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.65–2.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.06–2.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over 12.7 thru 25 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.64–.76</td>
<td>1</td>
<td>.600 m</td>
<td>2</td>
</tr>
<tr>
<td>0.79–.81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.84–.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.94–1.22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.24–1.63</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.65–2.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.06–2.44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over 25 thru 50 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.41–.46</td>
<td>1</td>
<td>.600 m</td>
<td>2</td>
</tr>
<tr>
<td>0.48–.61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.64–.81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.84–1.22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.24–1.52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.55–1.62</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.65–2.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.06–2.44</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### NOTES

1. Tie rods and washers must be no more than .410 m on centers across duct dimension.
2. Ducts of 1.200 m width and over require use of anti-sag devices.
3. If dimensions require, tie rods run in both horizontal and vertical directions.
4. Some fittings may require reinforcement even though the schedule for straight duct does not require it.
TIE ROD TERMINATION METHODS

FASLOOP METHOD* (PROPRIETARY)

Materials required per the road assembly:
- 12 gauge galvanized steel wire 1¾" longer than outside duct dimension.
- Two washers, 2½" square × 0.028" thick galvanized steel, volcano type with beveled edges and 0.150" hole in center. NOTE: Other types of manufactured flat washers are not suitable for this application.

* A TIMA report states that no other size or shape of loop has been tested to determine compliance with the 50,000 cycle test.

![Figure 3-2 FASLOOP TERMINATION]

<table>
<thead>
<tr>
<th>IN</th>
<th>.020</th>
<th>.028</th>
<th>0.05</th>
<th>0.15</th>
<th>3/16</th>
<th>5/32</th>
<th>5/8</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>.51</td>
<td>.71</td>
<td>1.3</td>
<td>3.7</td>
<td>4.8</td>
<td>5.6</td>
<td>9.5</td>
</tr>
</tbody>
</table>

POP RIVET SLEEVE METHOD

Materials required per tie rod assembly:
- 12 gauge galvanized steel wire, cut exactly to outside duct dimension.
- Two washers, 2½" square × 0.020" (min.) thick galvanized steel with beveled edges and 7/32" diameter center hole.
- Two 3/16" steel pop rivet sleeves, ¾" long.

![Figure 3-3 POP RIVET SLEEVE TERMINATION]

<table>
<thead>
<tr>
<th>IN</th>
<th>3/16</th>
<th>5/32</th>
<th>1/4</th>
<th>5/32</th>
<th>12 GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>11</td>
<td>22.2</td>
<td>44</td>
<td>63</td>
<td>2.7</td>
</tr>
</tbody>
</table>

LOCKING CAP METHOD

(Not to be used on sloped panels of fittings)

Materials required per tie rod assembly:
- 12 gauge galvanized steel wire, cut ¾" longer than outside duct dimension.
- Two washers, 2½" square × 0.020" (min.) thick galvanized steel with beveled edges and 0.150" dia. hole in center.
- Two locking caps, ¾" diameter, having spring steel or stainless steel locking inserts.

![Figure 3-4 LOCKING CAP TERMINATION]

NOTES

1. An ordinary insulation locking washer does not have sufficient holder power.
2. Wire must be free to move within the 2½" square washer.
3. Do not re-use locking caps.

Reuse of cap is prohibited.
TIE ROD REINFORCEMENT AT JOINT

SAG CONTROL—TIE ROD REINFORCEMENT

Top panels of fibrous glass duct sections or fittings 48" wide or greater must have sag supports per Figure 3-7 or 3-8. Sag supports do not replace tie rod assemblies as called for in the reinforcement schedule, but must be installed in addition to them. Sag supports must be located within 12" of hangers.

<table>
<thead>
<tr>
<th>IN</th>
<th>12 GA</th>
<th>.028</th>
<th>½</th>
<th>2½</th>
<th>3</th>
<th>4</th>
<th>12</th>
<th>48</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>.27</td>
<td>.71</td>
<td>12.7</td>
<td>63</td>
<td>76</td>
<td>101</td>
<td>305</td>
<td>1.22 m</td>
</tr>
</tbody>
</table>

Figure 3-5 BUTT JOINT REINFORCEMENT

Figure 3-6 SHIPLAP JOINT REINFORCEMENT

Figure 3-7 SAG CONTROL

Figure 3-8 SAG CONTROL
TABLE 3-2. CHANNEL SYSTEM REINFORCEMENT SCHEDULE

<table>
<thead>
<tr>
<th>Static Pressure,</th>
<th>Maximum Inside Duct Dimension (I.D.), in.</th>
<th>TYPE 475 BOARD</th>
<th>TYPE 800 BOARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 thru ½&quot; W.G.</td>
<td>Negative 0-30 NOT REQUIRED</td>
<td>NOT REQUIRED</td>
<td>NOT REQUIRED</td>
</tr>
<tr>
<td></td>
<td>31-36 24&quot; 22 1&quot;</td>
<td></td>
<td>48&quot; 22 1&quot;</td>
</tr>
<tr>
<td></td>
<td>36-60 24&quot; 22 1&quot;</td>
<td></td>
<td>48&quot; 22 1&quot;</td>
</tr>
<tr>
<td></td>
<td>61-72 24&quot; 22 1&quot;</td>
<td></td>
<td>24&quot; 1&quot;</td>
</tr>
<tr>
<td></td>
<td>73-84 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
<tr>
<td></td>
<td>85-96 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
<tr>
<td>0 thru ½&quot; W.G.</td>
<td>Positive 0-24 NOT REQUIRED</td>
<td>NOT REQUIRED</td>
<td>NOT REQUIRED</td>
</tr>
<tr>
<td></td>
<td>24-30 24&quot; 22 1&quot;</td>
<td></td>
<td>48&quot; 22 1&quot;</td>
</tr>
<tr>
<td></td>
<td>31-36 24&quot; 22 1&quot;</td>
<td></td>
<td>48&quot; 22 1&quot;</td>
</tr>
<tr>
<td></td>
<td>37-42 24&quot; 22 1½&quot;</td>
<td></td>
<td>24&quot; 1&quot;</td>
</tr>
<tr>
<td></td>
<td>49-60 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
<tr>
<td></td>
<td>61-72 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
<tr>
<td></td>
<td>73-84 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
<tr>
<td></td>
<td>85-96 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
<tr>
<td>Over ½&quot; thru 1&quot;</td>
<td>Positive or Negative 0-15 NOT REQUIRED</td>
<td>NOT REQUIRED</td>
<td>NOT REQUIRED</td>
</tr>
<tr>
<td>W.G.</td>
<td>16-18 24&quot; 22 1&quot;</td>
<td></td>
<td>48&quot; 22 1&quot;</td>
</tr>
<tr>
<td></td>
<td>19-24 24&quot; 22 1½&quot;</td>
<td></td>
<td>24&quot; 1&quot;</td>
</tr>
<tr>
<td></td>
<td>25-36 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
<tr>
<td></td>
<td>37-48 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
<tr>
<td></td>
<td>49-60 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
<tr>
<td></td>
<td>61-72 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
<tr>
<td></td>
<td>73-84 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
<tr>
<td></td>
<td>85-96 24&quot; 22 1½&quot;</td>
<td></td>
<td>1½&quot;</td>
</tr>
</tbody>
</table>

NOTES

1. Ducts of 48" maximum width and over require use of anti-sag devices. See Figure 3-11 and 3-12.
2. Some fittings may require reinforcement even though the schedule for straight duct does not require it.
3. Reinforcement for positive pressure need not be attached to the duct board except when required for sag control. See attachment details for both positive and negative pressure application.
4. On negative pressure ducts, attach channels to each duct side on 15" centers one fastener minimum (see Figure 3-15).
Table 3-2M gives perimeter wrap reinforcement schedules for galvanized steel channels having G 60 or G 90 zinc coating weight. The application is for straight duct sections. Supplemental requirements for fittings are given in Table 3-3 and details related thereto.

### Notes

1. Ducts of 1.20 m maximum width and over require use of anti-sag devices.
2. Some fittings may require reinforcement even though the schedule for straight duct does not require it.
3. Reinforcement for positive pressure need not be attached to the duct board except when required for sag control. See attachment details for both positive and negative pressure application.
4. On negative pressure ducts, attach channels to each duct side on .41 m centers, one side.

#### Table 3-2M: Channel System Reinforcement Schedule

<table>
<thead>
<tr>
<th>W.G. Static Pressure</th>
<th>Maximum Inside Duct Dimension (I.D.) Meters</th>
<th>TYPE 475 BOARD</th>
<th>TYPE 800 BOARD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maximum longitudinal spacing</td>
<td>Channel gauge</td>
</tr>
<tr>
<td>0 thru 12.7 mm</td>
<td></td>
<td>.600 m</td>
<td>A</td>
</tr>
<tr>
<td>0 thru 12.7 mm</td>
<td>.79-.91</td>
<td>NOT REQUIRED</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0-.91</td>
<td>NOT REQUIRED</td>
<td></td>
</tr>
<tr>
<td>0 thru 12.7 mm</td>
<td>.94-1.07</td>
<td>.600 m</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>1.09-1.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.24-1.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.55-1.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.85-2.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.16-2.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over 12.7 mm Positive or Negative</td>
<td>.64-.76</td>
<td>.600 m</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>.79-.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.94-1.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.09-1.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.24-1.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.55-1.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.85-2.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.16-2.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over 12.7 mm Positive or Negative</td>
<td>.41-.46</td>
<td>.600 m</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>.48-.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.64-.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>.94-1.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.24-1.52</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.55-1.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.85-2.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.16-2.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over 25.4 mm Positive or Negative</td>
<td>.600 m</td>
<td>A</td>
<td>25 mm</td>
</tr>
<tr>
<td></td>
<td>.600 m</td>
<td>B</td>
<td>32 mm</td>
</tr>
<tr>
<td></td>
<td>.400 m</td>
<td>B</td>
<td>32 mm</td>
</tr>
<tr>
<td></td>
<td>.400 m</td>
<td>A</td>
<td>32 mm</td>
</tr>
</tbody>
</table>

### Diagram

![Diagram of reinforcement schedule with notes and units]
FITTING REINFORCEMENT POSITIVE PRESSURE SYSTEMS

PARTIAL WRAP-AROUND REINFORCEMENT

Where reinforcement is required but cannot be fastened to opposite sides of a duct section or fitting, it is necessary to install formed sheet metal channels that partially wrap around a fibrous glass duct system fitting at the required location. In such cases, #10 x 1\(\frac{1}{4}\)" plated sheet metal screws and 2\(\frac{3}{8}\)" square washers are used to attach the ends of the channels to the duct board. LS is the longitudinal spacing.

**Figure 3-9 PARTIAL WRAP-AROUND REINFORCEMENT**

<table>
<thead>
<tr>
<th>TABLE 3-3. PARTIAL WRAP-AROUND REINFORCEMENT SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive static Pressure</td>
</tr>
<tr>
<td>Maximum Inside Duct Dimension, Inches</td>
</tr>
<tr>
<td>0' thru 1/2&quot; W.G.</td>
</tr>
<tr>
<td>37-96</td>
</tr>
<tr>
<td>Over 1/2&quot; thru 1&quot; W.G.</td>
</tr>
<tr>
<td>49-64</td>
</tr>
<tr>
<td>65-80</td>
</tr>
<tr>
<td>81-96</td>
</tr>
<tr>
<td>Over 1&quot; thru 2&quot; W.G.</td>
</tr>
<tr>
<td>16-24</td>
</tr>
<tr>
<td>25-32</td>
</tr>
<tr>
<td>33-48</td>
</tr>
<tr>
<td>49-64</td>
</tr>
<tr>
<td>65-80</td>
</tr>
<tr>
<td>81-96</td>
</tr>
</tbody>
</table>
Fitting Reinforcement Positive Pressure Systems (Metric)

Partial Wrap-Around Reinforcement

Where reinforcement is required but cannot be fastened to opposite sides of a duct section or fitting, it is necessary to install formed sheet metal channels that partially wrap around a fibrous glass duct system fitting at the required location. In such cases, #10 x 1¼" plated sheet metal screws and 2½" square washers are used to attach the ends of the channels to the duct board. LS is the longitudinal spacing.

Figure 3-9M Partial Wrap-Around Reinforcement

<table>
<thead>
<tr>
<th>TABLE 3-3M. PARTIAL WRAP-AROUND REINFORCEMENT SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>W.G. Positive static Pressure</td>
</tr>
<tr>
<td>Maximum Inside Duct Dimension, Meters</td>
</tr>
<tr>
<td>0° thru 12.7 mm</td>
</tr>
<tr>
<td>0.64–1.22</td>
</tr>
<tr>
<td>Over 12.7 mm thru 25.4 mm</td>
</tr>
<tr>
<td>1.24–1.63</td>
</tr>
<tr>
<td>1.65–2.03</td>
</tr>
<tr>
<td>2.06–2.44</td>
</tr>
<tr>
<td>Over 25.4 mm thru 50.8 mm</td>
</tr>
<tr>
<td>0.64–.81</td>
</tr>
<tr>
<td>.64–.81</td>
</tr>
<tr>
<td>.84–1.22</td>
</tr>
<tr>
<td>1.24–1.63</td>
</tr>
<tr>
<td>1.65–2.03</td>
</tr>
<tr>
<td>2.06–2.44</td>
</tr>
</tbody>
</table>

3.8
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CHAPTER 3

CHANNEL REINFORCEMENT EXAMPLES, POSITIVE PRESSURE

The number of channels along the duct shall be as shown in Table 3-2 or 3-2M.

Figure 3-11 CHANNEL REINFORCEMENT
OFFSET TO CLEAR CLOSURE ON DUCTS
48" AND OVER

Figure 3-12 TYPICAL CHANNEL REINFORCEMENT ON 24" CENTERS, 48" DUCT SECTIONS AND 48" OR MORE WIDTH
See Table 3-2.

<table>
<thead>
<tr>
<th>IN</th>
<th>2 ½</th>
<th>3</th>
<th>4</th>
<th>24</th>
<th>48</th>
<th>18 GA</th>
<th>22 GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>63</td>
<td>76</td>
<td>101</td>
<td>.61 M</td>
<td>1.22 M</td>
<td>1.181</td>
<td>.7534</td>
</tr>
</tbody>
</table>

For sag support in ducts 48" or greater in maximum dimension, each reinforcement must be fastened to top of duct in midspan. Detail ©.

Figure 3-10 CHANNEL REINFORCEMENT, AT JOINTS ON DUCTS WITH WIDTH LESS THAN 48"

Smagha
Fibrous Glass Duct Construction Standards • Sixth Edition

3.9
CHANNEL REINFORCEMENT NEGATIVE PRESSURE SYSTEMS

CONSTRUCTION DETAILS

Each reinforcement may be fabricated from a continuous length of channel having three 90 degree bends and a fourth 90 degree corner which is securely fastened with bolts, screws, rivets, spotwelds or staples. Reinforcements may also be fabricated with two, three, or four securely fastened corners.

LOCATING REINFORCING CHANNELS

In negative pressure applications, reinforcement is applied over male shiplap and is attached with screws and clips at intervals not exceeding 16". When additional channels are required (between joints), they are attached to the duct with #10 plated sheet metal screws and 2½" square washers as in Figure 3-15A, for positive pressure applications.

<table>
<thead>
<tr>
<th>TRANSVERSE DIMENSION (INCHES)</th>
<th>FASTENER REQUIREMENTS, NEGATIVE PRESSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM NUMBER OF CLIPS OR WASHERS PER REINFORCING MEMBER</td>
<td>16&quot;-32&quot;</td>
</tr>
<tr>
<td>METERS</td>
<td>.41-81</td>
</tr>
<tr>
<td>MINIMUM NUMBER OF CLIPS OR WASHERS</td>
<td>1</td>
</tr>
</tbody>
</table>

Figure 3-14 CHANNEL REINFORCEMENT

Figure 3-13 CHANNEL REINFORCEMENT AT JOINTS FOR NEGATIVE PRESSURE SYSTEMS

Figure 3-15A TYPICAL CHANNEL REINFORCEMENT ON 16" CENTERS, 48" DUCT SECTIONS

Figure 3-15 CHANNEL REINFORCEMENT ON 16" CENTERS, 48" DUCT SECTIONS
FITTING REINFORCEMENT 90 DEGREE ELBOWS

SHIPLAP CONSTRUCTION
Cheek Panels—Positive Pressure

If neither A nor W are greater than the maximum unreinforced duct dimension but diagonal X-Y is greater than the maximum unreinforced duct dimension per Table 3-1 or 3-1M, pages 3.1 or 3.2; install tie rod reinforcement at mid-span of diagonal.

NOTE
Turning vanes omitted for clarity.

<table>
<thead>
<tr>
<th>IN</th>
<th>2½</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>64</td>
<td>101</td>
</tr>
</tbody>
</table>

Figure 3-16 TIE ROD REINFORCEMENT AT DIAGONAL X-Y MID-SPAN, 90° ELBOWS

If either A or W is greater than the maximum unreinforced duct dimension:
• Reinforce per Table 3-1, or 3-1M, pages 3.1, or 3.2.
• Reinforce 4" upstream from female shiplap joints.
• Reinforce where centerlines intersect.

NOTE
Turning vanes do not replace reinforcement. For reinforcement of mitered elbows use reinforcement standards for offsets.

Figure 3-17 TIE ROD REINFORCEMENT, CHEEK PANELS, LARGE 90° ELBOWS
FITTING REINFORCEMENT 90 DEGREE ELBOWS (Continued)

SHIPLAP CONSTRUCTION—HEAD AND THROAT PANELS—POSITIVE PRESSURE

If duct dimension $H$ is less than the maximum unreinforced duct dimension from Table 3-1 or 3-1M, page 3.1 or 3.2, but more than 24"$, install sheet metal angle per Detail ☀ below. (Angle may also be installed on inside of throat.)

**Figure 3-18 SHEET METAL ANGLE REINFORCEMENT AT THROAT, 90 DEGREE ELBOWS**

When duct dimension $H$ normally requires reinforcing, install sheet metal angle per Detail ☀ below. Install tie rods through angle on upstream side, 16" on centers, in accordance with Table 3-1 or 3-1M, page 3.1 or 3.2 with angle length $L$ from table below.

<table>
<thead>
<tr>
<th>No. Tie Rods</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Length $L$, in.</td>
<td>4</td>
<td>20</td>
<td>36</td>
<td>52</td>
<td>68</td>
</tr>
</tbody>
</table>

**Figure 3-19 SHEET METAL ANGLE REINFORCEMENT AT THROAT, LARGE 90 DEGREE ELBOWS**

For reinforcement of mitered elbows use reinforcement standards for offsets.
FITTING REINFORCEMENT BRANCH CONNECTIONS

BRANCH CONNECTIONS
Reinforcement—Positive Pressure

If W is greater than one half the Table 3-1, or 3-1M maximum unreinforced duct dimension, but not greater than the maximum unreinforced duct dimension, reinforce per Fig. 3-20, 4" off female shiplap.

DETAIL A THROAT REINFORCEMENT

If H is greater than 16" and W is greater than the Table 3-1, or 3-1 maximum unreinforced duct dimension, reinforce per Fig. 3-21, Detail A and Table 3-1, or 3-1M, page 3.1, or 3.2. For angle length L, see table below.

<table>
<thead>
<tr>
<th>No. Tie Rods</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Length L, in.</td>
<td>4</td>
<td>20</td>
<td>36</td>
<td>52</td>
<td>68</td>
</tr>
</tbody>
</table>

3" x 3" x 20 GAUGE ANGLE

If W is greater than the maximum longitudinal reinforcement spacing of the trunk duct, and/or H is greater than 16", reinforce per Fig. 3-22 and Table 3-3 or 3-3M, page 3.7 or 3.8.

NOTE
When a tie rod location per Table 3-1 or 3-1M falls in the branch opening it is omitted and a tie rod is placed on each side of the branch.
FITTING REINFORCEMENT TEES

TEES—CHEEK PANELS—POSITIVE PRESSURE

If \( W_1 \) is less than the maximum unreinforced duct dimension but diagonals \( X-Y \) or \( Y-Z \) exceed the maximum allowable unreinforced duct dimensions, install tie rods per Fig. 3-23, 4" from female shiplaps.

NOTE
Turning vanes omitted for clarity.

<table>
<thead>
<tr>
<th>No. Tie Rods</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angle Length L, in.</td>
<td>4</td>
<td>20</td>
<td>36</td>
<td>52</td>
<td>68</td>
</tr>
</tbody>
</table>

DETAIL ② THROAT REINFORCEMENT

If \( W_1 \) is greater than the maximum unreinforced duct dimension and \( W_2 \) is greater than half the maximum unreinforced duct dimension, install tie rods 4" from female shiplap joints, per Figure 3-24 along \( W_2 \) width center lines spaced per Table 3-1, or 3-1M and across \( W_1 \) width per Table 3-1, or 3-1M.

Where a splitter damper interferes with rod reinforcement, wraparound channels must be used in their place.

NOTE
Throat reinforcement is the same as for Figures 3-18, 3-19 and 3-21.

NOTE
Turning vanes do not replace reinforcement.

<table>
<thead>
<tr>
<th>IN</th>
<th>2(\frac{1}{2} )</th>
<th>3</th>
<th>4</th>
<th>20</th>
<th>24</th>
<th>36</th>
<th>52</th>
<th>58</th>
<th>20 GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>64</td>
<td>76</td>
<td>101</td>
<td>.51 M</td>
<td>.61 M</td>
<td>.91 M</td>
<td>1.32 M</td>
<td>1.47 M</td>
<td>.906</td>
</tr>
</tbody>
</table>

Figure 3-23 TEE REINFORCEMENT AT FEMALE SHIPLAP JOINTS

COMPLY WITH TABLE 3-3 OR 3-3M

Figure 3-24 TEE REINFORCEMENT NORMAL TIE ROD LOCATIONS
FITTING REINFORCEMENT OFFSETS AND MITERED ELBOWS

OFFSETS AND MITERED ELBOWS—POSITIVE PRESSURE

Figure 3-25 MITER REINFORCEMENT WITH INTERMEDIATE TIE RODS AND EXTENDED SHEET METAL PLATES

If H is greater than the maximum unreinforced duct dimensional and cheek panels have butt joints, install reinforcement at butt joints.

NOTES
1. Tie rod spacing must not exceed Table 3-1, or 3-1M in either direction.
2. Reinforcement of mitered connections shall otherwise conform to Figure 3-5 through 3-8 and Table 3-1, or 3-1M.

<table>
<thead>
<tr>
<th>IN</th>
<th>1/8</th>
<th>1 1/2</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>20 GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>3.18</td>
<td>38</td>
<td>51</td>
<td>76</td>
<td>102</td>
<td>.906</td>
</tr>
</tbody>
</table>

Figure 3-26 REINFORCEMENT CHEEK PANELS WITH BUTT JOINTS
FITTING REINFORCEMENT TRANSITIONS

TRANSITIONS—CHEEK PANELS—POSITIVE PRESSURE

If \( H \) is greater than the maximum unreinforced duct dimension, reinforce per Table 3-1, or 3-1M, page 3.1 or 3.2. Determine tie rod spacing from larger duct dimension per Table 3-1, or 3-1M. Maintain spacing and number of tie rods throughout length of transition.

<table>
<thead>
<tr>
<th>IN</th>
<th>2½</th>
<th>3</th>
<th>4</th>
<th>20 GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>64</td>
<td>76</td>
<td>102</td>
<td>.906</td>
</tr>
</tbody>
</table>

Figure 3-27 TRANSITION REINFORCEMENT CHEEK PANELS

TRANSITIONS—SLOPED PANELS

If \( W \) is greater than the maximum unreinforced duct dimension, reinforce 4" from female shiplap and continue with reinforcement per Table 3-1, or 3-1M and Detail © below. As an alternate to Detail ©, single 2½" square washers may be glued to the facing with an adhesive system documented by the duct board manufacturer.

If facing is cut use 3" x 4" 20 gauge sheet metal plate, bent to conform to transition angle.

(Tie rod terminations must be made with Fasloop or pop rivet terminations. They may not be made using the locking cap method.) As an alternate to the steel plate, if facing is not cut, a 2½" square washer, pre-bent to conform to slope angle, may be used to secure tie rods. See Detail ©.

Figure 3-28 TRANSITION REINFORCEMENT, SLOPING SECTION

©10 PLATED SHEET METAL SCREWS
2½" SQ. WASHER
DURO-DYN GR-1 WASHER, OR EQUAL, INSIDE DUCT

DETAIL A MUST BE USED ON SLOPES

ALTERNATE WHEN FACING IS NOT CUT:
2½" SQ. WASHER PRE-BENT TO CONFORM TO SLOPE ANGLE

DETAIL B USE ON MITER JOINT, LARGE END
FITTING REINFORCEMENT ACCESS DOORS

ACCESS DOORS—POSITIVE PRESSURE

If access door width is not greater than the maximum longitudinal reinforcement spacing from Table 3-1, or 3-1M, but interferes with reinforcement locations per Table 3-1, or 3-1M, install tie rods 4" from both sides of door opening. Maximum reinforcement spacing must be in accordance with Table 3-1, or 3-1M, page 3.1 or 3.2.

If access door height is greater than 16" and width is greater than maximum longitudinal reinforcement spacing shown in Table 3-1, or 3-1M, page 3.1 or 3.2, install tie rods near vertical sides of door frame per spacing in Table 3-1, or 3-1M. Install tie rods near horizontal sides of frame per spacing in Table 3-1, or 3-1M, measuring upstream from vertical tie rod location.

NOTES

1. No access door can be located less than 4" from a transverse joint or from an end panel. All access doors require metal frames in openings.
2. Use channel reinforcement in place of tie rods between access door and fire damper where tie rods would interfere with damper access or operation.

<table>
<thead>
<tr>
<th>IN</th>
<th>4</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>102</td>
<td>.41 M</td>
</tr>
</tbody>
</table>
FITTING REINFORCEMENT END CAPS

END CAPS, SHIPLAPPED CONSTRUCTION

Channel Reinforcement—Positive or Negative Pressure

Channel reinforcement must be installed on the inside of the duct to enable the end cap to withstand the static and velocity pressures to which it will be subjected.

See Table 3-2, or 3-2M, page 3.5 or 3.6, for reinforcement channel height H and Table 3-3, or 3-3M, page 3.7 or 3.8, for channel L. Also see Table 3-3, or 3-3M for longitudinal spacing and number of attaching screws for the applicable duct span and static pressure.

<table>
<thead>
<tr>
<th>IN</th>
<th>1/8</th>
<th>1 1/4</th>
<th>2 1/4</th>
<th>3</th>
<th>60</th>
<th>18 GA</th>
<th>22 GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>3.2</td>
<td>32</td>
<td>63</td>
<td>76</td>
<td>.41 M</td>
<td>1.52 M</td>
<td>1.181</td>
</tr>
</tbody>
</table>

NOTES

1. End cap reinforcement may be applied either parallel to the longest inside dimension or parallel to the shortest, depending on sheet metal and fastener usage required.

2. End caps require reinforcement whenever the schedule for straight ducts of the same dimension shows reinforcement is required.

Figure 3-30 END CAP REINFORCEMENT CHANNEL

Figure 3-31 END CAP REINFORCEMENT INSTALLED
CHAPTER 4
RECTANGULAR DUCT HANGERS AND SUPPORTS

HANGERS AND SUPPORTS
ALLOWABLE HANGER SPACING, STRAIGHT DUCT, 3" WIDE CHANNEL

(METERS) (IN.)
(1.22) 48
(1.12) 44
(1.02) 40
(.91) 36
(.81) 32
(.71) 28
(.61) 24
(.51) 20
(.41) 16
(.30) 12
(.20) 8
(.10) 4

8 FT. MAX.  
(2.44 M)  

6 FT. MAX.  
(1.83 M)  

48" AND LARGER
EITHER DIMENSION  

DUCT HEIGHT, INSIDE

DUCT WIDTH, INSIDE  

PLOT 4-1  
(see Table 4-1)

<table>
<thead>
<tr>
<th>IN</th>
<th>1</th>
<th>6</th>
<th>12 GA</th>
<th>4 FT.</th>
<th>6 FT.</th>
<th>8 FT.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>25</td>
<td>152</td>
<td>2.7</td>
<td>1.22 M</td>
<td>1.83 M</td>
<td>2.44 M</td>
</tr>
</tbody>
</table>

HANGER WIRE, 12 GAUGE (MIN.)  
HANGER STRAP, 1" WIDE (MIN.) 22 GA.  
HANGER STRAP, 1" WIDE (MIN.) 22 GA.  

CHANNEL (SEE TABLE 4-2 FOR SHEET METAL GAUGE AND DIMENSIONS)  
CHANNEL (SEE TABLE 4-2 FOR SHEET METAL GAUGE AND DIMENSIONS)  
CHANNEL REINFORCEMENT  

Figure 4-1  
Figure 4-2  
Figure 4-3

Fibrous Glass Duct Construction Standards - Sixth Edition
HANGERS AND SUPPORTERS (Continued)

STANDARD 3" WIDE HANGERS

Hanger extension is defined as the sum of the distances between the hanging wires and the duct walls (both sides).

<table>
<thead>
<tr>
<th>DUCT SIZE, INCHES</th>
<th>MAXIMUM HANGER SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>48&quot; Wide or greater</td>
<td>4 FT</td>
</tr>
<tr>
<td>Less than 48&quot; wide and less than 48&quot; deep</td>
<td>6 FT</td>
</tr>
<tr>
<td>Width between 28&quot; &amp; 48&quot; and greater than 16&quot; deep</td>
<td>6 FT</td>
</tr>
<tr>
<td>Less than 28&quot; wide and 16&quot; depth or less</td>
<td>8 FT</td>
</tr>
</tbody>
</table>

TABLE 4-2 CHANNEL SELECTION

<table>
<thead>
<tr>
<th>IF TOTAL EXTENSION IS NOT GREATER THAN:</th>
<th>MINIMUM CHANNEL GAUGE</th>
<th>MINIMUM CHANNEL PROFILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot;</td>
<td>24</td>
<td>3&quot; X 1.5&quot;</td>
</tr>
<tr>
<td>18&quot;</td>
<td>22</td>
<td>3&quot; X 2&quot;</td>
</tr>
<tr>
<td>30&quot;</td>
<td>18</td>
<td>3&quot; X 2&quot;</td>
</tr>
</tbody>
</table>

USE OF 2" WIDE HANGERS

22 gauge, 2" x 1.5" hangers may be substituted for 3" hangers for ducts with widths not over 48" and depths not over 24" provided that not more than one joint occurs between hangers and the maximum hanger spacing is 4 ft. Exception: When duct perimeter is 80" or less and does not require reinforcement two joints are permitted between hangers.

<table>
<thead>
<tr>
<th>IN</th>
<th>1.5</th>
<th>2</th>
<th>3</th>
<th>3.8</th>
<th>4</th>
<th>6</th>
<th>18</th>
<th>24</th>
<th>28</th>
<th>30</th>
<th>48</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>38</td>
<td>51</td>
<td>76</td>
<td>102</td>
<td>140</td>
<td>181</td>
<td>224</td>
<td>286</td>
<td>355</td>
<td>426</td>
<td>508</td>
<td>601</td>
</tr>
<tr>
<td>FT</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>18 GA</td>
<td>22 GA</td>
<td>24 GA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>M</td>
<td>1.22</td>
<td>1.83</td>
<td>2.44</td>
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<td>6010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4-4 HANGER SPACING AND EXTENSION 3" WIDE CHANNELS

Figure 4-5 USE OF 2" WIDE HANGER CHANNELS
CHAPTER 4

HANGING FITTINGS

HANGING FIBROUS GLASS DUCT FITTINGS UP TO 48" IN WIDTH

2/3 of the diagonal distance from throat to heel (approx.)

Required only when duct is greater than 48" in width.

<table>
<thead>
<tr>
<th>IN</th>
<th>12</th>
<th>18</th>
<th>48</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>.30</td>
<td>.46</td>
<td>1.22</td>
</tr>
</tbody>
</table>

Figure 4-6 ELBOW SUPPORT

If trunk duct hanger falls where branch duct is located, add trunk hangers on either side of branch duct.

Figure 4-7 BRANCH SUPPORT

If a tee run-out hanger falls where trunk duct is located, add run-out hangers on either side of trunk.

Figure 4-8 TEE SUPPORT
HANGERS AND SUPPORTS (Continued)

HANGING FIBROUS GLASS DUCT FITTINGS UP TO 48" IN WIDTH

<table>
<thead>
<tr>
<th>IN</th>
<th>1</th>
<th>2½</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
<th>48</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>25</td>
<td>64</td>
<td>76</td>
<td>152</td>
<td>228</td>
<td>300</td>
<td>1200</td>
</tr>
</tbody>
</table>

Required only when angled portion of offset is greater than 48" long. Additional hangers may be required to comply with spacing. See page 4.1 or 4.2.

NOTE

Hanger spacing may change when transition is from one hanger size to another. Use closest spacing called for per pages 4.1 and 4.2.

Required only when inclined portion of duct is greater than 48". Hanger is attached to duct per detail, Fig. 4-11. Additional hangers may be required to comply with hanger spacing per pages 4.1 and 4.2.

DETAIL OF SUPPORT AT INCLINED BOTTOM SURFACE

Figure 4-9 OFFSET SUPPORT (FLAT BOTTOM SURFACE)

Figure 4-10 TRANSITION SUPPORT (FLAT BOTTOM SURFACE)

Figure 4-11 SUPPORTING OFFSETS AND TRANSITIONS WITH INCLINED BOTTOM SURFACES
VERTICAL RISER SUPPORT

Risers in fibrous glass duct systems of 8 feet or greater require the use of special support as shown in Fig. 4-12, or 4-13. This reinforcement and support are in addition to reinforcement as may be required by provisions of Chapter 3 of this manual. Vertical riser supports shall be installed at maximum spacing intervals of 12 feet.

NOTE
Riser height is limited to not more than two (2) stories.

Figure 4-12 SUPPORT FROM WALL

Figure 4-13 SUPPORT FROM FLOOR

---

Fibrous Glass Duct Construction Standards • Sixth Edition
HEATER SUPPORT

SLIP-IN ELECTRIC HEATER SUPPORT

Figure 4-14

FIBROUS GLASS DUCT

SHEET METAL SLEEVE, 22 GAUGE, INSIDE DUCT, MUST EXTEND 6" (MIN.) BEYOND EACH SIDE OF HEATER

Hangers must be installed at sleeves to support weight of heater. Hang heater separately if weight exceeds 50 pounds.

FLANGED HEATER SUPPORT

Flanged sheet metal sleeve 6" (min.) long, 22 gauge, screwed to heater flange with suitable fasteners inserted into ends of duct.

<table>
<thead>
<tr>
<th>IN</th>
<th>6</th>
<th>12</th>
<th>22 GA</th>
<th>50 LB</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>152</td>
<td>.30 M</td>
<td>.7534</td>
<td>22.7 KG</td>
</tr>
</tbody>
</table>

Hangers must be installed at sleeves to support heater weight. Hang heater separately if weight exceeds 50 pounds.

Figure 4-15
VOLUME DAMPER INSTALLATION

3" (MIN.) BEYOND DAMPER BLADES, BOTH ENDS OF SLEEVE

Attach operator mounting brackets with #10 × 1 1/4" sheet metal screws, 12" bracket and min. 2 per side.

22 GAUGE GALVANIZED STEEL, TURNED EDGES TO PREVENT CUTTING INTO DUCT BOARD

MS OR BB JOINT AT SHAFT LOCATION

DAMPER OPERATOR MOUNTING FLANGE MIN. 6" WIDE, OR 2" OVER OPERATOR WIDTH INTERNAL SLEEVE MUST EXTEND AS FAR AS OPERATOR MOUNTING FLANGE

Figure 4-16

<table>
<thead>
<tr>
<th>DUCT SPAN, INCHES</th>
<th>SHEET METAL GAUGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 12</td>
<td>26</td>
</tr>
<tr>
<td>13 to 30</td>
<td>24</td>
</tr>
<tr>
<td>31 to 54</td>
<td>22</td>
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</tbody>
</table>

<table>
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<th>54</th>
<th>22 GA</th>
<th>24 GA</th>
<th>26 GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>32</td>
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<td>76</td>
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<td>1.37 M</td>
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<td>.6010</td>
<td>.4712</td>
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INSPECTION CHECKLIST FOR FIBROUS GLASS DUCT SYSTEM INSTALLATION

References
SMACNA Standards
North American Installation Manufacturers Association (NAIMA)*
Board Manufacturer’s Standards
*Formerly Thermal Insulation Manufacturers Association (TIMA) Standards

General
1. Is the duct used within its service limitations? YES NO
2. Is system operating within the design limitations for which it was built? YES NO
3. Are all sheet metal accessory items galvanized? YES NO
4. Is the EI rating printed on the board facing? YES NO
5. Is the UL label present on much of the duct surface? YES NO
6. Is the system free from visual signs of duct board facing delamination? YES NO

Fabrication and installation
7. Are turning vanes installed in accordance with the Standards? (Pressing your hand into the cheek of the ell will reveal if specified vanes are being used.) YES NO
8. When metal parts are attached, are 2½" (minimum) square steel washers used on 16" (maximum) centers? YES NO
9. When staples can’t be used, are 8" cross tabs of approved closure being used in place of staples? (Tab spacing requirements are 12" O.C., minimum one per side) YES NO
10. Is the system completely free from tears or punctures in the facing? YES NO
11. Is the system free from areas where excessive amounts of closure materials, such as several wraps around a joint, may have been used to conceal potential problem areas? YES NO
12. Are all system joints tight, free from bulges, with taped joints showing good workmanship? YES NO
13. Are all fittings fabricated in accordance with the Standards and do they demonstrate good workmanship? YES NO
14. Have offsets been installed so duct sections aren’t forced to bend around obstructions? YES NO
15. Are all panels in any fitting at least 4" long, including male or female joints? YES NO

Electric Heaters
16. Is interior sleeve present, properly attached with screws and washers 16" on centers? YES NO
17. Is heater separately supported? YES NO

Dampers
18. If a motorized damper operator is being used, is the sheet metal sleeve extended so the operator is mounted on the same sleeve with the damper? YES NO
19. On a manual volume damper, does the quadrant move a full 90 degrees? YES NO

Fire Dampers
20. Is sheet metal sleeve present? (Fibrous duct stops at barrier) YES NO
21. Is duct properly attached to sleeve with screws and washers 16" on centers? YES NO

Access Doors
22. Is installation in accordance with the Standards? YES NO

Grilles, Diffusers, Registers
23. Is the extra weight of the item being separately supported and not dependent on the duct alone for support? (Exception: Registers not greater than 150 square inches in area may be attached to the duct with metal channel without other support.) YES NO

Equipment Unit Connection
24. Are sheet metal screws and washers used to secure duct system to flange extensions? YES NO
   (Mechanical fasteners must be used!)

Closure
25. Are all joints in the system properly sealed? YES NO
26. Are closure mateante of a listed type as evidenced by presence of UL instruction sheet in duct board carton? Is tape imprinted? YES NO

<table>
<thead>
<tr>
<th>IN</th>
<th>2½</th>
<th>4</th>
<th>8</th>
<th>12</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>64</td>
<td>101</td>
<td>203</td>
<td>.30 M</td>
<td>.41 M</td>
</tr>
</tbody>
</table>
27. Are there staples or cross tabs, properly spaced, on circumferential joints?  
28. Are staples, if used, of the correct type and size, and spaced in proper intervals as recommended by the duct board manufacturer?  
29. Are all pressure-sensitive tape closures rubbed down adequately, with staples or scrim in facing clearly visible through the tape?  
30. If heat-sealable tape closure was used, was it applied correctly, as evidenced by dot color change?  
31. If glass fabric and mastic are used, is the mesh of the glass fabric completely filled with mastic?

Reinforcement
32. Is reinforcement system of recommended type (formed metal, tie rod, or combination)?  
33. Is tie rod wire 12 gauge or heavier?  
34. Is tie rod spacing correct according to duct span, board type and static pressure?  
35. Are tie rod washers 2½" square and proper gauge by type?  
36. Do tie rod washers have turned edges facing away from duct board so they won’t cut into it?  
37. If tie rods reinforce a butt joint, are rods used on both sides of butt joint?  
38. Is wire termination one of those in the Standards?  
39. Are anti-sag devices used on ducts 48" span or greater, to support top panel of ducts?  
40. Do tie rods run straight through ducts and not at angles?  
41. Are heels of tees, elbows and end caps reinforced (formed sheet metal channel, tie rod, combination)?  
42. When formed sheet metal channel reinforcement is used, are sheet metal gauges, dimensions, and spacing correct?  
43. On supply ducts, is reinforcing member on the female side of the shiplap?  
44. On return ducts, are sheet metal channel reinforcements attached to ducts with screws and 2½" square washers or 2" × 6" clips?  
45. On return ducts, is the reinforcing member attached to the male shiplap side of the joint?  
46. For the heels of tees, elbows, end caps, and any other fittings where a panel faces an opening on the opposite side, is correct reinforcing member (type: sheet metal channel, tie rod, or combination) applied?

Hangers and Supports
47. Are hangers installed in accordance with the Standards  
48. Are hanger designs in accordance with the Standards?  
49. Are accessories that add weight to the duct system separately supported so as not to stress the system? (consult the standards)  
50. Are vertical risers limited to two stories and supported on 12 foot (maximum) centers?  
51. If formed sheet metal reinforcements are used as hangers, are attachments within 6 of duct sides?  
52. Are all fittings supported by hangers in accordance with the standards?

<table>
<thead>
<tr>
<th></th>
<th>IN</th>
<th>2</th>
<th>2½</th>
<th>6</th>
<th>48</th>
<th>12 FT</th>
<th>12 GA</th>
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</thead>
<tbody>
<tr>
<td>MM</td>
<td>51</td>
<td>64</td>
<td>152</td>
<td>1.22 M</td>
<td>3.66 M</td>
<td>2.68</td>
<td></td>
</tr>
</tbody>
</table>
PROCEDURE FOR RATING
DUCT CONSTRUCTION METHODS RELATIVE
TO THE SMACNA CONSTRUCTION TABLES

METHOD 1
Show by *written analysis and commentary* that the features that are different in the reinforcement and assembly scheme will not produce:

a) a system that satisfies the general requirements for all ducts to a lesser extent than the published assembly scheme it is being introduced in, nor
b) noncompliance with the functional standards outlined.

METHOD 2
Present substantial evidence of *historical acceptability* for the use intended and that the record of use confirms subjection to the pressures, velocity levels, and other conditions for which rating is desired.

METHOD 3
Construct, *test and rate specimens* of the contemplated design.

*Method 3A—Test only the component* being substituted or test the component plus any contingently related components in a manner that will simulate the actual loading and will correlate with performance on the duct and show that this approach will not impair or reduce the performance of the entire assemblage.

*Method 3B—Test a full specimen.* Construct a specimen using the desired scheme of sheet thickness, joint type, intermediate stiffener, sealant, fasteners, etc. Conduct tests in the positive or negative mode of pressurization as desired. Use instrumentation and follow procedures that will produce laboratory accuracy. Record proceedings and observations. Write conclusions showing equivalence to the construction tables published by SMACNA. Include a diagram of the specimen tested.
**Figure 2-12 DUCT ACCESS DOORS**

**DUCT ACCESS DOORS**

<table>
<thead>
<tr>
<th>Door Size</th>
<th>No. Hinges</th>
<th>No. Locks</th>
<th>Metal Gage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2” w.g.</td>
<td>12” x 12” 2</td>
<td>1-S</td>
<td>24</td>
</tr>
<tr>
<td>Static</td>
<td>16” x 20” 2</td>
<td>2-S</td>
<td>22</td>
</tr>
<tr>
<td>and</td>
<td>24” x 24” 3</td>
<td>2-S</td>
<td>22</td>
</tr>
<tr>
<td>Less</td>
<td></td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>3” w.g.</td>
<td>12” x 12” 2</td>
<td>1-S</td>
<td>22</td>
</tr>
<tr>
<td>Static</td>
<td>16” x 20” 2</td>
<td>1-S, 1-T, 1-B</td>
<td>20</td>
</tr>
<tr>
<td>and</td>
<td>24” x 24” 3</td>
<td>2-S, 1-T, 1-B</td>
<td>20</td>
</tr>
<tr>
<td>Less</td>
<td></td>
<td></td>
<td>26</td>
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<td>4” w.g.</td>
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<td>1-S, 1-T, 1-B</td>
<td>20</td>
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<tr>
<td>to</td>
<td>16” x 20” 3</td>
<td>2-S, 1-T, 1-B</td>
<td>20</td>
</tr>
<tr>
<td>10” w.g.</td>
<td>24” x 24” 3</td>
<td>2-S, 2-T, 2-B</td>
<td>18</td>
</tr>
</tbody>
</table>

S = Side opposite hinges, T = Top, B = Bottom

CONSTRUCTION AND AIRTIGHTNESS MUST BE SUITABLE FOR THE DUCT PRESSURE CLASS USED.
THE CEILING SUPPORT SYSTEM MUST SUPPORT DIFFUSER WEIGHT WHEN FLEXIBLE CONNECTIONS ARE USED! A PROPERLY SIZED HOLE IS PROVIDED IN THE CEILING TILE. THE DIFFUSER DOES NOT SUPPORT THE TILE.

Figure 2-17 CEILING DIFFUSER BRANCH DUCTS
### Recommended Minimum Sleeve Thickness for Fire Dampers

<table>
<thead>
<tr>
<th>Type of Connection</th>
<th>Duct</th>
<th>Duct Dimension</th>
<th>Sleeve Gauge</th>
</tr>
</thead>
</table>
| **Rigid**          | Round-Rectangular | 24" maximum diameter  
                      |                  | 24" maximum height and  
                      |                  | 36" maximum width | 16 |
| **Rigid**          | Round-Rectangular | over 24" diameter  
                      |                  | over 24" height  
                      |                  | over 36" width | 14 |
| **Breakaway** (See Pages 2-4 and 2-5) | Round or Rectangular | 12" down  
                      |                  | 13"-30"  
                      |                  | 31"-54"  
                      |                  | 55"-84"  
                      |                  | 85" up | 26  
                      |                  | 24  
                      |                  | 22  
                      |                  | 20  
                      |                  | 18 |

By U.L. Standard 555, all ducts are required to terminate at the fire damper sleeves or the damper frames. Sleeve thickness is contingent on type of connection. All U.L. listed dampers also have maximum dimensions associated with the test rating. Contingent on sleeve thickness a rigid connection may be used in lieu of a breakaway connection. Sleeves may be omitted where dampers are designed to be in nonducted air passages or where damper housing permits attachment of retaining angles to the housing. Attachment of retaining angles must not restrict operation of the fire damper. Certain U.L. approved designs do not require retaining angles.

Where the fire damper sleeve is exposed to the airstream, the metal sleeve will be of the same material as the duct system. A steel sleeve, of the type or finish specified by the system designer, will be used for fibrous glass ductwork and where the fire damper sleeve is not exposed to the airstream.

*See Pages 2-4 and 2-5 for details and exceptions. (Fire Damper Guide, Fourth Edition)*
TYPICAL INSTALLATION DETAILS

(A) Retaining Angles:
Minimum 1½" x 1½" x 0.054 (16 ga.)
Retaining angles must overlap structure opening
1" minimum and cover corners of openings as shown.

(B) Clearance: ¼" Per Linear Foot
Both Dimensions (see Note 1 below)

(C) Steel Sleeve: See Schedule 2

(D) Approved Fire Damper (curtain or blade type)

(E) Secure Retaining Angles To Sleeve
Only, On 8" Centers With:
1. ½" long Welds Or
2. ¾" Bolts And Nuts, Or
3. No. 10 Steel Screws, Or
4. Minimum ¾" Steel Rivets

(F) Secure Damper To Sleeve On 8" Centers With:
1. ½" long Welds Or
2. ¾" Bolts And Nuts, Or
3. No. 10 Steel Screws, Or
4. Minimum ¾" Steel Rivets

(G) Connect Duct To Sleeve As Shown On Pages
2-4 and 2-5 and as outlined on Table 2.2

(H) Install access door or panel as shown in Figure 6.1.

NOTES:
1. FIRE DAMPER SLEEVE CLEARANCE
   WITHIN WALL OPENING
Clearance requirements for damper sleeves within a wall
opening are based on 1½ inch per foot of width (or height)
unless otherwise stated in the listing of the assembly. The
sleeve may rest on the bottom of the opening, and need not be
centered. (Fractional dimensions shall be taken as the next
largest whole foot.)

Example: A 30 inch x 24 inch fire damper sleeve is installed in
a wall opening. The opening shall be 30½ inches wide (1½ inch x 3 feet) by 24½ inches high (1¼ inch x 2 feet.)

The sleeve is retained in the wall opening by the use of steel
retaining angles (A). These must over-lap the edge of the
framing by a minimum of one (1) inch over and beyond all
material in the opening. This means that the minimum width of
the retaining angle would be 1½ inches (good practice calls for
an additional safety factor by making the angle in this case 1½
inches wide.)

The dimensions required for the opening shall be those
remaining after the opening has been framed and fire resistive
materials provided where required (see Figure 3.1). The fire
resistive material shall be equal to the requirements for fire
resistive material used in the constructed wall so that a
continuous rating exists at the wall penetration. The contractor
erecting the wall is responsible for providing the fire resistive
material and correct size openings to achieve the required
clearance.

2. MANUFACTURERS’ INSTALLATION DETAILS
The fire damper manufacturers’ installation details and instructions as
tested and approved by UL must be used in lieu of the above details where applicable.
### TABLES OF METRIC CONVERSION UNITS

<table>
<thead>
<tr>
<th>FRACTIONAL INCHES</th>
<th>WHOLE INCHES</th>
<th>METRES</th>
<th>FEET</th>
<th>METRES</th>
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**Fibrous Glass Duct Construction Standards • Sixth Edition**
### METRIC CONVERSION CHART

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