

SPECIFICATION: **Dual Guard 2000**



Factory Mutual Approved 4922 (#B1A5.AM) Sprinkler Free
Factory Mutual Approved 4910 (#3003307) Clean Room
Underwriters Laboratories Listed U.L. 181
Fiberglass Duct and Fittings

CUSTOMER / PROJECT: _____

REQUIREMENTS

1.0 GENERAL

Fiberglass duct for corrosive fume and smoke exhaust shall bear the Factory Mutual 4922 test approval #4B1A5.AM as a non-sprinkled smoke removal duct and Factory Mutual 4910 #3003307 test approval as a Clean Room Approved material without requirement for emergency air exhaust blowers. These test results shall not be achieved by the use of any collapsing device that will shut off the airflow in case of an exhaust fire.

In addition, the duct shall be Listed by Underwriters Laboratories per U.L. 181 as a Class 1 Air Duct material report demonstrating compliance with the Uniform Building Code and the B.O.C.A. Code.

The duct must have been tested using ASTM E-84 test methods in a certified test laboratory resulting in a Flame Spread of 5 or less and a Smoke Development of 10 or less on both the inside and outside of the duct. The use of any coating to achieve these results will not be permitted. To maximize corrosion resistance, the duct must incorporate a synthetic Halar surfacing veil on the inside corrosion liner.

2.0 MATERIALS

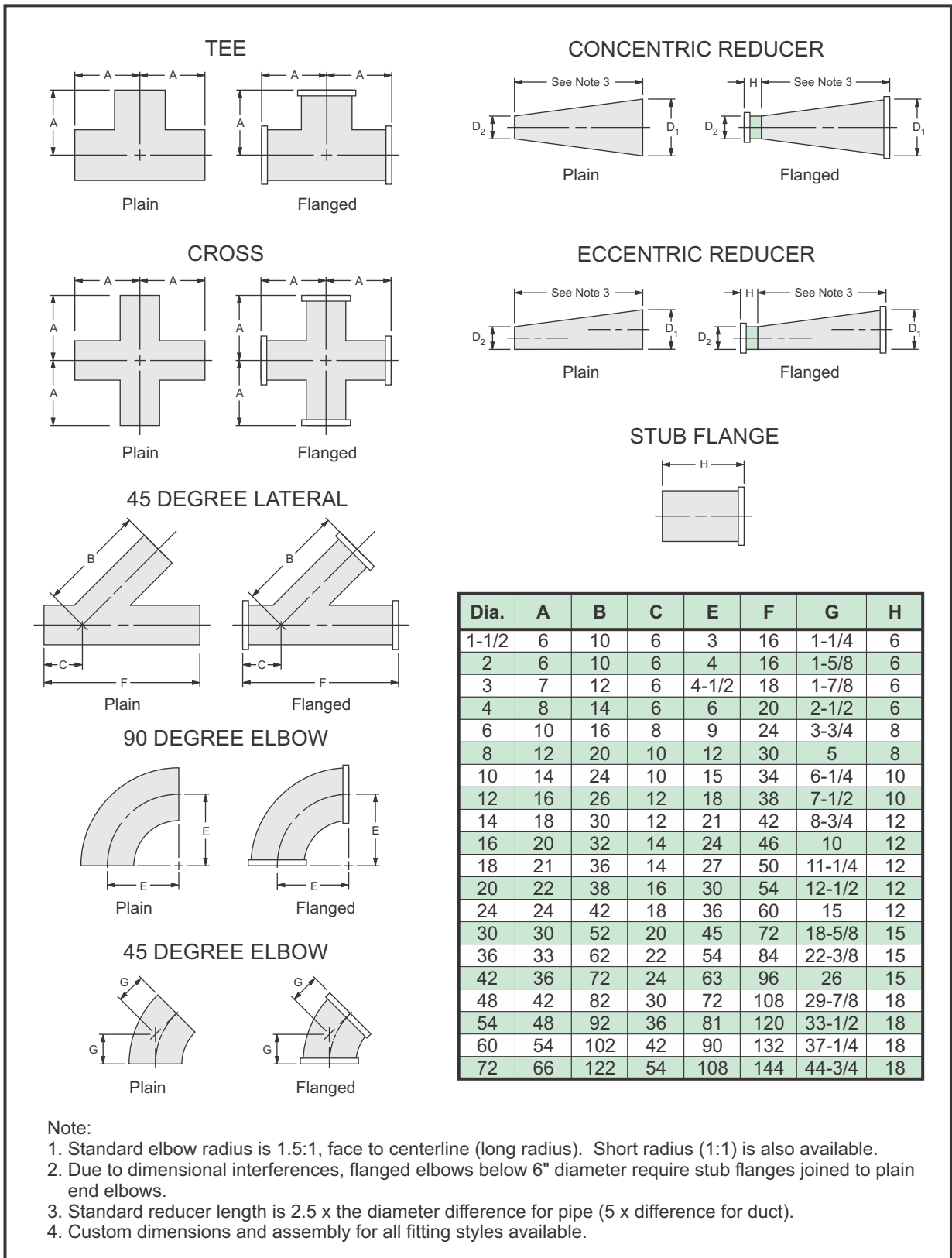
2.1 RESIN - The resin used shall be a premium grade corrosion resistant copolymer resin such as Dual Guard 2000. The resin shall be approved by Factory Mutual for non-sprinkled smoke removal duct fabrication under the 4922 test procedure without the use of collapsing dampers which would restrict air flow through the system.

- 2.2 REINFORCING MATERIAL** - The reinforcing material shall be a commercial grade of glass fiber having a coupling agent which will provide a suitable bond between the glass reinforcement and the resin.
- 2.3 SURFACING MATERIALS** - Composites USA, Inc. uses a Halar fluoropolymer synthetic surfacing veil on Dual Guard 2000 duct. A full chemical resistant corrosion liner incorporating a synthetic surfacing veil is to be used, resulting in a corrosion liner that meets the requirements of PS-15-69, ASTM C-581 and ASTM C-582.

3.0 CONSTRUCTION

- 3.1 LAMINATE** - The laminate shall consist of an inner surface, an interior layer, a structural layer and an exterior layer of bidirectional fiberglass cloth. The compositions specified for the inner surface and interior layer are intended to achieve optimum chemical resistance. Halar materials and liner thicknesses are to meet the requirements of the NBS PS-15-69 and ASTM C-581.
- 3.2 INNER SURFACE** - The inner surface shall be free of cracks and crazing with a smooth finish. Some waviness is permissible as long as the surface is smooth and free of pits. Between 0.020 and 0.030 inches of reinforced resin-rich surface shall be provided. This surface will be reinforced with Halar surfacing veil.
- 3.3 INTERIOR LAYER** - A layer next to the inner surface shall be reinforced with not less than 20% nor more than 30 percent by weight of non-continuous glass strands (having fiber lengths from 0.5 to 2.0 inches).
- 3.4 STRUCTURAL LAYER** - The structural layer or body of the laminate shall be filament wound or contact molded of chemically resistant construction suitable for the service and providing the additional strength necessary to meet the tensile and flexural requirements. The structural layer will be built up to meet the wall thickness required for the duct size shown in table 3.
- 3.5 EXTERIOR LAYER** - The exterior layer shall be fiberglass bi-directional cloth to provide additional strength, corrosion resistance and a surface optimized for secondary bonding. The exterior surface shall be relatively smooth with no exposed fibers or sharp projections.
- 3.6 CUT EDGES** - All cut edges shall be coated with resin so that no glass fibers are exposed and all voids filled. Structural elements having edges exposed to the chemical environment shall be made with chopped-strand glass reinforcement only. Design of the duct system is to facilitate water drainage.
- 3.7 JOINTS** - Finished joints shall be built up in successive layers and be as strong as the pieces being joined and as crevice free as is commercially practicable. The width of the first layer shall be 2 inches minimum. Successive layers are to increase uniformly to provide the specified minimum total width of overlay, which shall be centered on the joint. Crevices between jointed pieces shall be filled with resin or thixotropic resin paste, leaving a smooth inner surface.
- 3.8 WALL THICKNESS** - The minimum wall thickness shall be as specified in Table 3. Isolated small spots may be as thin as 80 percent of the minimum wall thickness, but in no case more than 1/8 inch below the specified wall thickness.

TABLE 1: Standard Duct and Pipe Fitting Dimensions (all dimensions in inches)



3.9 SURFACE HARDNESS - The laminate shall have a Barcol hardness of at least 90 percent of the resin manufacturer's minimum specified hardness for the cured resin. This applies to both interior and exterior surfaces.

3.10 APPEARANCE - The finished laminate shall be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, air bubbles, pinholes, pimples, and delamination.

TABLE 2: Requirements for properties of filament wound Dual Guard fiberglass reinforced laminates.

Property at 73.4°F (23°C)	Thickness (inches)			
	0.13	0.18	0.26	>0.31
Ultimate tensile strength - minimum (psi)	6,000	8,000	9,000	10,000
Flexural strength - minimum (psi)	10,600	12,600	13,300	14,600
Flexural modulus of elasticity, tangent minimum (psi)	700,000	800,000	900,000	1,000,000

4.0 DUCT SIZES AND TOLERANCES

4.1 SIZE - The standard duct size shall be the inside diameter in inches. Standard sizes are 3/4, 1, 1-1/2, 2, 2-1/2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36 inches, 36" through 140", 1556", 168", 180". Sizes from 36" through 140" diameter are available in any increment on our adjustable mandrels, using mitered elbows.

Continuous sweep elbows are available through 48" diameter. The tolerance including out-of-roundness shall be +1/16 inch for duct up to and including 6 inch inside diameter, and +1/8 inch or +1 percent, whichever is greater, for duct exceeding 6 inches inside diameter. This measurement shall be made at the point of manufacture with the duct in an unstrained vertical position.

4.2 LENGTH - Standard lengths are nominal 20 ft on sizes 1-1/2" diameter. When specified cut to length, the length of each fabricated piece of duct shall not vary more than +1/8 inch from the ordered length unless arrangements are made to allow for trim in the field.

4.3 WALL THICKNESS - The minimum wall thickness shall be in accordance with Table 3.

4.4 RECTANGULAR DUCT - The nominal size of rectangular duct shall be determined by the inside dimensions. There are no standard sizes for rectangular duct. Unless otherwise specified, the tolerances on rectangular duct shall be +/- 3/16" on sizes up to 18", and +/- 1% on sizes over 18". For rectangular duct, the minimum thickness shall be as specified in Table 3, substituting the longer side of the rectangular duct for the diameter. An engineering review should be made for all rectangular duct.

- 4.5 SQUARENESS OF ENDS** - All plain end duct shall be cut square with the axis of the duct within 1/8 inch up to and including 24 inch diameter and to within 3/16 inch for all larger diameter duct.
- 4.6 FITTINGS** - All fittings such as elbows, laterals, tees, and reducers shall be equal or superior in strength to the adjacent pipe section and shall have the same diameter as the adjacent pipe. The dimensions of fittings shall be as shown in Tables 1 and 3. Tolerance on angles of fittings shall be +/- 1° through 24 inches in diameter gradually reducing to +/- 1/2° for 48 inch diameter and above. Wall thickness of the fittings shall be at least the same as the duct of the same size, and evaluated for design conditions as appropriate.
- 4.7 ELBOW** - Standard elbows shall have a centerline radius of one and one half times the diameter of the fitting. Standard elbows, up to and including 48 inches shall be molded sweeps of one piece construction. Elbows of 54 inch diameter and larger may be of molded or mitered construction using pipe for the mitered sections. The width of the overlay on the mitered joint may have to be less than the minimum specified in Table 4 to avoid interference on the inner radius, but the joint strength must be at least equal to the strength of the adjacent pipe. Mitered elbows 45° or less will be two gore. Elbows above 45° through 90° shall have a minimum of three gores. Verify exact construction by referencing the appropriate Composites USA fitting figure number. Incorporation of straight pipe extensions on elbows is permissible.
- 4.8 REDUCERS** - Reducers of either concentric or eccentric style will have a length as determined by the ratio of the diameters of the reducer as indicated in Table 1 (5x the difference is standard). Alternate reducer lengths are acceptable in order to accommodate end user layout requirements.
- 4.9 BUTT JOINTS** - This type of joint shall be considered the standard means of joining pipe sections and pipe to fittings. The procedure used in making the butt joint is as follows. The finished joints shall be built up in successive layers and be as strong as the pieces being joined and as crevice free as is commercially practicable. The width of the first layer shall be 1-1/2 inches minimum, centered over the joint. Successive layers shall increase uniformly to provide the specified minimum total width of the overlay. Cavities between jointed pieces shall be filled with resin or thixotropic resin putty leaving a smooth inner surface.
- 4.10 FLANGES** - The use of flanges shall normally be kept to a minimum with the butt joint being used as the standard means of joining duct sections. All flanges shall be of the minimum thickness given in Table 3 for PS-15-69 flange thicknesses as quoted. Flanges are quoted field drilled per PS-15-69 standards. The construction of flanges is the same as that for laminates, using all mat construction, ie., no woven roving, for the flange faces.
- 4.11 FLANGE ATTACHMENT** - The minimum flange shear surface shall be four times the flange thickness indicated in Table 4. The thickness of the flange hub reinforcement measured at the top of the fillet radius shall be at least one-half the flange thickness and shall be tapered uniformly the length of the hub reinforcement. The fillet radius, where the back of the flange meets the hub, shall be 3/8 inch minimum.
- 4.12 FLANGE FACE** - The flange face shall be perpendicular to the axis of the pipe within 1/2°. A camber of 1/8" with respect to the centerline, measured at the flange outside diameter shall be allowable.

TABLE 3: Dual Guard reinforced fiberglass duct dimensions.

Duct Internal Diameter	Wall Thick.	Allowable Vacuum	Allowable Pressure	Flange O.D.	Flange Thick. CUSA	Flange Thick. PS 15-69	Bolt Circle	Bolt Hole Dia.	No. of Bolt Holes	Support Spacing
2	0.13	292	1550	6-3/8	1/2	1/4	5	7/16	4	7
3	0.13	167	1136	7-3/8	1/2	1/4	6	7/16	4	8
4	0.13	111	914	8-3/8	1/2	1/4	7	7/16	4	9
6	0.13	62	651	10-3/8	1/2	1/4	9	7/16	8	9
8	0.13	41	457	12-3/8	1/2	1/4	11	7/16	8	9
10	0.13	29	360	14-3/8	1/2	3/8	13	7/16	12	9
12	0.13	22	305	16-3/8	1/2	3/8	15	7/16	12	8
14	0.13	18	269	18-3/8	1/2	3/8	17	7/16	12	8
16	0.13	14	227	20-3/8	1/2	1/2	19	7/16	16	8
18	0.13	12	208	22-3/8	1/2	1/2	21	7/16	16	8
20	0.13	10	180	24-3/8	1/2	1/2	23	7/16	20	8
24	0.18	18	158	28-3/8	1/2	1/2	27	7/16	20	10
30	0.18	13	122	34-3/8	1/2	1/2	33	7/16	28	9
36	0.18	10	103	40-3/8	1/2	1/2	39	7/16	32	9
42	0.26	19	86	46-3/8	5/8	5/8	45	7/16	36	11
48	0.26	16	54	54-3/8	5/8	5/8	52	9/16	44	10
54	0.26	13	50	60-3/8	5/8	5/8	58	9/16	44	10
60	0.26	11	44	66-3/8	5/8	5/8	64	9/16	52	10
72	0.31	13	37	78-3/8	3/4	3/4	76	9/16	60	11

1. Dimensions in inches and inches water column, except support spacing, which is in feet.
2. The specified wall thickness are based upon a minimum 10 to 1 safety factor on pressure and 5 to 1 on vacuum.
3. These ratings are suitable for use up to 180°F (82.2°C); for ratings at higher temperatures, consult the manufacturer.
4. Vacuum ratings are based upon duct stiffening ribs on 10'-0" centers.
5. Allowable pressures are governed by the lower of the (CUSA) flange or duct allowable pressure.
6. Standard flanges are supplied undrilled in accordance with PS-15-69.
7. Support spacing is typical based upon deflection, stress and cylinder buckling analysis. Consult the factory for specific guidance.

TABLE 4: Minimum total widths of overlays for reinforced-vinyl ester butt joints.

Duct wall thickness, inches	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4
Minimum total width of overlay, inches	3	4	5	6	7	8	9	10	11	12

5.0 RECOMMENDED INSTALLATION PRACTICE

- 5.1 DUCT HANGERS AND SPACING** - Hangers shall be band type hangers contacting a minimum of 180 degrees of the duct surface. The maximum duct hanger spacing shall be in accordance with Table 3, above, unless specifically engineered for the application.
- 5.2 UNDERGROUND INSTALLATION** - Special consideration must be given to installing pipe or duct underground. It is recommended that Composites USA, Inc. be consulted for design and installation procedures.
- 5.3 EXPANSIONS** - Since the expansion rate of fiberglass laminates is several times that of steel, proper consideration should be given to any duct installation to accommodate the overall linear expansion. Consult Composites USA when in doubt.
- 5.4 MECHANICAL PROPERTIES OF DUCT** - The minimum mechanical properties of duct shall be in accordance with Table 2. All contact molded products using mat construction have minimum properties given in the 0.13" thickness column.
- 5.5 VACUUM SERVICES** - Minimum vacuum handling capability for standard Composites USA Dual Guard duct and fittings is given in Table 3. Special engineering consideration is required for larger pipe sizes and for operation at temperatures above ambient atmosphere temperature. Complete engineering analysis can be performed on systems as required, with designs up to and including full vacuum.
- 5.5 BOLTS, NUTS, AND WASHERS** - Bolts, nuts, and washers shall be furnished by the customer, unless otherwise agreed in the purchase order acceptance. Metal washers shall be used under all nut and bolt heads. All nuts, bolts, and washers shall be of materials suitable for use in the exterior environment.
- 5.6 GASKETS** - Gaskets shall be furnished by the customer, unless otherwise agreed in the purchase order acceptance. Recommended gasketing materials shall be a minimum of 1/8 inch in thickness, 1/4" over 43" diameter, with a suitable chemical resistance to the service environment. Gaskets should have a Shore A or Shore A2 Hardness of 40 to 70.

6.0 SPECIAL REQUIREMENTS:

- 6.1 BUTTERFLY STYLE DAMPERS** - Butterfly style dampers are to be supplied to the same materials of construction and quality assurance parameters as the duct system. Each damper is to ship complete with all the components listed below:

- FRP Damper Body
- FRP Disc or Blade Assembly
- FRP Shaft with thermoplastic bushings
- SS Locking Quadrant Hand Mechanism
- Flanges - Optional
- Actuator - Optional

Certified dimensional drawings shall be provided for approval showing all damper assembly components weights, flange drilling patterns and critical dimensions.

6.2 BUTTERFLY DAMPER DESIGN:

6.2.1 Damper Body - Flange thickness and bolt hole layout shall be the same as for the duct dimensions quoted and shown above in Table 2. Face to face dimensions shall be specified at the time of the system layout and should generally be designed to minimize the number of system flange joints. Standard dimensions are shown on cut sheet drawings #300.

6.2.1.1 If automated, the damper body shall be clearly marked to show flow direction. Markings shall be permanent and clearly visible from greater than 10 feet. The damper body shall be designed with a mounting bracket suitable to properly mount the actuator or lock the manual shaft in proper operating position.

6.2.2 Damper Blade - Shall be manufactured from the same material as the duct. The blade should be designed to withstand the design conditions without failure with a safety factor of 5:1 or deflect in excess of 1.0% of the diameter.

6.2.3 Bushings - Thermoplastic shoulder bushings are supplied as standard. Optional outboard bearings shall be mounted in a packing gland outside of the damper body and shall be readily accessible for lubrication and / or removal.

6.2.4 Deformation or Creep - The equipment shall be suitable for all operating conditions. Deformation or creep shall not interfere with the damper operation under the most severe combined operating conditions.

6.3 OPTIONS:

6.3.1 Shaft Material - Fiberglass shafts are provided as standard construction. Stainless steel is available as an option.

6.3.2 Shaft Seals - Shaft seals where provided shall be Teflon or Viton unless otherwise specified - not provided with base bid.

6.3.3 Blade Seals - Blade seals where provided shall be neoprene unless otherwise specified - not provided with base bid.

6.3.4 Actuator / Coupling - All electrical components are to be NEMA 4. The design shall insure that thermal growth will not interfere with the damper or actuator operation over the full temperature range - not provided with base bid.