

# Thermoplastic Lined FRP Piping

## Armourplastics® Thermoplastic Lined FRP Piping

Fabricated Plastic's Armourplastics® are manufactured with machine made thermoplastic liners which are chemically /mechanically bonded to structural over wrap. Liner materials are carefully selected for each specific application.

Thermoplastic liner materials are machine made, offering a corrosion liner that is homogeneous, uniform in thickness and having proven mechanical properties. The thermoplastic liner when properly bonded to the FRP armoring creates a dual laminate that exhibits the best properties of both materials combined in the Armourplastic®.

### ARMOURPLASTIC® CONSTRUCTION

Fabricated Plastics manufactures Armourplastics® pipe and fittings with a variety of liner and structural wall construction.

**Inner Liner Surface** – The liner most suitable for the chemical service is selected, Fabricated Plastics offers:

- GrayKor®- PVC-U (Unplasticized Polyvinyl Chloride)
- GrayKor®-L - PVC-U-L (Unplasticized low calcium Polyvinyl Chloride)
- GrayKor®-R - PVC-U (Unplasticized Polyvinyl Chloride)
- OrangeKor® - CPVC/PVC-C (Chlorinated Polyvinyl Chloride)
- BlueKor® - PP (Polypropylene)
- KemKor® - PVDF (Polyvinylidene-Fluoride)
- Haline® - ECTFE (Ethylene Chlorotrifluoroethylene)

as liner materials. Each liner is specifically treated chemically or mechanically prior to FRP armoring. Liner thickness is not taken into consideration for structural requirements of the Armourplastic® system.

**Structural Layers** – This layer is the primary structural portion of the laminate and is designed to withstand the loads caused by pressure, wind, seismic and other conditions. It consists of alternating layers of chopped strand and 24 ounce per square yard woven roving to the required thickness. The glass content in these layers will be 30-45% depending on the amount of woven roving used. This layer may also be composed of filament wound continuous strand fiberglass reinforcement, which is typically helically wound onto the mandrel and has a glass content of 55 – 70% by weight.

**Outer Surface Layer** – This surface is a resin coating formulated to be non-air inhibited and fully cured. When exposed to the environment, this coating contains ultraviolet absorbers or pigments to minimize ultraviolet degradation. If the outer surface of a laminate is to be exposed to a corrosive environment, a veil layer or a chopped strand layer may be added over the structural layer for exterior protection. The outer surface can be pigmented for colour designation if required.

### MANUFACTURING METHODS

Fabricated Plastics offers two standard types of FRP laminate construction as over wrap for thermoplastic piping systems. Filament Wound, and Contact Molded (hand lay up).

**Liner Preparation** – The Thermoplastic liner undergoes various surface preparations dependent on the liner material.

- i) GrayKor® PVC, GrayKor®-L PVC-L, GrayKor®-R PVC and OrangeKor® CPVC liner is cleaned, abraded and a proprietary bonding resin is applied to achieve a chemical bond between the thermoplastic (PVC / CPVC) and the FRP.
- ii) BlueKor® Polypropylene liner is cleaned and a bonding cloth is mechanically embedded into the surface under controlled heat conditions. Proprietary bonding resin is applied to achieve a mechanical bond between the thermoplastic and the FRP.
- iii) KemKor® PVDF liner is chemically etched, cleaned and proprietary bonding resin is applied to achieve a chemical bond between the PVDF and the FRP.
- iv) Haline® ECTFE, Tefline®-P PFA, Tefline®-F FEP, Tefline®-M MFA, Tefline®-E ETFE liner is cleaned and a bonding cloth is mechanically embedded into the surface under controlled heat conditions. Proprietary bonding resin is applied to achieve a mechanical bond between the thermoplastic and FRP.



**Filament Wound Construction** – This process utilizes continuous glass strand roving that is pre-saturated in a resin bath and is then helically wound around a rotating mandrel at a specified winding angle. The winding process is continued in bi-directional layers until the desired wall thickness is achieved. Fabricated Plastics' pressure piping is made with a 54 3/4° winding angle, which provides the theoretical optimum 2 to 1 hoop to axial strength ratio required for pressure piping. Vacuum piping will normally be wound at greater winding angles, such as 65°, to increase the hoop strength.



**Contact Molded Construction** – This method of laminate construction uses multiple layers of fiberglass chopped strand, woven roving and non-woven glass fabrics saturated with resin and built up to the desired thickness. Each glass layer is layed on the mold and resin is applied. Hand pressure rolling saturates the glass and removes entrapped air to provide a strong dense laminate. Physical properties will vary with the amount of woven roving, unidirectional roving and /or fabric used.

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## TYPICAL THERMOPLASTIC PROPERTIES

|  | BLUEKOR® PP         |                      | GRAYKOR® PVC-U      | ORANGEKOR® CPVC PVC-U | KEMKOR® PVDF         |                 | HALINE® ECTFE   |
|--|---------------------|----------------------|---------------------|-----------------------|----------------------|-----------------|-----------------|
|  | HOMOPOLYMER         | COPOLYMER (UNFILLED) |                     |                       | HOMOPOLYMER          | COPOLYMER       |                 |
| DENSITY G/CM <sup>3</sup>  | 0.91                | 0.88-0.91            | 1.38                | 1.5                   | 1.75-1.79            | 1.76-1.79       | 1.88            |
| <b>MECHANICAL PROPERTIES</b>   |                     |                      |                     |                       |                      |                 |                 |
| TENSILE BREAK STRENGTH, ASTM D638, MPa (ksi)                               | 31-41 (4.5-6.0)     | 27.6-38.0 (4.0-5.5)  | 41-52 (6.0-7.5)     | 47-62                 | 31-48 (4.5-7.0)      | 24-41 (3.5-6.0) | 46-54 (6.6-7.8) |
| TENSILE MODULUS, ASTM D638, MPa (ksi)                                      | 1139-1553 (165-225) | 897-1242 (130-180)   | 2415-4140 (350-600) | 2353-3278 (341-475)   | 1380-5520 (200-800)  |                 | 1656 (240)      |
| ELONGATION, ASTM D638, %   | 100-600             | 200-500              | 40-80               | 4-100                 | 12-600               |                 | 200-300         |
| YIELD STRENGTH, ASTM D638, MPa (ksi)                                       | 31-37 (4.5-5.4)     | 20.7-29.7 (3.0-4.3)  | 41-45 (5.9-6.5)     | 41-55 (6-8)           | 20-57 (2.9-8.3)      | 20-38 (2.9-5.5) | 31-34 (4.5-4.9) |
| <b>THERMAL PROPERTIES</b>  |                     |                      |                     |                       |                      |                 |                 |
| HDT AT 0.46 MPa, ASTM D648, °C   | 107-121             | 54-60                | 57                  | 102-119               | 132-150              | 93-110          | 90              |
| HDT AT 66 PSI, ASTM D648, °F   | 225-250             | 130-140              | 158                 | 215-247               | 270-300              | 200-230         | 194             |
| LINEAR COEFFICIENT OF EXPANSION, ASTM D696, PER °C (°F) X 10 <sup>-5</sup> | 14.6-18.0 (8.1-10)  | 12.2-17.1 (6.8-9.5)  | 5.0-10.0 (2.7-5.6)  | 11.2-14.0 (6.2-7.8)   | 12.6-25.6 (7.0-14.2) |                 | 14.4 (8)        |
| THERMAL CONDUCTIVITY, ASTM C177, W/m-K                                     | 0.1                 | 0.16                 | 0.16-0.18           | 0.12                  | 0.09-0.11            | 0.16            | 0.14            |
| THERMAL CONDUCTIVITY, ASTM C177, BTU/FT <sup>3</sup> -HR °F/IN.            | 0.7                 | 1.1                  | 1.1-1.23            | 0.81                  | 0.59-0.76            | 1.11            | 0.97            |

NOTE: PROPERTIES ARE AT ROOM TEMPERATURE UNLESS OTHERWISE STATED. PROPERTIES ARE TYPICAL VALUES AND ARE NOT TO BE USED FOR DESIGN PURPOSES.

## PIPE LINER MATERIALS AND SERVICE CONDITIONS

| LINER MATERIAL DESIGN            | ASTM MATERIAL SPECIFICATIONS                                  | LINER COLOR                   | BACKING MATERIAL | INSTALLATION METHOD          | LINER JOINING METHODS         | MAXIMUM OPERATING TEMPERATURE |
|----------------------------------|---|-------------------------------|------------------|------------------------------|-------------------------------|-------------------------------|
| GreyKor® PVC-U<br>PVC-L<br>PVC-R | D 1784 Cell 12454, D 1593, D 1927, D 2241, and D 1785         | Dark Grey<br>Dark Grey<br>Red | None             | Chemical Bond                | Solvent Cement or Butt Fusion | 170°F (77°C)                  |
| OrangeKor® CPVC<br>PVC-C         | D 1784 Cell 23447B  | Dark Grey<br>Light Grey       | None             | Chemical Bond                | Solvent Cement or Butt Fusion | 210°F (99°C)                  |
| BlueKor® PP                      | D 4101 Group 1, Class 1, Grade 1 or Group 2, Class 1, Grade 1 | Tan/Grey                      | Glass            | Mechanical Bond              | Butt Fusion                   | 220°F (105°C)                 |
| KemKor® PVDF                     | D3222   | Natural<br>White              | None/<br>Glass   | Chemical/<br>Mechanical Bond | Butt Fusion                   | 220°F (105°C)                 |
| Haline® ECTFE                    | D3275   | Natural<br>Beige              | Glass            | Mechanical Bond              | Butt Fusion                   | 250°F (128°C)                 |

\*OPERATING TEMPERATURE IS USUALLY DICTATED BY THE FRP RESIN'S MAXIMUM SERVICE.

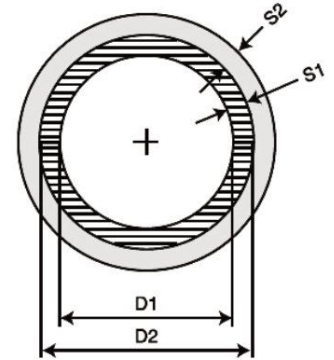


# Thermoplastic Lined FRP Piping

## Fabco Armourplastics® Pipe

| NOMINAL PIPE SIZE | GRAYKOR PVC LINED |        |       |      |       |        | ORANGEKOR CPVC LINED |        |       |      |       |        | KEMKOR PVDF LINED * |     |       |     |       |       |
|-------------------|-------------------|--------|-------|------|-------|--------|----------------------|--------|-------|------|-------|--------|---------------------|-----|-------|-----|-------|-------|
|                   | D2                |        | SI    |      | DI    |        | D2                   |        | SI    |      | DI    |        | D2                  |     | SI    |     | DI    |       |
| IN MM             | IN                | MM     | IN    | MM   | IN    | MM     | IN                   | MM     | IN    | MM   | IN    | MM     | IN                  | MM  | IN    | MM  | IN    | MM    |
| 1/2 15            | 0.84              | 21.34  | 0.147 | 3.73 | 0.55  | 13.87  | 0.84                 | 21.34  | 0.147 | 3.73 | 0.55  | 13.87  |                     |     |       |     |       |       |
| 3/4 20            | 1.05              | 26.67  | 0.154 | 3.91 | 0.74  | 18.85  | 1.05                 | 26.67  | 0.154 | 3.91 | 0.74  | 18.85  | 0.98                | 25  | 0.075 | 1.9 | 0.83  | 21.2  |
| 1 25              | 1.32              | 33.40  | 0.179 | 4.55 | 0.96  | 24.31  | 1.32                 | 33.40  | 0.179 | 4.55 | 0.96  | 24.31  | 1.26                | 32  | 0.094 | 2.4 | 1.07  | 27.2  |
| 1-1/4 32          | 1.66              | 42.16  | 0.191 | 4.85 | 1.28  | 32.46  | 1.66                 | 42.16  | 0.191 | 4.85 | 1.28  | 32.46  | 1.57                | 40  | 0.094 | 2.4 | 1.39  | 35.2  |
| 1-1/2 40          | 1.90              | 48.26  | 0.200 | 5.08 | 1.50  | 38.10  | 1.90                 | 48.26  | 0.200 | 5.08 | 1.50  | 38.10  | 1.97                | 50  | 0.114 | 2.9 | 1.74  | 44.2  |
| 2 50              | 2.38              | 60.33  | 0.218 | 5.54 | 1.94  | 49.25  | 2.38                 | 60.33  | 0.218 | 5.54 | 1.94  | 49.25  | 2.48                | 63  | 0.118 | 3.0 | 2.24  | 57.0  |
| 2-1/2 65          | 2.88              | 73.03  | 0.276 | 7.01 | 2.32  | 59.00  | 2.88                 | 73.03  | 0.276 | 7.01 | 2.32  | 59.00  | 2.95                | 75  | 0.118 | 3.0 | 2.72  | 69.0  |
| 3 90              | 3.50              | 88.90  | 0.216 | 5.49 | 3.07  | 77.93  | 3.50                 | 88.90  | 0.300 | 7.62 | 2.90  | 73.66  | 3.54                | 90  | 0.118 | 3.0 | 3.31  | 84.0  |
| 4 100             | 4.50              | 114.30 | 0.237 | 6.02 | 4.03  | 102.26 | 4.50                 | 114.30 | 0.337 | 8.56 | 3.83  | 97.18  | 4.33                | 110 | 0.118 | 3.0 | 4.09  | 104.0 |
| 5 125             | 5.58              | 141.30 | 0.273 | 6.93 | 5.02  | 127.43 |                      |        |       |      |       |        | 4.92                | 125 | 0.118 | 3.0 | 4.69  | 119.0 |
| 6 150             | 6.63              | 168.28 | 0.297 | 7.54 | 6.03  | 153.19 | 6.63                 | 168.28 | 0.187 | 4.75 | 5.25  | 158.78 | 6.30                | 160 | 0.118 | 3.0 | 6.06  | 154.0 |
| 8 200             | 8.63              | 219.08 | 0.341 | 8.66 | 7.94  | 201.75 | 8.63                 | 219.08 | 0.187 | 4.75 | 8.25  | 209.58 | 7.87                | 200 | 0.118 | 3.0 | 7.64  | 194.0 |
| 10 250            | 10.75             | 273.05 | 0.387 | 9.83 | 8.98  | 253.39 | 10.75                | 273.05 | 0.187 | 4.75 | 10.38 | 263.55 | 9.84                | 250 | 0.118 | 3.0 | 9.61  | 244.0 |
| 12 315            | 12.75             | 323.85 | 0.187 | 4.75 | 12.38 | 314.35 | 12.75                | 323.85 | 0.187 | 4.75 | 12.38 | 314.35 | 12.40               | 315 | 0.157 | 4.0 | 12.09 | 307.0 |
| 14 355            | 14.00             | 355.60 | 0.187 | 4.75 | 13.63 | 346.10 | 14.00                | 355.60 | 0.187 | 4.75 | 13.63 | 346.10 | 13.98               | 355 | 0.197 | 5.0 | 13.58 | 345.0 |
| 16 400            | 16.00             | 406.40 | 0.187 | 4.75 | 15.63 | 396.90 | 16.00                | 406.40 | 0.187 | 4.75 | 15.63 | 396.90 | 15.75               | 400 | 0.197 | 5.0 | 15.35 | 390.0 |
| 18 450            | 18.00             | 457.20 | 0.187 | 4.75 | 17.63 | 447.70 | 18.00                | 457.20 | 0.187 | 4.75 | 17.63 | 447.70 |                     |     |       |     |       |       |
| 20 500            | 20.00             | 508.00 | 0.219 | 5.56 | 19.56 | 496.87 | 20.00                | 508.00 | 0.199 | 5.05 | 19.60 | 497.89 |                     |     |       |     |       |       |
| 24 600            | 24.00             | 609.60 | 0.250 | 6.35 | 23.50 | 596.90 | 24.00                | 609.60 | 0.250 | 6.35 | 23.50 | 596.90 |                     |     |       |     |       |       |

\* 18IN (450MM) - 28IN (700MM)  
AVAILABLE ON REQUEST



S1 - Liner Wall Thickness  
S2 - FRP Wall Thickness  
D1 - Pipe Nominal Inside Diameter  
D2 - Outside Diameter of Liner

| NOMINAL PIPE SIZE | BLUEKOR - GR POLYPROPYLENE LINED |     |       |      |       |       | HAND LAY UP S2 |       |         |       |         |       |
|-------------------|----------------------------------|-----|-------|------|-------|-------|----------------|-------|---------|-------|---------|-------|
|                   | D2                               |     | SI    |      | DI    |       | 75 PSI         |       | 100 PSI |       | 150 PSI |       |
| IN MM             | IN                               | MM  | IN    | MM   | IN    | MM    | IN             | MM    | IN      | MM    | IN      | MM    |
| 1/2 15            | 0.79                             | 20  | 0.098 | 2.5  | 0.59  | 15.0  | 0.187          | 4.75  | 0.187   | 4.75  | 0.187   | 4.75  |
| 3/4 20            | 0.98                             | 25  | 0.106 | 2.7  | 0.77  | 19.6  | 0.187          | 4.75  | 0.187   | 4.75  | 0.187   | 4.75  |
| 1 25              | 1.26                             | 32  | 0.098 | 2.5  | 1.06  | 27.0  | 0.187          | 4.75  | 0.187   | 4.75  | 0.187   | 4.75  |
| 1-1/4 32          | 1.57                             | 40  | 0.146 | 3.7  | 1.28  | 32.6  | 0.187          | 4.75  | 0.187   | 4.75  | 0.187   | 4.75  |
| 1-1/2 40          | 1.97                             | 50  | 0.146 | 3.7  | 1.68  | 42.6  | 0.187          | 4.75  | 0.187   | 4.75  | 0.187   | 4.75  |
| 2 50              | 2.48                             | 63  | 0.181 | 4.6  | 2.12  | 53.8  | 0.187          | 4.75  | 0.187   | 4.75  | 0.187   | 4.75  |
| 2-1/2 65          | 2.95                             | 75  | 0.228 | 5.8  | 2.50  | 63.4  | 0.187          | 4.75  | 0.187   | 4.75  | 0.250   | 6.35  |
| 3 90              | 3.54                             | 90  | 0.201 | 5.1  | 3.14  | 79.8  | 0.187          | 4.75  | 0.187   | 4.75  | 0.250   | 6.35  |
| 4 100             | 4.33                             | 110 | 0.248 | 6.3  | 3.83  | 97.4  | 0.187          | 4.75  | 0.250   | 6.35  | 0.250   | 6.35  |
| 5 125             | 4.92                             | 125 | 0.280 | 7.1  | 4.35  | 110.8 | 0.250          | 6.35  | 0.250   | 6.35  | 0.375   | 9.53  |
| 6 150             | 6.30                             | 160 | 0.197 | 5.0  | 5.91  | 150.0 | 0.250          | 6.35  | 0.250   | 6.35  | 0.375   | 9.53  |
| 8 200             | 7.87                             | 200 | 0.205 | 5.2  | 7.46  | 189.6 | 0.250          | 6.35  | 0.313   | 7.95  | 0.438   | 11.13 |
| 10 250            | 9.84                             | 250 | 0.240 | 6.1  | 9.36  | 237.8 | 0.313          | 7.95  | 0.329   | 9.53  | 0.500   | 12.70 |
| 12 315            | 12.40                            | 315 | 0.303 | 7.7  | 11.80 | 299.6 | 0.375          | 9.53  | 0.438   | 11.13 | 0.625   | 15.88 |
| 14 355            | 13.98                            | 355 | 0.343 | 8.7  | 13.29 | 337.8 | 0.375          | 9.53  | 0.500   | 12.70 | 0.750   | 19.05 |
| 16 400            | 15.75                            | 400 | 0.236 | 6.0  | 15.28 | 388.0 | 0.438          | 11.13 | 0.563   | 14.30 | 0.813   | 20.05 |
| 18 450            | 17.72                            | 450 | 0.276 | 7.0  | 17.17 | 436.0 | 0.500          | 12.70 | 0.625   | 15.88 | 0.938   | 23.83 |
| 20 500            | 19.69                            | 500 | 0.315 | 8.0  | 19.06 | 484.0 | 0.500          | 12.70 | 0.688   | 17.48 | 1.000   | 25.40 |
| 24 600            | 24.80                            | 630 | 0.394 | 10.0 | 24.02 | 610.0 | 0.625          | 15.88 | 0.813   | 20.55 | 1.250   | 31.75 |
| 28 700            | 27.95                            | 710 | 0.477 | 12.0 | 27.01 | 686.0 | 0.750          | 19.05 | 0.937   | 23.81 | 1.438   | 36.51 |

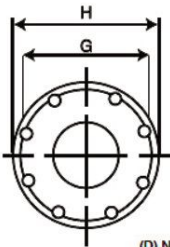
| FILAMENT WOUND S2 ** |      |         |       |         |       |
|----------------------|------|---------|-------|---------|-------|
| 75 PSI               |      | 100 PSI |       | 150 PSI |       |
| IN                   | MM   | IN      | MM    | IN      | MM    |
| 0.19                 | 4.83 | 0.19    | 4.83  | 0.19    | 4.83  |
| 0.19                 | 4.83 | 0.19    | 4.83  | 0.19    | 4.83  |
| 0.19                 | 4.83 | 0.19    | 4.83  | 0.19    | 4.83  |
| 0.19                 | 4.83 | 0.24    | 6.10  | 0.28    | 7.11  |
| 0.24                 | 6.10 | 0.24    | 6.10  | 0.28    | 7.11  |
| 0.24                 | 6.10 | 0.28    | 7.11  | 0.33    | 8.38  |
| 0.24                 | 6.10 | 0.28    | 7.11  | 0.37    | 9.40  |
| 0.28                 | 7.11 | 0.28    | 7.11  | 0.42    | 10.67 |
| 0.28                 | 7.11 | 0.33    | 8.38  | 0.46    | 11.68 |
| 0.28                 | 7.11 | 0.33    | 8.38  | 0.46    | 11.68 |
| 0.33                 | 8.38 | 0.42    | 10.67 | 0.55    | 13.97 |
| 0.37                 | 9.40 | 0.46    | 11.68 | 0.64    | 16.25 |

\*\* 1/2IN (100MM) - 3IN (90MM) AVAILABLE ON REQUEST

FRP - FIBER REINFORCED PLASTIC & GRATING

# Thermoplastic Lined FRP Piping

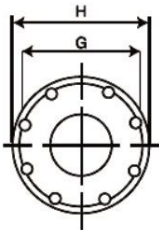
**Fabco Armo** • Ershigs' FRP duct can be provided with contact molded or filament wound construction.



**FLANGE Contact Molded Duct**

- Thicknesses shown include a 100 mil structural corrosion liner.
- Pressure ratings for contact molded duct are based on a 10 to 1 safety factor.

- Pressure ratings for filament wound duct are based on a strain of .001 in./in.
- Vacuum ratings are based on a 5 to 1 safety factor.
- Thicknesses shown are recommended minimum. Systems should be designed for actual operating conditions.



**VANSTONE FL WITH C.S. BACKL**

- \* FLANGE DRILLING
- ANSI B16.5 150
- JIS 10K
- DIN 2051 PN10

**NOMINAL PIPE SIZE**

|   | 1/2   | 3/4   | 1      |
|---|-------|-------|--------|
| A | 5     | 5 3/4 | 6      |
| B | 4     | 4 1/2 | 4 3/4  |
| C | 1 3/8 | 1 3/4 | 1 3/4  |
| D | 4     | 4     | 4      |
| E | 5/8   | 5/8   | 5/8    |
| F | 6     | 6     | 6      |
| G | 2 3/8 | 2 3/4 | 3 1/8  |
| H | 3 1/2 | 3 7/8 | 4 1/4  |
| J | 10    | 11    | 12     |
| K | 5 1/2 | 5 1/2 | 6      |
| L | 7 7/8 | 9 3/4 | 10 1/4 |
| M | 4 7/8 | 5 3/4 | 6 1/4  |

| Dia   | Thk | Wt   | Vac | Press |
|---|-----|------|-----|-------|
| 4   | .14 | 1.3  | 329 | 1744  |
| 6   | .14 | 1.9  | 97  | 1162  |
| 8   | .14 | 2.6  | 41  | 872   |
| 10  | .14 | 3.2  | 21  | 697   |
| 12  | .14 | 3.8  | 12  | 581   |
| 14  | .14 | 4.5  | 7   | 498   |
| 16  | .14 | 5.1  | 5   | 436   |
| Stiffeners on 10 ft centers are placed on 18 in. dia and larger duct. |     |      |     |       |
| 18  | .14 | 5.7  | 6   | 732   |
| 20  | .14 | 6.4  | 5   | 658   |
| 24  | .18 | 9.8  | 7   | 705   |
| 26  | .18 | 10.7 | 7   | 651   |
| 28  | .18 | 11.5 | 6   | 605   |
| 30  | .18 | 12.3 | 5   | 564   |
| 36  | .18 | 14.7 | 5   | 470   |
| 42  | .22 | 21.0 | 6   | 493   |
| 48  | .22 | 24.0 | 5   | 431   |
| 54  | .22 | 27.0 | 4   | 383   |
| 60  | .22 | 30.0 | 3   | 345   |

Dimensions are in inches.  
Pressure and vacuum ratings are in inches water gauge.  
Weights are in lb per ft and are based on a laminate density of .06 lb/in.<sup>3</sup>.

**Filament Wound Duct**

| Dia   | Thk | Wt   | Vac  | Press |
|---|-----|------|------|-------|
| 4   | .21 | 2.3  | 3394 | 49    |
| 6   | .21 | 3.4  | 1005 | 32    |
| 8   | .21 | 4.5  | 424  | 24    |
| 10  | .21 | 5.7  | 217  | 19    |
| 12  | .21 | 6.8  | 125  | 16    |
| 14  | .21 | 7.9  | 79   | 14    |
| 16  | .21 | 9.0  | 53   | 12    |
| Stiffeners on 10 ft centers are placed on 18 in. dia and larger duct. |     |      |      |       |
| 18  | .21 | 10.1 | 54   | 10    |
| 20  | .21 | 11.2 | 46   | 9     |
| 24  | .21 | 13.4 | 35   | 8     |
| 26  | .21 | 14.5 | 31   | 7     |
| 28  | .21 | 15.6 | 28   | 7     |
| 30  | .21 | 16.7 | 25   | 6     |
| 36  | .21 | 20.1 | 19   | 5     |
| 42  | .26 | 29.0 | 26   | 5     |
| 48  | .26 | 33.1 | 21   | 5     |
| 54  | .26 | 37.2 | 18   | 4     |
| 60  | .26 | 41.3 | 15   | 4     |

Dimensions are in inches.  
Pressure and vacuum ratings are in inches water gauge.  
Weights are in lb per ft and are based on a laminate density of .07 lb/in.<sup>3</sup>.

