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INDUSTRIAL CAPABILITIES AND VARIATIONS

Spunstrand® Inc. has been manufacturing filament wound fiberglass reinforced plastic duct and piping for over fifty years. Variations in resin, glass, liners, wall thickness, and their application in corrosive air, HVAC or fluids are as diverse as the markets we serve. We have made just about every size and shape imaginable including insulated industrial ductwork. We also have FDA approved insulated duct for use in food manufacturing plants.

The standard guide specification we use is centered around the National Bureau of Standards PS 15-69 and / or the SMACNA Thermoset FRP duct construction manual. We also manufacture to various ASTM specifications, ANSI, Military specs, and many custom application specifications. We do more custom spec work and spec writing than most FRP manufacturers due to the diversity of product lines, personnel and years of FRP experience.

CAPABILITIES LIST

- Custom Spec Work
- Special Shapes and Sizes
- Polyester, Vinylester, Epoxy Duct and Piping
- Custom Wall Thickness
- Factory Manifolding
- Round Sizes Std. From 2"∅ to 120"∅
- All Fittings; Round and Rectangular
- Carbon Scrubbers, FRP Tanks
- Custom Liners (Glass, Synthetic, Teflon®)
- Insulated Duct
- Consulting (Product or Field)
- Flanges, Blast Gates, Dampers: (Manual or Motorized), Access Doors, etc.
- Zero Leak Isolation Dampers
- Complete Line of Fittings and Accessories
- FRP Duct Silencers
- Mist Eliminators and Grease Filters

Spunstrand® Inc. Fiberglass Reinforced Plastic Duct is custom manufactured for Industrial Corrosion Resistant Fume Exhaust applications. The resin system used is determined by the chemical, pressure and temperature exposures that the duct is subject to. Typical applications include the following:

INDUSTRIAL FRP DUCTING / CORROSIVE FUME HANDLING

- Wastewater Treatment Plants
- Petrochemical Plants
- Laboratory Exhaust
- Glass and Metal Foundries
- Clean Rooms
- Plating & Metal Finishing Facilities
- Micro-Electronic Plants
- Pulp and Paper Industry
- Aerospace Industry
- Automotive Industry
- Marine Exhaust Systems
- Food Processing Facilities

Spunstrand® Inc. duct for these applications is manufactured using the filament wound method, where continuous fiberglass strands are impregnated with resin and machine wound onto a mandrel, providing a stronger part than hand lay-up or centrifugally cast laminate. A corrosion barrier is first applied on the mandrel. For the standard 20 mil resin rich surface mat or synthetic ceil corrosion barrier, the duct is filament wound prior to the gellation of the liner in order to ensure a complete bond. Liner type and thickness are available from 10 to 200 mils depending on specifications and customer requirements.

For 50 or 100 mil liners, the liner must first be post cured in order to ensure that proper resin content and liner thickness is maintained.

The filament winding is then required to be applied within four hours of the liner completion to ensure a complete bond. Winding continues until the desired wall thickness is reached and then the mandrel with the duct laminate is moved to a heated curing station where it is rotated until the resin is set.

Spunstrand® Inc. Industrial Air Duct is fabricated to a wide range of standards to establish dimensional requirements, technical requirements and methods of testing, grading and making the product. PS 15-69, ASTM D-2310, ASTM D-2996, ASME RTP-1 and / or the SMACNA Thermoset FRP Duct construction manual are the applicable standards that cover the current FRP duct fabrication methods.

Factory fabricated standard fittings include elbows, (one piece smooth radius through 30”∅), saddle taps and laterals, tees, crosses, concentric and eccentric reducers, flanges, volume dampers, and end caps. The fittings are fabricated from standard duct material with the fiberglass joints built up by hand. Centerline or tangent takeouts are available.

Accessories include the necessary wet joint material for the standard field butt joints. Spunstrand® Inc. duct can also be fabricated for bell and spigot field joint connections or with flanges all in accordance with SMACNA standards and / or NBS Voluntary Product Standard PS 15-69.

The end result is a custom manufactured duct system that is easily and quickly installed, corrosion and weather resistant and suitable for the temperature, pressure and exposure properties of the air to be handled.

NBS PS 15-69 SPECIFICATIONS FOR FRP DUCTWORK
Standard for Lab Exhaust or Waste Water Treatment

Part 2-**Products**

2.01 **GENERAL**

A. Fiberglass Reinforced Plastic Duct as manufactured by Spunstrand® Inc. or approved equal shall be used to convey and distribute air, backwash water, tank drainage and miscellaneous services as shown on the drawings.

2.02 **MATERIALS**

A. FRP Duct:

1. Type: Filament wound rated at design pressures indicated in the drawings. Minimum wall thickness shall be .125 2" thru 22", .187 24" thru 36", .250 42" thru 60". Rectangular ductwork thickness shall be determined by substituting the long side dimension for the round equivalent diameter thickness, and 1/16 inch greater.
2. Grade: Type 1, Grade 2 RTRP vinylester, Class E per ASTM D-2310.
3. All duct shall be designed for not less than 20 inches water column pressure and 12 inches water column vacuum.
4. A minimum structural safety factor of 5 to 1 shall be used in the design of ducting.
5. Maximum deflection of rectangular ducts under deadload and operating conditions shall not exceed 1% of the width of the longest side.
6. The Type A resin used shall be Hetron 992SB, selected to meet the exposures and temperatures of the air to be exhausted. (See resin application page.) Fillers, other than those added for flame retardance when required, shall **not** be allowed, and should not exceed 5% by weight. Flame spread rating shall be 25 or less per ASTM E-84.
7. Corrosions Liner: Inner surface shall contain a 20 mil thick minimum surface veil saturated with vinylester resin consisting of approximately 90% resin and 10% glass content by weight. The surface veil shall be overlapped a minimum of 1".
8. Structural layer shall be filament wound of Type A premium grade vinylester resin and glass as required for the specific working pressure, bedding conditions, and design conditions.
9. Exterior of pipe shall contain sufficient resin to ensure a relatively smooth surface free from exposed glass fibers or sharp projections and shall contain an ultra violet inhibiting agent.
10. Standard lengths shall be in accordance with the manufacturers published product data sheets. Wall thickness of the duct furnished shall not at any joint be less than 87.5% of the nominal wall thickness specified when measured in accordance with ASTM D-3567 Standard Method of Determining Dimensions of Reinforced Thermosetting Resin Pipe and Fittings.
11. Duct Stiffness: The duct shall have sufficient strength to exhibit, without structural damage, a minimum rated stiffness in accordance with ASTM D-2412 for the pipe laying conditions as noted for the design conditions.
12. Duct manufactured with a composite structural wall containing sand, alumina or other granular fillers is **not** acceptable.

2.03 **ACCESSORIES**

A. Fittings:

1. Construction shall be as specified for the ducting.
2. Bends shall be formed over a removable mold up thru 30”∅ and fabricated from straight duct for larger sizes with the following miter segments:
    a. Bends up to 30° - 1 miter / 2 gore
    b. 31° to 60° bend - 2 miter / 3 gore
    c. 61° to 90° bend - 4 miter / 5 gore
3. Corrosion resistance and working pressure equal to that of connecting duct.

B. Duct Joints: Same material as the duct and shall meet or exceed the hoop tensile strength and axial strength requirements of the duct.

1. Joints:
    a. Duct joints shall be butt and wrap.
    b. Fittings shall be plain end for butt and wrap.
    c. Adhesive material for field joints shall be suitable for minimum 250° F continuous service.
2. Flanges:
    a. Flanges shall be hand lay-up per NBS PS 15-69 and furnished undrilled.
    b. Flange gasket shall be suitable for 250° F continuous service and constructed of neoprene rubber or approved equal.

C. Supports and Hangers:

1. FRP ductwork shall be supported at intervals no greater than 10-foot centers. Supports and hangers shall transmit all ductwork load into the building structural frame through a system of intermediate beams and struts as necessary to accommodate requirements of these specifications.

D. Dampers:

1. FRP dampers shall be fabricated with the same materials as the duct. No resin variations will be acceptable. Blade shall be FRP 2 piece molded including blade stiffeners per schedule on drawing. Damper blade shall be offset 5° in closed position to form a normal stop on wall of duct. Axle to be pultruded FRP made with same resin and continuous strand roving. Bearings to be Teflon. O-rings shall be Viton. No metal parts or cut edges in airstream will be allowed.
2. Volume dampers to be manually operated Spunstrand® Inc. single blade, plain end by plain end volume dampers.
3. Balancing dampers to be Spunstrand® Inc. BA series, or Swartwout model 912 with blade shop, axle shaft seals and locking hand quadrant.
4. Isolation dampers to be Spunstrand® Inc. ZL Series (Zero Leak), Ershigs type “B”, or Swartwout model 914 with blade seals, axle shaft seals, and gear operator. Flanges included on all isolation dampers and on balancing dampers when shown on drawings. Either damper submitted shall have AMCA certified leakage rates or shall be individually water tested and certified leak free. No other shop-fabricated dampers shall be allowed. See separate specifications for Zero Leak Dampers and cut-sheets.
5. Rectangular Dampers:
    a. Rectangular multi-blade volume dampers to be single blade manual dampers manufactured by Spunstrand Inc.
    b. Rectangular multi-blade dampers shall be Swartwout 426AF with airfoil blade seals, rated with certified AMCA leakage rates and shall not exceed 20 cfm per sq./ft.

E. Silencers:

1. Fiberglass Reinforced Plastic Silencers shall be manufactured by **Spunstrand® Inc. and David P. Wilson, FiberSonic Model FS-00-00-00**, or pre-approved equal. Silencer shall be tested for insertion loss, self-noise, and pressure drop in an independent NVLAP accredited laboratory in full accordance with ASTM E477. Testing shall be completed and data available for review, 72 hours prior to bid date. Test data for insertion losses to meet or exceed the acoustical data published in the specification tables.
2. Silencers above ground to installed per manufacturer's recommendations.
3. Silencers installed below ground should either be accessible inside a watertight concrete vault, or fitted with a schedule 80 PVC drain at the lowest point for piping back to plenum. Water entering the duct by any means will find a low point in the silencer, and must have a provision for draining.
4. See Fibersonic Silencer™ Construction Specification for details on page 24 of this catalog section.

2.04 **Quality Assurance**

A. Manufacturer shall provide the following information with the pre-approval package:

1. (2) sample cutouts demonstrating 100 to 110 mil clear liner with no antimony and filament wound structural laminate. Samples to be a minimum of 8"∅ cut-out and a 12"∅ piece of duct at least 12" long complying with RTP-1 visual level II.
2. Company filament winding history and at least two (2) FRP duct job names with similar type construction, including contact names and phone numbers.
3. (2) copies of the fabricators ISO 9000 based Quality Control Manual or equal.
4. A letter from an outside testing agency confirming RTP-1 visual level II quality and the quantity and the size of the specimens examined.
5. Certified testing data from an outside testing agency confirming the resin and glass contents of the liner and structural layers separately.
6. Copies of burial calculations for at least 3 sizes of duct between 18" and 48"∅.
7. Any fabricator unable to provide this information and samples to the engineer 48 hours prior to bid date will not be considered.

B. All FRP ductwork shall be fabricated and installed by qualified, experienced mechanics who have a minimum of 5 years experience with the lay-up, fabrication and joining of this type of material.

C. Factory Inspection:

1. Owner shall be given access to the FRP ductwork and all quality control records during fabrication and upon completion for the purpose of verifying compliance to the Contract Documents.
2. The owner shall maintain the right to tour the FRP duct manufacturer's plant anytime that fabrication is in process prior to final shipment. The owner and engineer may exercise the option, without any advance notice, to tour the plant and inspect all stages of fabrication to ensure that quality control is being maintained.
3. Inspection by owner does not relieve any responsibility of the fabricator to meet the requirements of this specification.
4. Final Inspection: The engineer and owner may carry out a final inspection of the equipment prior to shipment. Fabricator shall give the owner a minimum of 5 days advance notice of scheduled ductwork shipment. Prior to final inspection by owner the ductwork shall be cleaned of all foreign material and shall be in a position that allows easy access and viewing.

D. Acceptance:

1. Lack of compliance with any aspect of the specifications and drawings will be grounds for rejection of the equipment.
2. Repair of rejected equipment - repair procedures must be approved by the owner prior to implementation. No more than 5% of the surface area of each FRP duct component may be repaired.

E. The fabricators inspector (Quality Control Manager) will provide the owner with a complete Quality Control report for the job. The report will be available within 15 days after the final parts are shipped. The fabricator will have available after each shipment the complete QC sheets for review upon request at any time.

2.05 **Submittals**

A. Provide the following information in addition to the standard submittal requirements with the Bid:

1. The fabricator shall submit for approval all reference standards, calculations, fabrication drawings and all engineering details of the duct design prior to the beginning of fabrication.
    a. The submittal should include all information utilized by the fabricator which describes specifically how their FRP duct is manufactured. This should be in the form of shop drawings, standards, specifications, other instructions and QC records. This should include, but not be limited to:
        1. Resin type
        2. Types and amounts of filler
        3. Corrosion liner description
        4. Reinforcement types for hand lay-up or chopped laminates
    b. For filament-wound laminates
        1. Helix angle
        2. Glass content range
        3. Strand yield
        4. Strands per inch in the winding band
        5. Ply thickness
        6. Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate
    c. For all fabricated parts
        1. Construction type
        2. Laminate thickness
        3. Ply sequences
        4. Glass content range
    d. For all secondary overlays (both interior and exterior)
        1. Laminate thickness
        2. Ply sequences and widths
    e. Construction details for all other special configurations and fabricated parts

2. FRP duct cutout a minimum of 8” diameter and of the quality of workmanship and glass / resin being quoted. These will be retained for quality comparison on materials shipped to jobsite.
3. Recommended procedure for the protection and handling of materials prior to installation.
4. ISO 9000 based Quality Control System, or approved equal, detailing shop QC inspection procedures and documentation and samples of all shop QC forms utilized in the process.

SMACNA SPECIFICATION FOR FRP DUCTWORK
Municipal applications rated at 10" negative pressure.

Part 2 - **Products**

2.01 **GENERAL**

A. Fiberglass Reinforced Plastic Duct as manufactured by Spunstrand® Inc., or pre-approved equal, and shall be used to convey and distribute air with continuous mixtures of chemical fumes, and environmental conditions as described in these specifications and drawings. Unless otherwise noted, FRP ductwork shall comply with all sections pertaining specifically to FRP ductwork.

2.02 **Materials**

A. FRP Duct:

1. Type: Filament wound rated at design pressures indicated in the drawings. Minimum wall thickness shall be in accordance with SMACNA SI at .145 for 2" through 30", S3 at .180 for 32" through 42", S5 at .220 for 48" through 60", and S7 at .260 for 72". Rectangular ductwork thickness shall be as specified in SMACNA, NBS PS 15-69, the drawings and detail sheets.
2. Grade: Type 1, Grade 2 RTRP, Class E per ASTM D2310 and D2996.
3. All duct shall be designed for not less than 30 inches water column pressure and 10 inches water column vacuum. The design, application construction and inspections shall be in accordance with SMACNA and visual inspection criteria in accordance with ASME RTP-1. Table 6, Visual Level II.
4. A minimum structural safety factor of 4 shall be used in the design of ducting.
5. Maximum deflection of rectangular duct under deadload and operating conditions shall not exceed 1% of the width of the longest side.
6. The resin used shall be Hetron 992SB, or Derakane 510 C-350 depending on availability, selected to meet the exposures and temperatures of the air to be exhausted. Minimum barcol hardness: 36. Fillers other than antimony trioxide added for flame retardancy when required shall not be allowed and should not exceed 5% by weight. A thixotropic agent for viscosity control may be used as recommended by the resin manufacturer. No thixotropic agent is to be used in the corrosion liner or on surfaces to be in contact with the corrosive environment. Flame spread rating shall be 25 or less per ASTM E-84. Catalyst shall be DHD9, High Point 90 or Norox MEKP-9H per resin manufacturer.
7. Corrosion Liner: Inner surface shall contain one ply of 10 mil thick minimum C-glass surfacing veil saturated with vinylester resin. The surface veil shall be overlapped a minimum of 1". Two (2) layers of 1-1/2 oz. / sq ft chopped strand mat shall follow surface veil layer. Corrosion liner is to gel completely before proceeding with structural laminates. In no case shall the interruption exceed 12 hours. Total liner thickness to be 100 mils. No thixotropic agent or fire retardant additive is to be used in the liner resin. Corrosion liner shall contain not less than 20% or more than 30% glass by weight. Liner shall pass ASME RTP-1 Table 6, level II visual inspection. Total glass content 25 to 30%.

8. Structural layer shall be filament wound using Hetron 992SB, or Derakane 510C-350 premium grade, vinylester resin and Type E 250 strand yield continuous glass roving. The band width is 2 1/4" using an average of (7) strands per inch. Filament winding cycle thickness to be 0.06" maximum. Glass content 55 to 65%. Winding angle shall be 65° ± 2° for increased vacuum service.
9. Exterior of all laminates shall contain sufficient resin to insure a relatively smooth surface free from exposed glass fibers or sharp projections. An ultraviolet stabilizer added to the final coat of resin that also incorporates paraffinated wax curing elements. Ductwork located outdoors shall contain an exterior colored surface coat. Color to be selected by owner. Ductwork indoors shall have 2 coats of PPG 42-7 intumescent paint to provide a Class 1 flame and smoke rating. ASTM E-84 Steiner Tunnel test results shall be attached as part of the submittal packet.
10. Standard lengths shall be in accordance with the manufacturers published product data sheets and shop drawings. Wall thickness of the duct furnished shall not at any point be less than specified minimum wall thickness when measured in accordance with ASTM D3567.
11. Duct stiffness: The duct shall have a minimum pipe stiffness in accordance with ASTM D2412 for the pipe laying conditions as noted for the design conditions.

2.03 **ACCESSORIES**

A. FITTINGS:
1. Construction shall be similar to that for the ducting.
2. Radius elbow shall be formed over a removable mold for diameters up to 30"∅ and fabricated from straight duct for all sizes 32"∅ and larger as follows:
    a. Bends up to 30° - 1 miter / 2 gore
    b. 31° to 60° - 2 miter / 3 gore
    c. 61° to 90° bend - 4 miter / 5 gore
3. Turning vanes and splitters shall be provided at all single mitered bends 46° and greater and similar fittings that are not one-piece smooth radius fittings per SMACNA and ASHRAE standards. Turning vanes shall be filament wound and reinforced with unidirectional glass in lieu of stainless steel. Stainless steel does not expand and contract at the same rate as FRP, does not bond well, and is not recommended in a 50 ppm H2S environment.

B. DUCT JOINTS:
1. Joints
    a. Duct joints shall be butt and wrap joint connections.
    b. Fittings shall be butt and wrap joint connections.
    c. Adhesive material for field joining shall be supplied in rolls and resin containers no larger than five gallons.
    d. All joints shall be per SMACNA standard and per attached laminate schedule.
2. Flanges
    a. Flanges shall be per SMACNA Thermoset Duct construction manual and supplied undrilled for field drilling and alignment. Flange dimensions shall comply with NBS PS 15-69.
    b. All gaskets, bolts, nuts and washers shall be 316 stainless steel and supplied by contractor.

C. DAMPERS:

1. Round Dampers:
    a. FRP dampers shall be fabricated with the same materials as the duct. No resin variations will be acceptable. Blade shall be FRP 2 piece molded including blade stiffeners per schedule on drawing. Damper blade shall be offset 5° in closed position to form a normal stop at wall of duct. Axle to be pultruded FRP made with same resin and continuous strand roving. Bearings to be Teflon. O-rings shall be Viton No metal parts or cut edges in airstream will be allowed.
    b. Volume dampers to be manually operated Spunstrand® Inc. single blade, plain end by plain end volume dampers.
    c. Balancing dampers to be Spunstrand® Inc. BA Series or Swartwout model 912 with blade stop, axle shaft seal, and locking hand quadrant.
    d. Isolation dampers to be Spunstrand® Inc. ZL Series (Zero Leak), Ershigs type “B”, or Swartwout model 914 with blade seals, axle shaft seals, and gear operator. Flanges included on all isolation dampers and on balancing dampers when shown on drawings. Either damper submitted shall have AMCA certified leakage rates or shall be individually water tested and certified leak free. No other shop-fabricated dampers shall be allowed. See separate specifications for Zero Leak Dampers and cut-sheets.
2. Rectangular Dampers:
    a. Rectangular volume dampers to be single blade manual dampers manufactured by Spunstrand Inc.
    b. Rectangular multi-blade dampers shall be Swartwout 426AF with airfoil blade seals, rated with certified AMCA leakage rates and shall not exceed 20 cfm per sq / ft.

D. SILENCERS:

1. Fiberglass Reinforced Plastic Silencers shall be manufactured by **Spunstrand® Inc. and David P. Wilson <u>FiberSonic Model FS-00-00-00</u>**, or pre-approved equal. Silencer shall be tested for insertion loss, self-noise, and pressure drop in an independent NVLAP accredited laboratory in full accordance with ASTM E477. Testing shall be completed and data available for review, 72 hours prior to bid date. Test data for insertion losses to meet or exceed the acoustical data published in the specification tables.
2. Silencers above ground to installed per manufacturer’s recommendations.
3. Silencers installed below ground should either be accessible inside a watertight concrete vault, or fitted with a schedule 80 PVC drain at the lowest point for piping back to plenum. Water entering the duct by any means will find a low point in the silencer, and must have a provision for draining.
4. See Fibersonic Silencer™ Construction Specification for details on page 24 of this catalog section.

E. SUPPORTS AND HANGERS:

1. Supports and hangers shall be designed, fabricated, and installed in accordance with the requirements of SMACNA’s FRP Duct Construction Manual or equivalent. Supports and hangers to be by others.

F. MISCELLANEOUS REQUIREMENTS:

1. Markings on duct and spool pieces shall be in accordance with shop drawings.
2. Fabricators bid shall include as a standard to wrap all gel coated or intumescent painted duct and fittings in bubble wrap to completely protect the finishes. The bubble wrap should then be left on while being unloaded and stored on site. After transportation to the final installation point the wrap should finally be removed. Since storage, installation schedules and transportation around the job site present many challenges this method is a worthy precaution. While shipping from the factory, the duct can be stacked in layers to 3 high in diameter up to 24"∅ and 2 high in diameters over 30"∅. Stagger stacking and blocking with the use of bubble wrap will provide full length support along the length of the duct and eliminate bouncing and point wear to the coatings. Fabricators shall fully warranty this method and use only dedicated trucks, factory pre-qualified in this method.
3. Pre-approved Vendors:
    a. Spunstrand® Inc. Wallace, ID
    b.
    c.

    Note: All vendors not listed may obtain pre-approval by complying with pre-approval process of the Quality Assurance section of this section. No other bidders will be accepted.

2.04 **Quality Assurance**

A. Manufacturer shall provide the following information with the pre-approval package, as required:

1. (2) sample cutouts demonstrating 100 to 110 mils clear liner with no antimony and filament wound structural laminate. Samples to be a minimum of 8"∅ cut out and a 12"∅ piece of duct at least 12" long complying with RTP-1 visual level II.
2. Company filament winding history and at least (2) FRP duct job names with similar type construction, including contact names and phone numbers.
3. (2) copies of the fabricators ISO 9000 based Quality Control Manual, or equal.
4. A letter from an outside testing agency confirming RTP-1 visual level II quality and the quantity and the size of the specimens examined.
5. Certified testing data from an outside testing agency confirming the resin and glass contents of the liner and structural layers separately.
6. Copies of burial calculations for at least 3 sizes of duct between 18" and 48"∅.
7. Any fabricator unable to provide this information and samples to the engineer 48 hours prior to bid will not be considered.

B. All FRP ductwork shall be fabricated and installed by qualified, experienced mechanics, who have a minimum of 5 years experience with the lay-up, fabrication and joining of this type of material.

C. Factory Inspection:

1. Owner shall be given access to the FRP ductwork and all quality control records during fabrication and upon completion for the purpose of verifying compliance to the Contract Documents.
2. The owner shall maintain the right to tour the FRP duct manufacturer's plant anytime that fabrication is in process prior to final shipment. The owner and engineer may exercise the option, without any advance notice, to tour the plant and inspect all stages of fabrication to ensure that quality control is being maintained.
3. Inspection by owner does not relieve any responsibility of the fabricator to meet the requirements of this specification.
4. Final Inspection: The engineer and owner may carry out a final inspection of the equipment prior to shipment. Fabricator shall give the owner a minimum of 5 days advance notice of scheduled ductwork shipment. Prior to final inspection by owner, the ductwork shall be cleaned of all foreign material and shall be in a position that allows easy access and viewing.

D. Acceptance:

1. Lack of compliance with any aspect of the specifications and drawings will be grounds for rejection of the equipment.
2. Repair of rejected equipment: Repair procedures must be approved by the owner prior to implementation. No more than 5% of the surface area of each FRP duct component may be repaired.

E. The fabricator's inspector (Quality Control Manager) will provide the owner with a complete Quality Control report for the job. The report will be available within 15 days after the final parts are shipped. The fabricator will have available after each shipment the completed QC sheets for review upon request at any time.

2.05 **Submittals**

A. The following information has been provided with the standard submittal requirements:

1. The fabricator shall submit for approval all reference standards, fabrication drawings and any engineering details of the duct design prior to beginning fabrication.
    A. The submittal should include all information utilized by the fabricator which describes specifically how their FRP duct and fittings are manufactured. This should be in the form of shop drawings, standards, specifications, other shop instructions and QC records. This should include, but not be limited to:
        1. Resin type
        2. Types and amounts of filler
        3. Corrosion liner description
        4. Reinforcement types for hand lay-up or chopped laminates
        5. For filament-wound laminates:
            a. Helix angle
            b. Glass content range
            c. Strand yield
            d. Strands per inch in the winding band
            e. Ply thickness
            f. Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate
        6. For all fabricated parts
            a. Construction type
            b. Laminate thickness
            c. Ply sequences
            d. Glass content range

7. For all secondary overlays (both interior and exterior)
    a. Laminate thickness
    b. Ply sequences and widths
8. Construction details for all other special configurations and fabricated parts.

2. FRP round duct sample, minimum size 12” diameter by 12” long and a 45° elbow showing the quality of workmanship and glass / resin being quoted. These will be retained for quality comparison on materials shipped to jobsite.
3. Recommended procedure for the protection and handling of materials prior to installation.
4. ISO 9000 based Quality Control Manual detailing shop QC inspection procedures, documentation and samples of all shop QC forms utilized in the process.

SMACNA SPECIFICATION FOR FRP DUCTWORK
Municipal Application, Rate at 30'' Negative Pressure

Part 2 - **PRODUCTS**

2.01 **General**

A. Fiberglass Reinforced Plastic Duct as manufactured by Spunstrand® Inc. or pre-approved equal and shall be used to convey and distribute air with continuous mixtures of chemical fumes and environmental conditions as described in these specification and drawings. Unless otherwise noted, FRP ductwork shall comply with all sections pertaining specifically to FRP ductwork.

2.02 **Materials**

A. FRP Duct:

1. Type: Filament wound rated at design pressures indicated in the drawings. Minimum wall thickness shall be in accordance with SMACNA table 5-7 combination SI at .145 for 2"∅ through14"∅, S3 at .180 for 16"∅ though 22"∅, S5 at .220 for 24∅" through 30∅", S7 at .260 for 32∅" through 36∅", S9 at .300 for 42∅" through 48∅", S11at .340 for 54∅" through 60∅", S13 at .380 for 72"∅, S15 at .420 for 84"∅, and S17 at .460 for 96"∅. Rectangular ductwork thickness shall be as specified in SMACNA, the drawings and detail sheets. In no case shall the rectangular duct thickness be less than substituting the long side of the rectangular duct for the round equivalent thickness.
2. Grade: Type 1, Grade 2 RTRP, Class E per ASTM D2310 and D2996.
3. All duct shall be designed for no less than 60" water column pressure and 30" water column vacuum. The design, applicable construction and inspections shall be in accordance with SMACNA and visual inspection criteria in accordance with ASME RTP-1. Table 6, Visual Level II.
4. A minimum structural safety factor of 4 shall be used in the design of ducting.
5. Maximum deflection of rectangular duct under deadload and operating conditions shall not exceed 1% of the width of the longest side.
6. The resin used shall be Hetron 992SB or Derakane 510, depending on availability, selected to meet the exposures and temperatures of the air to be exhausted. Minimum barcol hardness: 36. Fillers other than antimony trioxide added for flame retardancy when required shall **not** be allowed and should not exceed 5% by weight. A thixotropic agent for viscosity control may be used as recommended by the resin manufacturer. No thixotropic agent is to be used in the corrosion liner or on surfaces to be in contact with the corrosive environment. Flames spread rating shall be 25 or less per ASTM E-84. Catalyst shall be DHD9, High Point 90 or Norox MEKP-9H per resin manufacturer.
7. Corrosion Liner: Inner surface shall contain one ply of 10 mil thick minimum C-glass surfacing veil saturated with vinylester resin. The surface veil shall be overlapped a minimum of 1" (2) layers of 1-1/2 oz / sq ft chopped strand mat shall follow surface veil layer. Corrosion liner is to gel completely before proceeding with structural laminates. In no case shall the interruption exceed 12 hours. Total liner thickness to be 100 mils minimum. No thixotropic agent or fire retardant additive is to be used in the liner resin. Corrosion liner shall contain not less than 20% or more than 30% glass by weight. Liner shall pass ASME RTP-1 Table 6, level II visual inspection. Total glass content 25 to 30%.

8. Structural layer shall be filament wound using Hetron 992SB or Derakane 510 premium grade vinylester resin and Type E 250 strand yield continuous glass roving. The band width is 2 1/4" using (7) strands per inch. Filament winding cycle thickness to be 0.06" maximum. Glass content 55 to 65%. Winding angle shall be 65°±2° for increased vacuum service.
9. Exterior of all laminates shall contain sufficient resin to ensure a relatively smooth surface free from exposed glass fibers or sharp projections. An ultraviolet stabilizer added to the final coat of resin that also incorporates paraffinated wax curing elements. Ductwork located outdoors shall contain an exterior colored surface coat. Color to be selected by owner. Ductwork indoors shall have 2 coats of PPG 42-7 Intumescent paint to provide a Class 1 flame and smoke rating. ASTM E-84 Steiner Tunnel test results shall be attached as part of the submittal packet.
10. Standard lengths shall be in accordance with the manufacturers published product data sheets and approved shop drawings. Wall thickness of the duct furnished shall not at any point be less than specified minimum wall thickness when measured in accordance with ASTM D3567.
11. Duct Stiffness: The duct shall have a minimum rated stiffness in accordance with ASTM D2412 for the pipe laying conditions as noted for the design conditions.

2.03 **ACCESSORIES**

A. FITTINGS:
1. Construction shall be similar to that for the ducting.
2. Radius elbow shall be formed over a removable mold for diameters up to 30∅ and fabricated from straight duct for all sizes 32"∅ and larger as follows:
    a. Bends up to 30° - 1 miter / 2 gore
    b. 31° to 60° - 2 miter / 3 gore
    c. 61° to 90° bend - 4 miter / 5 gore
3. Turning vanes and splitters shall be provided at all single mitered bends 46° and and similar fittings that are not one-piece smooth radius fittings per SMACNA and ASHRAE standards. Turning vanes shall be filament wound and reinforced with unidirectional glass in lieu of stainless steel. Stainless steel does not expand and contract at the same rate as FRP, does not bond well, and is not recommended in a 50 ppm H2S environment.

B. DUCT JOINTS:
1. Joints:
    a. Duct joints shall be butt and wrap joint connections.
    b. Fittings shall be butt and wrap joint connections.
    c. Adhesive material for field joining shall be supplied in rolls and resin containers no larger than five gallons.
    d. All joints shall be per SMACNA standard and per attached laminate schedule.
2. Flanges:
    a. Flanges shall be per SMACNA Thermoset Duct construction manual and supplied undrilled for field drilling and alignment. Flange dimensions shall comply with NBS PS 15-69.
    b. All gaskets, bolts, nuts and washers shall be 316 stainless steel and supplied by contractor.

C. DAMPERS:

1. Round Dampers:
    a. FRP dampers shall be fabricated with the same materials as the duct. No resin variations will be acceptable. Blade shall be FRP 2 piece molded including blade stiffeners per schedule on drawing. Damper blade shall be offset 5° in closed position to form a normal stop at wall of duct. Axle to be pultruded FRP made with same resin and continuous strand roving. Bearings to be Teflon. O-rings shall be Viton No metal parts or cut edges in airstream will be allowed.
    c. Volume dampers to be manually operated Spunstrand® Inc. single blade blade, plain end by plain end volume dampers.
    c. Balancing dampers to be Spunstrand® Inc. BA Series or Swartwout model 912 with blade stop, axle shaft seal, and locking hand quadrant.
    d. Isolation dampers to be Spunstrand® Inc. ZL Series (Zero Leak), Ershigs type “B”, or Swartwout model 914 with blade seals, axle shaft seals, and gear operator. Flanges included on all isolation dampers and on balancing dampers when shown on drawings. Either damper submitted shall have AMCA certified leakage rates or shall be individually water tested and certified leak free. No other shop fabricated dampers shall be allowed. See separate specifications for Zero Leak Dampers and cut-sheets.
2. Rectangular Dampers:
    a. Rectangular volume dampers to be single blade manual dampers manufactured by Spunstrand® Inc.
    b. Rectangular multi-blade dampers shall be Swartwout 426AF with airfoil blade seals, rated with certified AMCA leakage rates and shall not exceed 20 cfm per sq / ft.

D. SILENCERS:

1. Fiberglass Reinforced Plastic Silencers shall be manufactured by **Spunstrand® Inc. and David P. Wilson, FiberSonic Model FS-00-00-00**, or pre-approved equal. Silencer shall be tested for insertion loss, self-noise, and pressure drop in an independent NVLAP accredited laboratory in full accordance with ASTM E477. Testing shall be completed and data available for review, 72 hours prior to bid date. Test data for insertion losses to meet or exceed the acoustical data published in the specification tables.
2. Silencers above ground to installed per manufacturer’s recommendations.
3. Silencers installed below ground should either be accessible inside a watertight concrete vault, or fitted with a schedule 80 PVC drain at the lowest point for piping back to plenum. Water entering the duct by any means will find a low point in the silencer, and must have a provision for draining.
4. See Fibersonic Silencer™ Construction Specification for details on page 24 of this catalog section.

E. SUPPORTS AND HANGERS:

1. Supports and hangers shall be designed, fabricated, and installed in accordance with the requirements of SMACNA’s FRP Duct Construction Manual or equivalent. Supports and hangers to be by others.

F. MISCELLANEOUS REQUIREMENTS:

1. Markings on duct and spool pieces shall be in accordance with shop drawings.
2. Fabricators bid shall include as a standard to wrap all gel coated or intumescent painted duct and fittings in bubble wrap to completely protect the finishes. The bubble wrap should then be left on while being unloaded and stored on site. After transportation to the final installation point the wrap should finally be removed. Since storage, installation schedules and transportation around the job site present many challenges this method is a worthy precaution. While shipping from the factory, the duct can be stacked in layers to 3 high in diameter up to 24"∅ and 2 high in diameters over 30"∅. Stagger stacking and blocking with the use of bubble wrap will provide full length support along the length of the duct and eliminate bouncing and point wear to the coatings. Fabricators shall fully warranty this method and use only dedicated trucks, factory pre-qualified in this method.
3. Pre-approved Vendors:
    a. Spunstrand® Inc. Wallace, ID
    b.
    c.

    Note: All vendors not listed may obtain pre-approval by complying with pre-approval process of the Quality Assurance section of this section. No other bidders will be accepted.

2.04 **Quality Assurance**

A. Manufacturer is able to provide the following information with the pre-approval package as required:

1. (2) sample cutouts demonstrating 100 to 110 mils clear liner with no antimony and filament wound structural laminate. Samples to be a minimum of 8"∅ cut out and a 12"∅ piece of duct at least 12" long complying with RTP-1 visual level II.
2. Company filament winding history and at least (2) FRP duct job names with similar type construction including contact names and phone numbers.
3. (2) copies of the fabricators ISO 9000 based Quality Control Manual, or equal.
4. A letter from an outside testing agency confirming RTP-1 visual level II quality and the quantity and the size of the specimens examined.
5. Certified testing data from an outside testing agency confirming the resin and glass contents of the liner and structural layers separately.
6. Copies of burial calculations for at least 3 sizes of duct between 18" and 48"∅.
7. Any fabricators unable to provide this information and samples to the engineer 48 hours prior to bid date will not be considered.

B. All FRP ductwork shall be fabricated and installed by qualified, experienced mechanics who have a minimum of 5 years experience with the lay-up, fabrication and joining of this type of material.

C. Factory Inspection:

1. Owner shall be given access to the FRP Ductwork and all quality control records during fabrication and upon completion for the purpose of verifying compliance to the Contract Documents.
2. The owner shall maintain the right to tour the FRP manufacturer's plant anytime that fabrication is in process prior to final shipment. The owner and engineer may exercise the option, without any advance notice, to tour the plant and inspect all stages of fabrication to ensure that quality control is being maintained.
3. Inspection by owner does not relieve any responsibility of the fabricator to meet the requirements of this specification.
4. Final Inspection: The engineer and owner may carry out a final inspection of the equipment prior to shipment. Fabricator shall give the owner a minimum of 5 days advance notice of scheduled ductwork shipment. Prior to final inspection by owner, the ductwork shall be cleaned of all foreign material and shall be in a position that allows easy access and viewing.

D. Acceptance:

1. Lack of compliance with any aspect of the specifications and drawings will be grounds for rejection of the equipment.
2. Repair of rejected equipment: Repair procedures must be approved by the owner prior to implementation. No more than 5% of the surface area of each FRP duct component may be repaired.

E. The fabricator's inspector (Quality Control Manager) will provide the owner with a complete Quality Control report for the job. The report will be available within 15 days after the final parts are shipped. The fabricator will have available after each shipment the completed QC sheets for review upon request at any time.

2.05 **Submittals**

A. The following information has been provided with the standard submittal requirements:

1. The fabricator shall submit for approval all reference standards, fabrication drawings and any engineering details of the duct design prior to beginning fabrication.
    a. The submittal should include all information utilized by the fabricator which describes specifically how their FRP duct and fittings are manufactured. This should be in the form of shop drawings, standards, specifications, other shop instructions and QC records. This should include, but not be limited to:
        1. Resin type
        2. Types and amounts of filler
        3. Corrosion liner description
        4. Reinforcement types for hand lay-up or chopped laminates
        5. For filament-wound laminates:
            a. Helix angle
            b. Glass content range
            c. Strand yield
            d. Strand by inch in the winding band
            e. Ply thickness
            f. Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate
        6. For all fabricated parts:
            a. Construction type
            b. Laminate thickness
            c. Ply sequences
            d. Glass content range

7. For all secondary overlays (both interior and exterior):
    a. Laminate thickness
    b. Ply sequences and widths
8. Construction details for all other special configurations and fabricated parts

2. FRP round duct sample, minimum size 12"∅ by 12" long and a 45° elbow quality of workmanship and glass / resin being quoted. These will be retained for quality comparison on materials shipped to jobsite.
3. Recommended procedure for the protection and handling of materials prior to installation.
4. ISO 9000 based Quality Control Manual detailing shop QC inspection procedures, documentation and samples of all shop QC forms utilized in the process.

SPECIFICATION FOR FRP DUCTWORK MEDIUM DUTY LAB OR WASTE WATER TREATMENT EXHAUST

Part 2 - **PRODUCTS**

2.01 **General**

A. Fiberglass Reinforced Plastic Duct as manufactured by Spunstrand® Inc. or approved equal shall be used to convey and distribute air, backwash water, tank drainage and miscellaneous services as shown on drawings.

2.02 **Materials**

A. FRP Duct:

1. Type: Filament wound rated at design pressures indicated in the drawings. Nominal wall thickness shall be .090 2" thru 18", .105 20" thru 24", .130 26" thru 36", .180 42" thru 48", .212 for 54", .225 for 60", .250 for 72", .325 for 84". Rectangular duct work thickness shall be determined by substituting the long side dimension for the round equivalent diameter thickness, and 1/16" greater.
2. Grade: Type 1, Grade 2 RTRP vinylester, Class E per ASTM D2310.
3. All ducts shall be designed for not less than 12" water column pressure and 5" water column vacuum. See attached schedule for reinforcing ribs for vacuum service.
4. A minimum structural safety factor of 5 shall be used in the design of ducting.
5. Maximum deflection of rectangular ducts under deadload and operating conditions shall not exceed 1% of the width of the longest side.
6. The Type A resin used shall be Hetron 992SB selected to meet the exposures and temperatures of the air to be exhausted. Fillers other than those added for flame retardance when required shall **not** be allowed and should not exceed 5% by weight. Flame spread rating shall be 25 or less per ASTM E-84.
7. Corrosion Liner: Inner surface shall contain a 10 mil thick minimum surface veil saturated with vinylester resin consisting of approximately 90% resin and 10% glass content by weight. The surface veil shall be overlapped a minimum of 1".
8. Structural layer shall be filament wound of Type A premium grade vinyl ester resin and glass as required for the specific working pressure, bedding conditions and design conditions.
9. Exterior of pipe shall contain sufficient resin to insure a relatively smooth surface free from exposed glass fibers or sharp projections and shall contain an ultra violet inhibiting agent.
10. Standard lengths shall be in accordance with the manufacturer's published product data sheets. Wall thickness of the duct furnished shall not at any joint be less than 87.5% of the nominal wall thickness specified when measured in accordance with ASTM D3567 Standard Method of Determining Dimensions of Reinforced Thermosetting Resin Pipe and Fittings.
11. Duct Stiffness: The duct shall have a minimum rated stiffness in accordance with ASTM D2412 for the pipe laying conditions as noted for the design conditions.
12. Duct manufactured with a composite structural wall containing sand, alumina or other granular fillers is **not** acceptable.

2.03 **ACCESSORIES**

A. Fittings:

1. Construction shall be as specified for the ducting.
2. Bends shall be either formed over a removable mold for sizes up to 30"∅ and fabricated from straight duct on larger sizes with the following miter segments:
    a. Bends up to 30° - 1 miter / 2 gore
    b. 31° to 60° bend - 2 miter / 3 gore
    c. 61° to 90° bend - 4 miter / 5 gore
3. Corrosion resistance and working pressure equal to that of connecting duct.

B. Duct Joints: Same material as the duct and shall meet or exceed the hoop tensile and axial strength requirements of the duct.

1. Flanges:
    a. Flanges shall be hand lay-up per NBS PS 15-69 and undrilled.
    b. Flange gaskets shall be suitable for 250° F continuous and constructed of neoprene rubber unless otherwise specified and furnished undrilled.
2. Joints:
    a. Duct joints shall be butt and wrap
    b. Fittings shall be plain end for butt and wrap
    c. Adhesive material for field joints shall be suitable for minimum 250° F continuous service.
3. Specials:
    a. For applications requiring fabricated duct specialties, filament wound duct with welds according to NBS PS 15-69 for the specified pressure and temperature rating shall be used.
    b. Supports and hangars: FRP ductwork shall be supported at intervals no greater than 10' centers. Supports and hangars shall transmit all ductwork loads into the building structural frame through a system of intermediate beams and struts as necessary to accommodate requirements of these specifications. All supports shall be designed to resist UBC Zone 3 seismic forces. All supports shall be fabricated from FRP, as shown on the drawings. Where supports are clamped to FRP laminates, neoprene sponge protective pads shall be employed to protect the FRP. All hardware, including drilled in anchors, shall be stainless steel.

C. Dampers:

a. FRP Dampers shall be fabricated with the same materials as the duct. No other resin will be acceptable. Blade shall be FRP 2 piece molded including blade stiffeners per schedule on drawing. Damper blade shall be offset 5° in closed position to form a normal stop on wall of duct. Seats and seals as required. Dampers to be manufactured by Spunstrand® Inc. or pre-approved equal. Axle to be pultruded FRP made with same resin and continuous strand roving. Bearing to be molded FRP or Teflon®. No metal parts or cut edges in airstream will be allowed. Balancing dampers to be Spunstrand Inc. BA Series, with blade stop, axle shaft seals and locking hand quadrant. Isolation dampers to be Spunstrand® Inc. ZL Series (Zero Leak)™, with blade seals, axle shaft seals and locking gear operator. Flanges included when shown on drawings. No other shop-fabricated dampers shall be allowed.

Pre-approved Vendors:
a. Spunstrand® Inc. , Wallace, ID
b.
c.

All vendors not listed may obtain pre-approval by complying with pre-approval section of the Quality Assurance section of this specification. No other bidders will be accepted.

D. Silencers:

1. Fiberglass Reinforced Plastic Silencers shall be manufactured by **Spunstrand® Inc. and David P. Wilson FiberSonic Model FS-00-00-00**, or pre-approved equal. Silencer shall be tested for insertion loss, self-noise, and pressure drop in an independent NVLAP accredited laboratory in full accordance with ASTM E477. Testing shall be completed and data available for review 72 hours prior to bid date. Test data for insertion losses to meet or exceed the acoustical data published in the specification tables.
2. Silencers above ground to installed per manufacturer's recommendations.
3. Silencers installed below ground should either be accessible inside a watertight concrete vault, or fitted with a schedule 80 PVC drain at the lowest point for piping back to plenum. Water entering the duct by any means will find a low point in the silencer, and must have a provision for draining.
4. See Fibersonic Silencer™ Construction Specification for details on page 24 of this catalog section.

2.04 **Quality Assurance**

A. Manufacturer is able to provide the following information with the pre-approval packages, if requested / required:
   1. (2) sample cutouts demonstrating 100 to 110 mils clear liner with no antimony and filament wound structural laminate. Samples to be a minimum of 8"∅ cut out and a 12"∅ piece of duct at least 12" long complying with RTP-1 visual level II.
   2. Company filament winding history and at least (2) FRP duct job names with similar type construction including contact names and phone numbers.
   3. (2) copies of the fabricators ISO 9000 based Quality Control Manual, or equal. the quantity and the size of the specimens examined.
   4. Certified testing data from an outside testing agency confirming the resin and glass content of the liner and structural layers separately.
   5. Copies of burial calculations for at least 3 sizes of duct between 18" and 48"∅.
   6. Any fabricator unable to provide this information and samples to the engineer 48 hours prior to bid date will not be considered.

B. All FRP ductwork shall be fabricated and installed by qualified, experienced mechanics who have a minimum of 5 years experience with the lay-up, fabrication and joining of this type of material.

C. Factory Inspection:
1. Owner shall be given access to the FRP Ductwork and all quality control records during fabrication and upon completion for the purpose of verifying compliance to the Contract Documents.
2. The owner shall maintain the right to tour the FRP duct manufacturer's plant anytime that fabrication is in process prior to final shipment. The owner and engineer may exercise the option, without any advance notice; to tour the plant and inspect all stages of fabrication to ensure that quality control is being maintained. Inspection by owner does not relieve any responsibility of the fabricator to meet the requirements of this specification.
3. Final Inspection: The engineer and owner may carry out a final inspection of the equipment prior to shipment. Fabricator shall give the owner a minimum of 5 days advance notice of scheduled ductwork shipment. Prior to final inspection by owner, the ductwork shall be cleaned of all foreign material and shall be in a position that allows easy access and viewing.

D. Acceptance:
1. Lack of compliance with any aspect of the specifications and drawings will be grounds for rejection of the equipment.
2. Repair of rejected equipment: The owner must approve repair procedures prior to implementation. No more than 5% of the surface area of each FRP duct component may be repaired.

E. The fabricator's inspector (Quality Control Manager) will provide the owner with a complete Quality Control report for the job. The report will be available within 15 days after the final parts are shipped. The fabricator will have available after each shipment the complete QC sheets for review upon request at any time.

2.05 **Submittals**

A. The following information has been provided with the standard submittal requirements:
1. The fabricator shall submit for approval all reference standards, fabrication drawings and any engineering details of the duct design prior to beginning fabrication.
    A. The submittal should include all information utilized by the fabricator which describes specifically how their FRP duct and fittings are manufactured. This should be in the form of shop drawings, standards, specifications, other shop instructions and QC records. This should include, but not be limited to:
        1. Resin type
        2. Types and amounts of filler
        3. Corrosion liner description
        4. Reinforcement types for hand lay-up or chopped laminates
        5. For filament-wound laminates:
            a. Helix angle
            b. Glass content range
            c. Strand yield
            d. Strand by inch in the winding band
            e. Ply thickness
            f. Amount of chop or unidirectional roving interspersed with winding, if any, and location within the laminate.

6. For all fabricated parts:
    a. Construction type
    b. Laminate thickness
    c. Ply sequences
    d. Glass content range
7. For all secondary overlays (both interior and exterior):
    a. Laminate thickness
    b. Ply sequences and widths
8. Construction details for all other special configurations and fabricated parts.

2. FRP round duct sample, minimum size 12"∅ by 12" long and a 45° elbow quality of workmanship and glass / resin being quoted. These will be retained for quality comparison on materials shipped to jobsite.
3. Recommended procedure for the protection and handling of materials prior to installation.
4. ISO 9000 based Quality Control Manual detailing shop QC inspection procedures and documentation and samples of all shop QC forms utilized in the process.

B. Field Quality Control:

1. The manufacturer's factory trained personnel for the material specified shall be present at the jobsite as requested by the Subcontractor for installation assistance and inspection and approval of the installation, testing, startup assistance and inspection during normal operation, a Barcol hardness impresser tool is available at startup if requested for testing the level of cure on the field joints.

2. Joint Material Storage: All resin, glass and catalyst used for field joints shall be stored in a warm and dry place. Resin and catalyst shall be stored between temperatures of 55° to 75° F. Even if the air temperature is at 60° F during installation, resin stored below 50° F will not follow the charted gel times without applying heat to the finished joint or allowing the resin temperature to rise. If at any time during installation the resin fails to gel within 10 minutes of specified gel time listed in the Wet Lay Up Joint instructions; contact the manufacturer or local representative before continuing further.

3. Use only the field joint instructions provided by the manufacturer. If prior to installation there are no instruction or MSDS sheets included, do not proceed. Contact the manufacturer or their local representative for the necessary documentation.

4. Do not use resin and glass that is not marked and provided by the duct manufacturer, unless approved prior to installation. Dissimilar materials could affect product performance and void the warranty. If the glass cloth for joint materials has gotten wet, soiled, or oily, do not use. Replacement glass is readily available. Glass may by dried, but soiled or oily glass should be removed from the jobsite and disposed of.

FIBERSONIC SILENCER™ CONSTRUCTION SPECIFICATION

1.01 GENERAL

Fiberglass Reinforced Plastic Silencers shall be **manufactured by Spunstrand® Inc. and David P. Wilson, FiberSonic Model FS-00-00-00,** or pre-approved equal. Silencer shall be tested for insertion loss, self noise and pressure drop in an independent NVLAP accredited laboratory in full accordance with ASTM E477. Testing shall be completed and data available for review, 72 hours prior to bid date.

1.02 MATERIALS

A. Shell:

1. FRP Shell shall be filament wound rated at design pressures as indicated on the drawings, Shell shall be type 1, grade 2 RTRP Polyester, or Vinylester Class E per ASTM D-2310. All shells shall be designed for not less than +20" SPWG pressure and -12" SPWG vacuum.
2. Resin shall be Hetron 99P or HETRON 992SB, selected to meet the exposures and temperatures of the air to be exhausted. Fillers, other than those added for flame retardance when required, shall not be allowed. Flame spread rating shall be 25 or less per ASTM-E84.
3. The corrosion liner shall contain a 20 mil thick minimum surface veil saturated with resin consisting of approximately 90% resin and 10% glass by weight. The surface veil shall be overlapped a minimum of 1".
4. The structural layer shall be filament wound of type A premium grade polyester resin and glass as required for the specific working conditions.
5. The exterior of the shell shall contain sufficient resin to ensure a relatively smooth surface, free from exposed glass fibers or sharp projections, and shall contain an ultraviolet light inhibiting agent.
6. The shell shall have sufficient strength to exhibit, without structural damage, a minimum rated stiffness in accordance with ASTM D-2412.
7. Shells manufactured with a composite structural wall containing sand, alumina or other granular fillers are not acceptable.

B. Liner(s):

1. The airstream liner shall be 1/8" thick perforated polypropylene.
2. Liner shall be suitably sealed to contain acoustic insulation.
3. Liner shall be braced with FRP reinforcement rings to prevent unreasonable deflection.
4. Insulation shall be contained by .065" thick fiberglass fabric sheeting.

C. Acoustic Insulation:

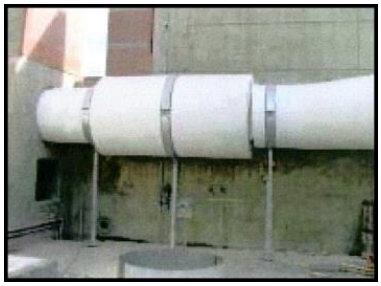
1. Insulation shall be 4 lb / ft3 density basalt mineral wool.

D. Center-body:

1. If required for additional noise reduction, a cylinder shaped center-body shall be located within the silencer. Center-body shall have the same acoustic insulation, and liners as listed above.
2. Center-body shall be adequately supported by FRP braces.

FIBERSONIC SILENCERS™

FRP SOUND CONTROL SILENCERS FOR POLLUTION CONTROL SYSTEMS



Description:

Spunstrand® Inc. Fibersonic Silencers™ are made of Fiberglass Reinforced Polyester and can be used where corrosive air streams prevent the use of standard metal silencers. Designed for use in waste water treatment plant exhaust systems where sound control is as essential to the environment as pollution control. Available in sizes up to 72" ID and 144" length. *Pictured at the right, is the Model FS-48-120.*

Construction Features:

- FRP Outer Body Casing
- FRP Center Body Supports
- 1/8" Perforated Polypropylene Liner
- Perforated Polypropylene Center Body Shell
- Mineral Wool Acoustic Insulation
- Available With & Without Center Body

ACCOUSTICAL DATA with CENTER BODY								
OCTAVE BAND CENTER FREQUENCY								
Insertion Loss (dB) **0 FPM Velocity**	63	125	250	500	1000	2000	4000	8000
	2	13	24	29	34	24	18	19
Above data based on Fibersonic Model #FS24-48CB. Silencer has been tested for insertion loss, self-noise and pressure drop in a NVLAP accredited acoustical laboratory in fill accordance with ASTM E477.								

ACCOUSTICAL DATA without CENTER BODY								
OCTAVE BAND CENTER FREQUENCY								
Insertion Loss (dB) **0 FPM Velocity**	63	125	250	500	1000	2000	4000	8000
	1	13	21	15	14	10	9	8
Above data based on Fibersonic Model #FS24-48. Silencer has been tested for insertion loss, self-noise and pressure drop in a NVLAP accredited acoustical laboratory in fill accordance with ASTM E477.								

FIELD WET JOINT INSTALLATION INSTRUCTIONS FOR INDUSTRIAL AIR DUCT

TOOLS and SUPPLIES

The following items are required to be on hand before attempting the field assembly of duct joints: Metal or plastic lamination roller, rubber gloves, paint brushes, measuring container and plastic pails for mixing resin and catalyst, goggles or other protective eyewear, utility knife or scissors, disc or belt sander with 24-grit abrasive, heat gun, wax paper or mylar and solvent such as acetone for cleanup of equipment.

PRECAUTIONS

Although most polyester and vinylester resins are quite stable, extended storage at elevated temperatures above 80° F (26.7°C) can decrease the reactivity of the resin or cause it to gel even without the use of catalyst. Be sure and read the resin data sheets that come with every shipment. Temperature extremes must be avoided for proper curing of the resin. See table 1 for mixing ratios at varying temperatures. Work must be done in a dry, well-ventilated area. A wide flat surface should be available to wet-out the glass mat strips. This surface should be covered with a disposable covering. Anyone coming into contact with resin or catalyst must wear rubber gloves and protective eyewear.

JOINING PROCEDURES

Cut the duct to the desired length using a circular saw with a carbide grit, metal cutting or masonry blade, making sure that the cut ends are cut squarely to butt closely as per the tolerances specified in S.M.A.C.N.A. STD. 7.26.3. With a disc sander, min. 24-grit disc, roughen the ends of the duct to be joined, removing the resin rich surface. The width of abraded surface for each duct end is 1 to 2 inches more than half the width of the mat that will be used on the joint. Duct diameters will use different joint material schedules depending on thickness, liner type and pressure ratings. See External Field Joint Schedules for each standard specification in this catalog section.

Cut the glass mats to length using number of layers and widths as indicated. Each mat length should be 3.2 times the normal duct diameter plus 2”. This will allow for a slight overlap. Where two layers of mat are used, stagger the two layers outward so that the overall width of the joint is about 1/2” to 1” wider than the mat layers used. On diameters over 36” or mat laying lengths exceeding 10’, it can be cut in half or thirds (adding extra for overlap) and then laid up in sequence. If this is done, allow for a minimum overlap of 3”.

Mix resin with catalyst in a disposable plastic, paper or metal container using only as much as you can work with in 15 to 20 minutes.

On a flat disposable surface covered with release film (such as wax paper or mylar®), lay the first (widest) section of fiberglass mat, chop strand side down, and wet out the woven side with catalyzed resin mix, see fig’s 1 & 2 on the following pages.

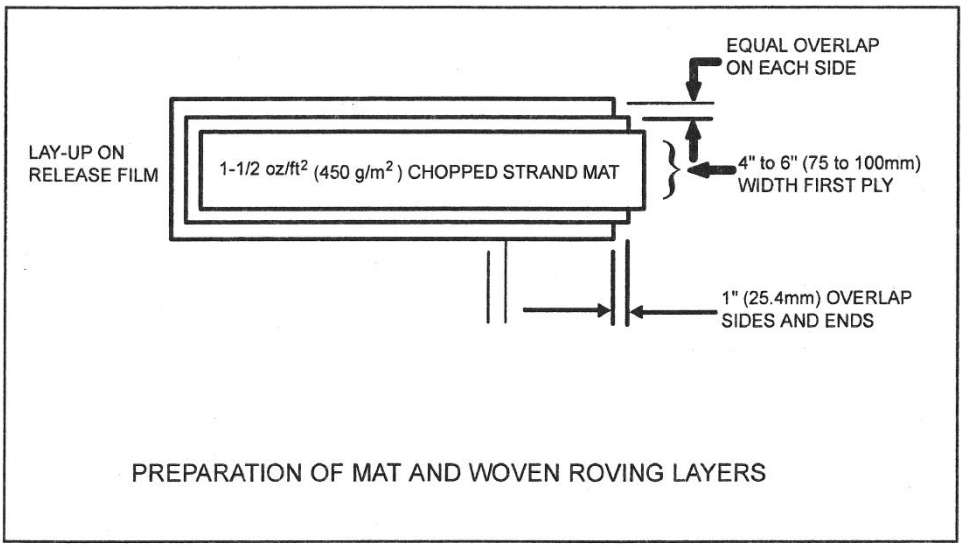


FIGURE 1

Work the resin up through the dry fiberglass mat to minimize air entrapment. Once completed, turn the mat over and coat the chopped strand side. Place additional layers of mat for the joint onto the coated mat with the woven side down and wet it out also. Repeat second step as required for the proper number of layers as listed in table 2. For SMACNA specs requiring separate layers of mat and woven roving, proceed as above using the sequences in table 2 and table 3 on pages 28 and 29 of this catalog section.

Begin the lay-up of the joint wrap by placing the chop strand side of the mat down against the duct. Use a 3” to 4” wide brush and laminating roller to work the resin in. Continue working the joint by rolling the resin from the center of the joint to the outer edges. Use moderate force with the roller to expel trapped air out of the laminate. Be careful not to remove too much resin. Each layer of fiberglass should overlap the layer beneath it (1/2” to 1”) and bond directly to the duct in order to achieve secondary bonding. If the joint looks dry use additional mixed catalyzed resin during rolling. Place the rollers and paint brushes in solvent after each use, swirling them around them to ensure the resin is dissolved.

Note

All solvent must be collected in a D.O.T. approved metal container at the end of each day. After the job is completed, the collected solvent that has not evaporated, should be disposed of through a licensed hazardous waste treatment storage and disposal facility.

When internal joints are required, the inner surface should be prepared prior to joining the two sections. Any gaps between the two sections should be filled with a catalyzed resin putty and overlaid with a minimum of two layers of 4” wide “C” veil. When called for in the specifications, the c-veil may be preceded with 2 layers of 4” or 6” wide 1.5 oz chopped strand mat. See Table 6 on page 32 of this catalog section for Putty Details.

Saddle Taps

FRP saddle taps are attached using the same wet joint procedure as described above. First cut a hole in the duct where the saddle tap is to be attached. The hole should be slightly smaller than the saddle tap opening. Use a carbide chip or a metal cutting blade on a sawsall or jigsaw taking care to remove the piece that is being cut out. Abrade the tap flange and the duct for 3" outside the tap flange perimeter. Place a 6" wide section of mat that has been saturated with resin so it is centered half way on the flange and the duct. Use brushes and laminating rollers to work out any air bubbles until mat is in total contact with the flange and duct surfaces.

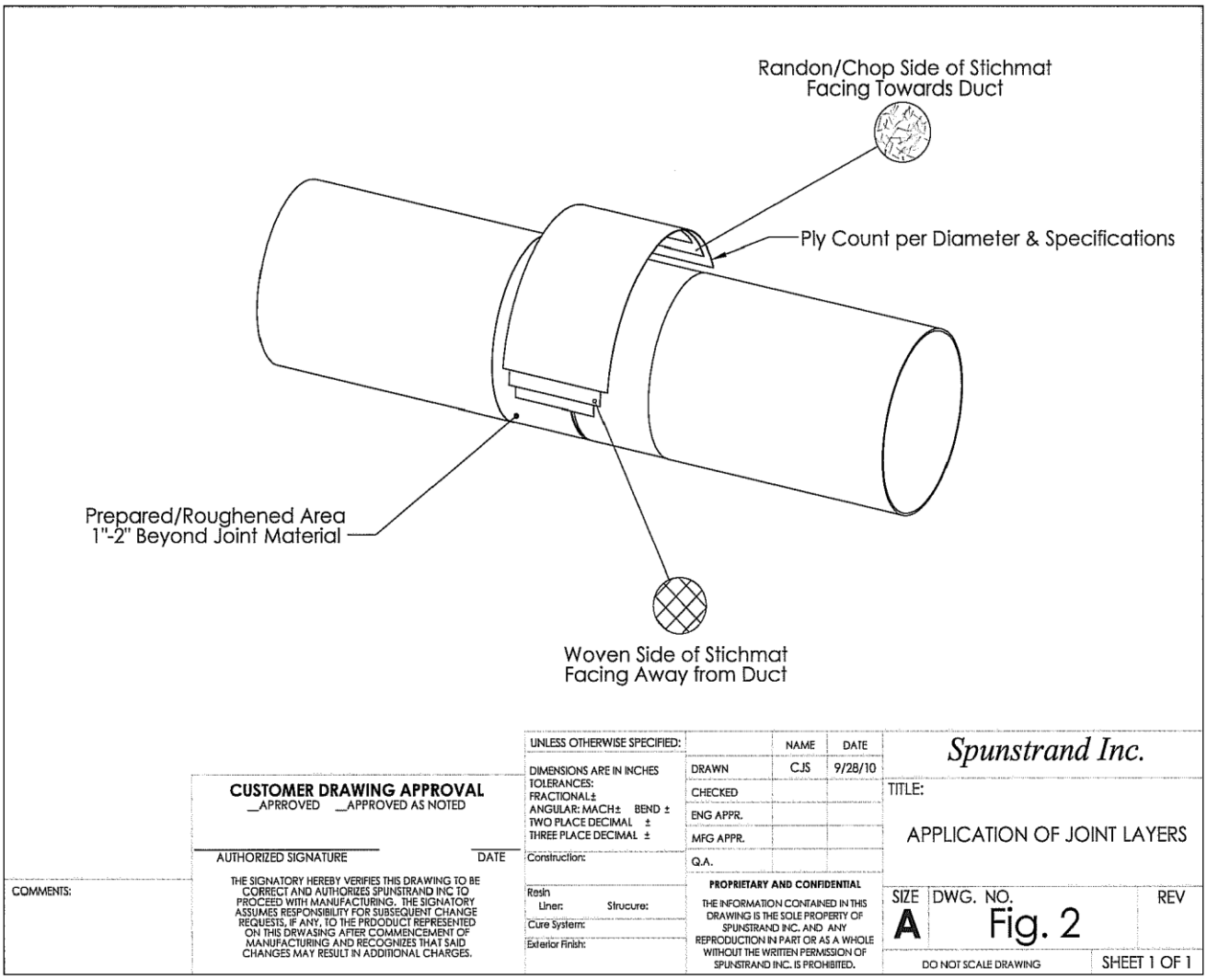


TABLE 1: GUIDE TO MIXING RATIOS

RESIN	CATALYST	AMBIENT TEMPERATURE
NOT RECOMMENDED BELOW 50° F (10° C) WITHOUT AN EXTERNAL HEAT SOURCE		
1 Pint (472 cc)	.34 oz (10 cc)	*50-60° F (10-16° C)
1 Pint (472 cc)	.27 oz (8 cc)	60-70° F (16-21° C)
1 Pint (472 cc)	.17 oz (5 cc)	70-80° F (21-27° C)
1 Pint (472 cc)	.14 oz (4 cc)	80-90° F (27-32° C)
1 Pint (472 cc)	.10 oz (3 cc)	90+° F (32 +° C)

Mix resin thoroughly before adding catalyst into the mixing container. The above catalyzation table will allow for a pot life of about 20 minutes.

Call Spunstrnd® Inc. for special recommendations - a heat gun or external heat source may be necessary.

WET JOINT MATERIAL

Jobsite Hazards and Precautions

While the materials provided to complete this project are all very stable and simple to use, there are some precautions that must be taken to assure that hazardous conditions do not develop on the jobsite. This information is all in the MSDS information provided, but this is for clarifications of crucial parts of these data sheets. Always follow OSHA and jobsite regulations with joint lay-up materials.

Please be sure to read all MSDS information for the chemicals being used and adhere to all personal protective equipment recommendations and storage information.

Storage

Temperature: Resin should be stored in a cool to warm environment with a recommended maximum temperature of 77 degrees. Excessive temperatures can cause the resin to harden even without the addition of the catalyst. Catalyst must also be kept at a recommended temperature below 77 degrees. Excessive temperature can cause hazardous conditions with the catalyst including hazardous polymerization and combustion. When storing resin, MEKP, acetone or any chemicals indoors, make certain the lids or caps are on tight, and no spills or fumes can be detected. Make certain that adequate ventilation is provided in occupied space, or any space that product is stored and could allow for a build-up of fumes due to leaks or spills.

Material usage and cleanup: When the resin and catalyst are mixed together, the reaction is exothermic, meaning it will create heat to help the curing process. When the material is mixed, the proper mixing ratios should be followed. While the ratios must be considerably out of compliance in order to cause a hazardous condition, it is a possibility. The more mass of mixed resin that is left in a container, the more heat will be generated. An improper mixing

large mass of mixed resin left in a container could create enough heat to cause a fire. Any amount of unused mixed resin must be moved out of any enclosed structure, and should be place in an area where high temperature cannot cause any other hazardous conditions. It must also be isolated from any electrical exposure, or other flammable materials or rags. Mark your buckets and measuring devices to maintain consistent performance and a record of your mixing history.

Acetone is the only acceptable solvent for cleanup of resin-saturated brushes, rollers or other necessary cleanup. Once the acetone has been used, it is classified as a hazardous material and must be disposed of in accordance with the law. Acetone is extremely flammable, and should always be stored in accordance with local and state regulations, and used away from any potential source of ignition. Note that fiberglass is a very hard plastic, and while grinding fiberglass does not produce a visible spark, sparks do occur. Make sure that all resin in buckets, brushes, wax paper (release films) or rollers is completely cured prior to dumping into jobsite waste dumpsters.

Moisture and water must be kept away from all materials during storage. If the fiberglass cloth material becomes wet or moist, it will inhibit that material from absorbing resin. It will also inhibit the cure of the resin, resulting in a potentially leaky joint. These materials must be kept completely dry. If they do get wet, the time for this material to dry out enough to use is extremely long. The material should be replaced if this occurs.

PRODUCT INFORMATION CONCENRNING SHIPPING, HANDLING and STORAGE

RECEIVING:

Regardless the mode of transportation, upon receiving, each piece should be inspected and checked against the Packing Slip / Bill of Lading.

INSPECTION:

Note damaged or missing items on the Bill of Lading and notify the carrier's agent *(truck driver)*. Obtain a signed acknowledgement of the damage or shortage at the time of unloading. **DO NOT** dispose of or return damaged items. Replacement materials must be re-ordered on a separate Purchase Order. Shipments are FOB factory – *Wallace, Idaho*. Once materials are loaded and leave the Spunstrand® Inc. factory, title of materials pass to the consignee – *customer*. If you do not note the damage and assist in filing a freight claim, any warranty work or replacement parts will be charged to the customer.

UNLOADING:

Small parts may be unloaded by hand but not thrown off the truck. Handle parts carefully, being sure not to scratch the interior surface or damage the ends.

- **DO NOT** push or roll duct off the truck with a fork lift.
- **DO NOT** use hooks to lift duct.
- **DO NOT** use wire rope or chains as a sling to lift large duct.

If slings are to be used, they must be a minimum of 4" wide webbed nylon or canvas. On 20 foot lengths of large duct, two slings should be placed approximately 7 feet in from each end, and the load lifted evenly. On 40 foot lengths, three slings placed at 10 foot intervals should be used.

STORAGE:

It is important that the resin and glass materials be stored out of the weather in a clean, dry location within a maximum temperature of 77°F. Cover all product (glass, duct) with a protective tarp. The glass materials and product should be covered to protect them from rain and snow. Keep resin out of the sun and store in an area where the temperature will not fall below 60ºF. Read the labels on all containers, the labels contain information about health and safety considerations as well as storage. Store and handle the duct and fittings so as to prevent damage. Note that most coated industrial duct arrives on-site wrapped in protective wrapping that is applied as an additional service by Spunstrand® Inc. to protect the product during transit. It is Spunstrand's recommendation that all gel coated ductwork be unwrapped immediately upon arrival to avoid any variations in coating consistency. All though very rare, any detrimental effects of leaving gel coated ductwork wrapped is not the responsibility of Spunstrand® Inc. Ductwork that is coated in intumescent paint can be stored in the protective wrap and should be stored out of the weather and away from moisture as both will affect the coating. For any questions regarding storage of our ductwork, please contact your local Spunstrand® Inc. Representative.

Table 2: SMACNA 10” External and Internal Field Joint Schedule

	EXTERNAL	INTERNAL
DIAMETER	SMACNA 10"	SMACNA 10"
4”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
5”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
6”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
7”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
8”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
9”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
10”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
12”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
14”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
16”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
18”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
20”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
22”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
24”	4" Wide - MRMM	6” MMVV**
26”	4" Wide - MRMM	6” MMVV**
28”	4" Wide - MRMM	6” MMVV**
30”	4" Wide - MRMM	6” MMVV**
32”	4" Wide - MR 5"Wide - MRM	6” MMVV**
36”	4" Wide - MR 5"Wide - MRM	6” MMVV**
42”	4" Wide - MR 5"Wide - MRM	6” MMVV**
48”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
54”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
60”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
72”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
84”	4" Wide - MR 6" Wide - MRMM	6” MMVV**

M = 1.5 oz. Chopped Strad Mat R = 24 oz. Woven Roving *SM = Stitchmat
*Stitchmat is a combination of chopped strand mat and woven roving stitched together.

Table 3: SMACNA 30”External and Internal Field Joint Schedule

	EXTERNAL	INTERNAL
DIAMETER	SMACNA 30"	SMACNA 30"
4”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
5”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
6”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
7”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
8”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
9”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
10”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
12”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
14”	4" Wide - MRMM	Resin Coat Sanded and Cut Edges Only
16”	4" Wide - MR 6"Wide - MRM	Resin Coat Sanded and Cut Edges Only
18”	4" Wide - MR 6"Wide - MRM	Resin Coat Sanded and Cut Edges Only
20”	4" Wide - MR 6"Wide - MRM	Resin Coat Sanded and Cut Edges Only
22”	4" Wide - MR 6"Wide - MRM	Resin Coat Sanded and Cut Edges Only
24”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
26”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
28”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
30”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
32”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
36”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
42”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
48”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
54”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
60”	4" Wide - MR 6" Wide - MRMM	6” MMVV**
72”	4", 6" and 8" Wide - MRM	6” MMVV**
84”	4" and 6" Wide - MRM 8" Wide - MRMM	6” MMVV**

M = 1.5 oz. Chopped Strad Mat R = 24 oz. Woven Roving *SM = Stitchmat
*Stitchmat is a combination of chopped strand mat and woven roving stitched together.

Table 4: PS 15-69 External and *Internal Field Joint Schedule

	EXTERNAL	INTERNAL
DIAMETER	PS 15-69	PS 15-69
4”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
5”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
6”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
7”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
8”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
9”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
10”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
12”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
14”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
16”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
18”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
20”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
22”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
24”	4", 6" and 8" Wide - SM	4” VV and Putty
26”	4", 6" and 8" Wide - SM	4” VV and Putty
28”	4", 6" and 8" Wide - SM	4” VV and Putty
30”	4", 6" and 8" Wide - SM	4” VV and Putty
32”	4", 6" and 8" Wide - SM	4” VV and Putty
36”	4", 6" and 8" Wide - SM	4” VV and Putty
42”	4", 6", 8" and 10" Wide - SM	4” VV and Putty
48”	4", 6", 8" and 10" Wide - SM	4” VV and Putty
54”	4", 6", 8" and 10" Wide - SM	4” VV and Putty
60”	4", 6", 8" and 10" Wide - SM	4” VV and Putty
72”	4", 6", 8", 10" and 12" Wide - SM	6” VV and Putty
84”	4", 6", 8", 10" and 12" Wide - SM	6” VV and Putty
96”	4", 6", 8", 10" and 12" Wide - SM	6” VV and Putty

M = 1.5 oz. Chopped Strad Mat R = 24 oz. Woven Roving **SM = Stitchmat

*Internal joints are reccommended only where internal joints are accessible.

**Stitchmat is a combination of chopped strand mat and woven roving stitched together.

Table 5: Medium Duty External and Internal Field Joint Schedule

	EXTERNAL	INTERNAL
DIAMETER	MEDIUM DUTY	MEDIUM DUTY
4”	6" Wide - SM	Resin Coat Sanded and Cut Edges Only
5”	6" Wide - SM	Resin Coat Sanded and Cut Edges Only
6”	6" Wide - SM	Resin Coat Sanded and Cut Edges Only
7”	6" Wide - SM	Resin Coat Sanded and Cut Edges Only
8”	6" Wide - SM	Resin Coat Sanded and Cut Edges Only
9”	6" Wide - SM	Resin Coat Sanded and Cut Edges Only
10”	6" Wide - SM	Resin Coat Sanded and Cut Edges Only
12”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
14”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
16”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
18”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
20”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
22”	4" and 6" Wide - SM	Resin Coat Sanded and Cut Edges Only
24”	4", 6" and 8" Wide - SM	4” VV and Putty
26”	4", 6" and 8" Wide - SM	4” VV and Putty
28”	4", 6" and 8" Wide - SM	4” VV and Putty
30”	4", 6" and 8" Wide - SM	4” VV and Putty
32”	4", 6" and 8" Wide - SM	4” VV and Putty
36”	4", 6" and 8" Wide - SM	4” VV and Putty
42”	4", 6" and 8" Wide - SM	4” VV and Putty
48”	4", 6" and 8" Wide - SM	4” VV and Putty
54”	4", 6" and 8" Wide - SM	4” VV and Putty
60”	4", 6", 8" and 10" Wide - SM	4” VV and Putty
72”	4", 6", 8", 10" and 12" Wide - SM	6” VV and Putty
84”	4", 6", 8", 10" and 12" Wide - SM	6” VV and Putty
96”	4", 6", 8", 10" and 12" Wide - SM	6” VV and Putty

M = 1.5 oz. Chopped Strad Mat R = 24 oz. Woven Roving *SM = Stitchmat
*Stitchmat is a combination of chopped strand mat and woven roving stitched together.

Table 6: Resin Putty Calculations
For Polyester and Vinylester FRP Construction

DUCT DIAMETER ”	RESIN PUTTY LBS. / JOINT	# of JOINTS PER CONTAINER		
		PINTS	QUARTS	GALLONS
4	0.08	12	24	96
5	0.10	10	20	80
6	0.11	8	16	64
7	0.13	7	14	56
8	0.15	6	12	48
9	0.17	5	10	40
10	0.19	5	10	40
12	0.23	4	8	32
14	0.27	3	6	24
16	0.30	3	6	24
18	0.34	2	5	20
20	0.38	2	5	20
22	0.42	2	4	16
24	0.46	2	4	16
26	0.49	2	4	16
28	0.53	1	3	12
30	0.57	1	3	12
32	0.61	1	3	12
36	0.68	1	2	10
42	0.80	1	2	9
48	0.91	1	2	8
54	1.03	0	1	7
60	1.14	0	1	6
72	1.37	0	1	5

Putty Application Procedures

When internal joints are required and accessible the void between the duct ends being jointed together should be filled with resin putty. The resin putty consists of the same material as the resin used on the joints with the additions of fillers to add viscosity. The mixing instructions and ratios for the putty are the same as the resin mixing ratios in Table 1 on page 26 of this catalog section. Since the putty is a thickened material it can be mixed on a small board or heavy cardboard to make application easier. Be sure that the catalyst is mixed thoroughly with the putty to avoid “hot spots” in your mixture once you are finished mixing the material, apply to the void on the duct joint. A heavy rubber or plastic squeegee is the easiest applicator. Apply pressure with the squeegee to remove excess material and smooth out the putty over the void. If additional mat layers are required on the internal joint they can be applied over the resin putty before it is cured.

Standard Industrial Duct and Fittings – Shipping Weights

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
NOMINAL DIAM. (IN)	STRAIGHT DUCT / FT (lbs)	45 ° ELBOW (lbs)	90 ° ELBOW (lbs)	CON. REDUCER (lbs)	ECC. REDUCER (lbs)	END CAP (lbs)	TEE (lbs)	SINGLE 45 ° y (lbs)	SINGLE 90 ° y (lbs)	CROSS (lbs)	DOUBLE 45 ° Y (lbs)	DOUBLE 90 ° Y (lbs)	TRUE Y (lbs)	SADDLE TAP (lbs)	TRANSITION (lbs)	FLANGE (lbs)
4	1.4	1	2	-	-	1	2	2	3	3	3	5	1	2	6	2
5	1.8	2	4	3	4	2	3	3	4	4	5	7	2	2	7	2
6	2.1	2	4	3	4	2	3	4	5	4	6	8	2	3	8	3
7	2.4	2	4	4	5	2	4	5	6	5	7	9	2	3	10	3
8	2.8	3	6	4	5	3	5	7	9	6	10	15	3	4	11	4
9	3.1	4	8	5	7	3	6	8	10	7	11	16	3	4	12	4
10	3.4	4	8	5	7	3	7	10	13	9	14	20	3	5	14	5
12	4.1	7	13	6	8	4	10	13	17	12	18	26	5	6	16	6
14	4.8	9	17	10	13	5	12	17	22	15	23	33	6	7	19	6
16	5.4	12	23	11	14	5	15	21	29	19	27	42	6	8	22	7
18	6.1	15	29	13	17	6	18	28	36	22	34	51	7	10	24	8
20	6.8	16	32	14	18	7	21	32	41	25	40	58	8	11	27	9
22	11.2	28	55	23	30	11	37	55	70	43	72	103	9	15	45	15
24	12.2	34	67	25	33	12	42	63	82	49	82	120	13	17	49	16
26	13.2	39	78	27	35	19	47	73	94	54	97	140	15	18	53	18
28	14.2	42	84	29	38	20	53	84	106	61	110	156	15	20	57	19
30	15.2	50	99	31	40	22	59	94	120	68	123	177	17	21	61	21
32	16.2	56	111	33	43	23	66	106	136	76	140	201	23	22	65	22
36	18.3	73	145	37	48	27	81	131	168	91	174	251	27	25	73	25
42	28.2	127	254	57	74	42	140	233	299	157	308	443	32	40	113	38
48	32.2	162	323	65	85	48	175	297	381	196	392	565	45	46	129	43
54	36.2	209	418	72	84	71	215	370	478	238	487	707	67	51	145	49
60	40.3	253	506	88	114	80	259	451	581	285	592	858	75	57	161	54
72	70.0	440	897	126	164	122	446	900	1020	1035	1057	1520	107	87	247	83

Standard SMACNA 10” Negative Pressure Duct and Fittings Shipping Weights

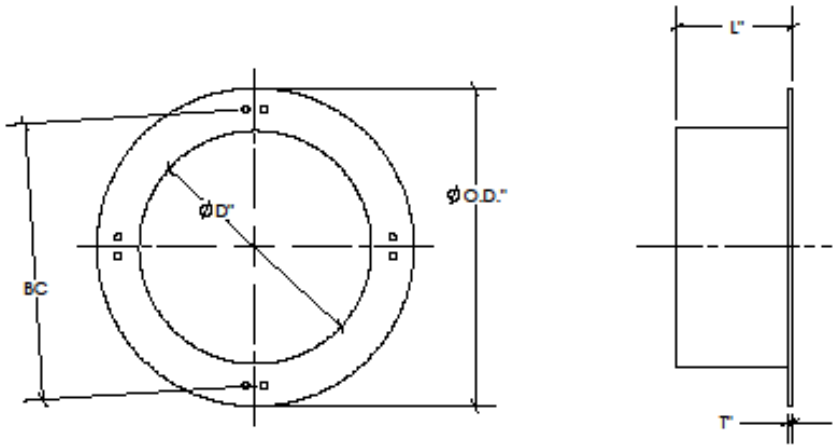
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
NOMINAL DIAM. (IN)	STRAIGHT DUCT / FT (lbs)	45 ° ELBOW (lbs)	90 ° ELBOW (lbs)	CON. REDUCER (lbs)	ECC. REDUCER (lbs)	END CAP (lbs)	TEE (lbs)	SINGLE 45 ° y (lbs)	SINGLE 90 ° y (lbs)	CROSS (lbs)	DOUBLE 45 ° Y (lbs)	DOUBLE 90 ° Y (lbs)	TRUE Y (lbs)	SADDLE TAP (lbs)	TRANSITION (lbs)	FLANGE (lbs)
4	1.6	1	2	-	-	1	2	2	3	3	3	6	1	2	7	2
5	2.0	2	5	3	5	2	3	3	5	5	6	8	2	2	8	2
6	2.3	2	5	3	5	2	3	5	6	5	7	9	2	3	9	3
7	2.7	2	5	5	6	2	5	6	7	6	8	10	2	3	12	3
8	3.1	3	7	5	6	3	6	8	10	7	12	17	3	5	13	5
9	3.5	5	9	6	8	3	7	9	12	8	13	19	3	5	14	5
10	3.9	5	9	6	8	3	8	12	15	10	16	23	3	6	16	6
12	4.7	8	15	7	9	5	12	15	20	14	21	30	5	7	19	7
14	5.5	10	20	12	15	6	14	20	25	17	27	38	6	8	22	7
16	6.3	14	27	13	16	6	17	24	34	22	31	49	6	9	26	8
18	7.0	17	34	15	20	7	21	32	42	26	39	59	7	12	28	9
20	7.8	19	37	16	21	8	24	37	48	29	46	67	8	13	31	10
22	8.6	23	45	19	24	9	30	45	57	35	58	84	9	13	35	11
24	9.4	26	52	19	25	9	32	49	63	38	63	93	13	13	38	12
26	10.2	30	60	21	27	15	36	56	73	42	75	108	15	14	41	14
28	11.0	32	65	22	29	15	41	65	82	47	85	120	15	15	44	15
30	11.7	39	76	24	31	17	45	72	93	52	95	136	17	16	47	16
32	16.4	57	112	33	43	23	67	107	138	77	142	203	23	22	66	22
36	18.5	74	147	37	49	27	82	132	170	92	176	254	27	25	74	25
42	21.5	94	193	43	56	32	106	177	227	119	234	337	32	30	86	29
48	30.5	152	304	61	80	45	165	279	358	184	369	531	47	43	121	40
54	34.3	196	393	68	88	67	202	348	449	224	458	665	67	48	136	46
60	38.1	238	478	83	107	75	243	424	546	268	556	806	75	54	151	51
72	54.4	397	794	111	145	107	395	798	903	434	937	1347	107	77	219	73

SMACNA HEAVY WALL 30” Negative Pressure Duct and Fittings – Shipping Weights

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
NOMINAL DIAM. (IN)	STRAIGHT DUCT / FT (lbs)	45 ° ELBOW (lbs)	90 ° ELBOW (lbs)	CON. REDUCER (lbs)	ECC. REDUCER (lbs)	END CAP (lbs)	TEE (lbs)	SINGLE 45 ° y (lbs)	SINGLE 90 ° y (lbs)	CROSS (lbs)	DOUBLE 45 ° Y (lbs)	DOUBLE 90 ° Y (lbs)	TRUE Y (lbs)	SADDLE TAP (lbs)	TRANSITION (lbs)	FLANGE (lbs)
4	1.6	1	2	-	-	1	2	2	3	3	3	6	1	2	7	2
5	2.0	2	5	3	5	2	3	3	5	5	6	8	2	2	8	2
6	2.3	2	5	3	5	2	3	5	6	5	7	9	2	3	9	3
7	2.7	2	5	5	6	2	5	6	7	6	8	10	2	3	12	3
8	3.1	3	7	5	6	3	6	8	10	7	12	17	3	5	13	5
9	3.5	5	9	6	8	3	7	9	12	8	13	18	3	5	14	5
10	3.9	5	9	6	8	3	8	12	15	10	16	23	3	6	16	6
12	4.7	8	15	7	9	5	12	15	20	14	21	30	5	7	19	7
14	5.5	10	20	12	15	6	14	20	26	17	27	38	6	8	22	7
16	7.8	17	32	15	19	7	21	29	40	26	37	58	7	11	31	10
18	8.7	21	40	18	24	8	25	39	50	31	47	71	8	14	33	11
20	9.7	22	44	19	25	10	29	44	57	35	55	80	10	15	37	12
22	10.7	28	54	22	29	11	36	54	68	42	69	100	11	16	42	13
24	14.3	37	73	27	36	13	46	69	90	54	90	131	18	19	54	18
26	15.4	43	85	30	38	21	51	80	103	59	106	153	21	20	58	20
28	16.6	46	92	32	42	22	58	92	116	67	120	171	22	22	62	21
30	17.8	55	108	34	44	24	65	103	131	74	135	194	24	23	67	23
32	22.5	74	146	43	56	30	87	139	179	100	184	264	30	29	85	29
36	25.3	96	190	48	63	35	106	171	219	119	227	327	35	33	96	33
42	34.0	141	282	63	82	47	155	259	332	174	342	492	47	45	126	42
48	38.9	186	370	75	97	55	201	341	437	225	450	648	55	53	148	49
54	49.6	266	533	92	120	90	275	473	611	304	623	904	90	65	185	62
60	55.1	322	640	112	144	102	331	577	743	364	757	1097	102	73	205	69
72	73.9	510	1020	143	186	138	505	1021	1156	555	1199	1724	138	99	281	94

Medium Duty Industrial Air Duct and Fittings – Shipping Weights

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
NOMINAL DIAM. (IN)	STRAIGHT DUCT / FT (lbs)	45 ° ELBOW (lbs)	90 ° ELBOW (lbs)	CON. REDUCER (lbs)	ECC. REDUCER (lbs)	END CAP (lbs)	TEE (lbs)	SINGLE 45 ° y (lbs)	SINGLE 90 ° y (lbs)	CROSS (lbs)	DOUBLE 45 ° Y (lbs)	DOUBLE 90 ° Y (lbs)	TRUE Y (lbs)	SADDLE TAP (lbs)	TRANSITION (lbs)	FLANGE (lbs)
4	1.1	1	2	-	-	1	1.5	1.5	2.3	2.3	2.36	3.9	0.77	1.54	4.62	1.54
5	1.3	2	3	2	3	2	2.3	2.3	3.1	3.1	3.9	5.4	1.54	1.54	5.39	1.54
6	1.5	2	3	2	3	2	2.3	3.1	3.9	3.1	4.6	6.2	1.54	2.31	6.16	2.31
7	1.8	2	3	3	4	2	3.1	3.9	4.6	3.9	5.4	6.9	1.54	2.31	7.7	2.31
8	2.1	2	5	3	4	2	3.9	5.4	6.9	4.6	7.7	12	2.31	3.08	8.47	3.08
9	2.3	3	6	4	5	2	4.6	6.2	7.7	5.4	8.5	12	2.31	3.08	9.24	3.08
10	2.6	3	6	4	5	2	5.4	7.7	10	6.9	11	15	2.31	3.85	10.8	3.85
12	3.2	5	10	5	6	3	7.7	10	13	9.2	14	20	3.08	4.62	12.3	4.62
14	3.6	7	13	8	10	4	9.2	13	17	12	18	25	3.85	5.39	14.6	4.62
16	4.2	9	18	8	11	4	12	16	22	15	21	32	3.85	6.16	16.9	5.39
18	4.7	12	22	10	13	5	14	22	28	17	26	39	4.62	7.7	18.5	6.16
20	5.2	12	25	11	14	5	16	25	32	19	31	45	5.39	8.47	20.8	6.93
22	5.7	15	30	12	16	6	20	30	38	23	39	55	8.47	11.6	34.7	11.6
24	9.3	26	52	19	25	9	32	49	63	38	63	92	9.24	13.1	37.7	12.3
26	10.1	30	60	21	27	15	36	56	72	42	75	108	14.6	13.9	40.8	13.9
28	10.9	32	65	22	29	15	41	65	82	47	85	120	15.4	15.4	43.9	14.6
30	11.7	39	76	24	31	17	45	72	92	52	95	136	16.9	16.2	47	16.2
32	12.5	43	85	25	33	18	51	82	105	59	108	155	17.7	16.9	50.1	16.9
36	14.0	56	112	28	37	21	62	101	129	70	134	193	20.8	19.3	56.2	19.3
42	21.9	98	196	44	57	32	108	179	230	121	237	341	32.3	30.8	87	29.3
48	24.9	125	249	50	65	37	135	229	293	151	302	435	37	35.4	99.3	33.1
54	28.1	161	322	55	72	55	166	285	368	183	375	544	54.7	39.3	112	37.7
60	31.2	195	392	68	88	62	199	347	447	219	456	661	61.6	43.9	124	41.6
72	46.9	339	677	95	123	92	336	680	770	370	798	1148	91.6	65.5	186	62.4



** Flanges come standard **UNDRILLED**

Standard (PS 15-69)							150lb ASA Pattern			
D	O.D.	L	T	BC	Number of Holes	Hole Size	Number of Holes	Hole Size	O.D.	BC-1
2	6 3/8	6	¼	5	4	7/16	4	3/4	6 ½	4 ¾
3	7 3/8	6	¼	6	4	7/16	4	3/4	8	6
4	8 3/8	6	¼	7	4	7/16	8	3/4	9 ½	7 ½
6	10 3/8	6	¼	9	8	7/16	8	7/8	11 ½	9 ½
8	12 3/8	6	¼	11	8	7/16	8	7/8	14	11 ¾
10	14 3/8	6	3/8	13	12	7/16	12	1	16 ½	14 ¼
12	16 3/8	6	3/8	15	12	7/16	12	1	19 ½	17
14	18 3/8	6	3/8	17	12	7/16	12	1 1/8	21 ½	18 ¾
16	20 3/8	6	½	19	16	7/16	16	1 1/8	23 ¾	21 ¼
18	22 3/8	6	½	21	16	7/16	16	1 1/4	25 ½	22 ¾
20	24 3/8	6	½	23	20	7/16	20	1 1/4	28	25
24	28 3/8	8	½	27	20	7/16	20	1 3/8	32 ½	29 ½
30	34 3/8	8	½	33	28	7/16				
36	40 3/8	10	½	39	32	7/16				
42	46 3/8	10	½	45	36	7/16				
48	54 3/8	10	5/8	52	44	9/16				
54	60 3/8	10	5/8	58	44	9/16				
60	66 3/4	10	5/8	64	52	9/16				
72	78 ½	12	¾	76	66	3/4				
84	100 5/8	12	¾	88	78	7/8				
96	102 ¾	12	1	100	88	1				

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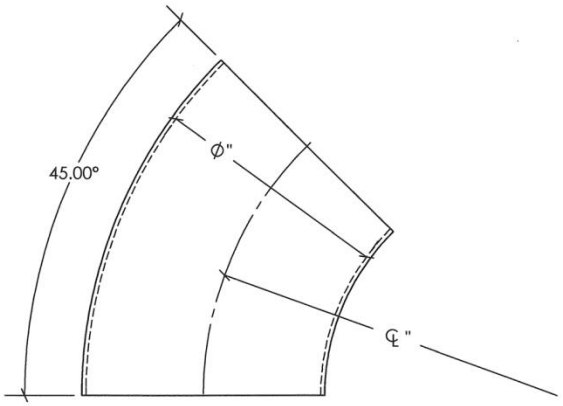
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±
MATERIAL
FINISH
NEXT ASSY | USED ON
APPLICATION | DO NOT SCALE DRAWING

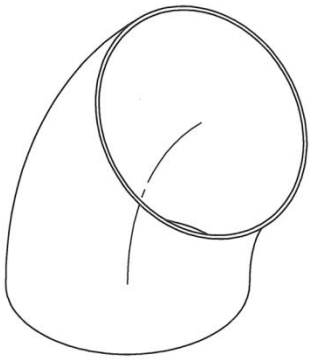
	NAME	DATE
DRAWN	C.JS	2009
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
COMMENTS:		

Spunstrand Inc.

Flanges

SIZE A | DWG. NO. Industrial FRP | REV. 6.1.12

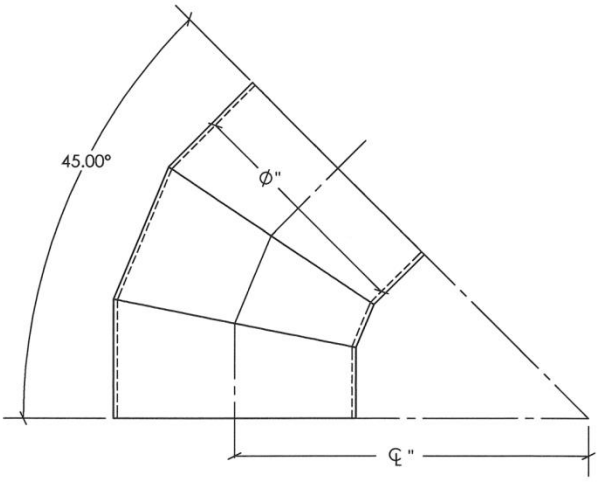


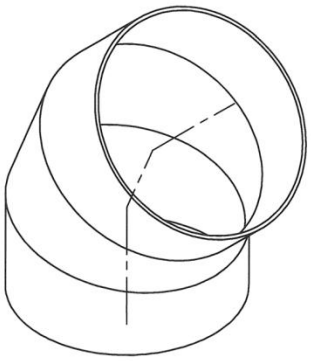


Elbows 2"Ø through 30"Ø are one (1) piece molded smooth radius.
32"Ø and larger are three (3) piece mitered elbows.

Long Radius (Standard): ℄ =1.5 x Diameter

Short Radius: ℄ = 1 x Diameter





		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN	CJS	2009
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

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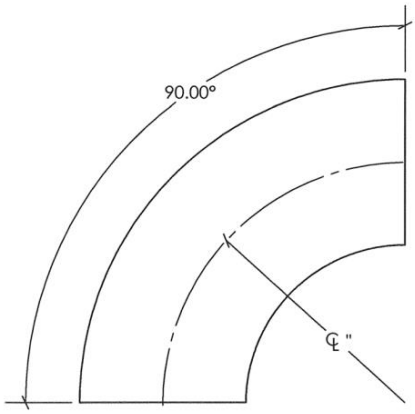
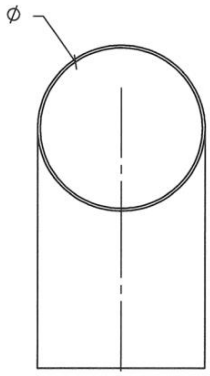
Spunstrand Inc.

45deg Elbows

SIZE	DWG. NO.	REV.
A	Industrial FRP	

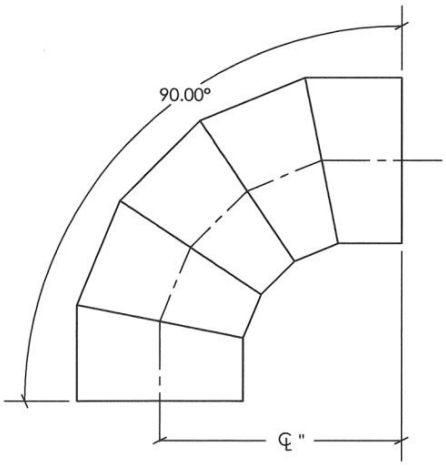


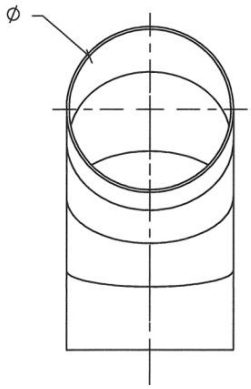


Elbows 2"Ø through 30"Ø are one (1) piece molded smooth radius.
32"Ø and larger are five (5) piece mitered elbows.

Long Radius (Standard): ℄ =1.5 x Diameter

Short Radius: ℄ = 1 x Diameter





		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE	*Spunstrand Inc.*
			DRAWN	CJS	2009	
			CHECKED			**90deg Elbows**
			ENG APPR.			
			MFG APPR.			
		MATERIAL	Q.A.			
			COMMENTS:			
NEXT ASSY	USED ON	FINISH				SIZE A · DWG. NO. Industrial FRP · REV.
APPLICATION		DO NOT SCALE DRAWING				

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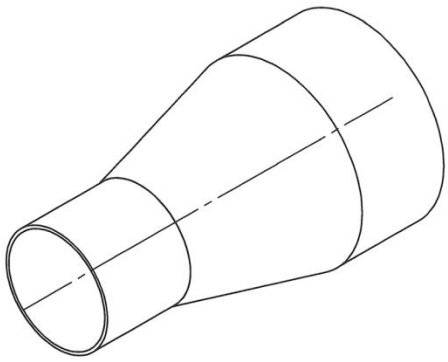
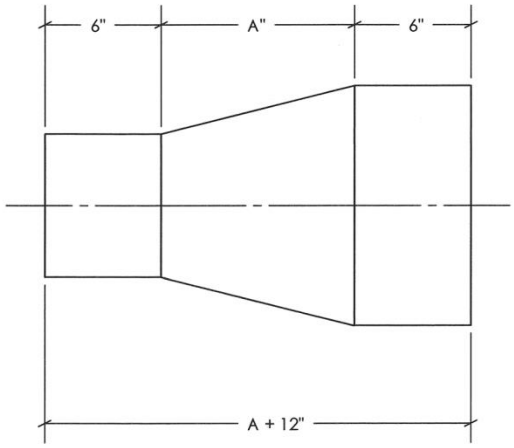
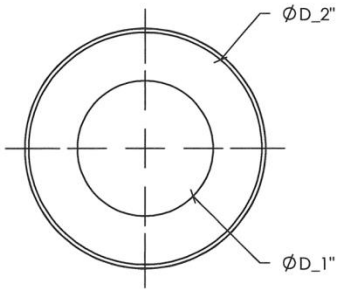
Inches of Reduction	A
1"	2 1/8"
2"	4
3"	5 7/8"
4"	7 3/4"
5"	9 5/8"
6"	11 1/2"
7"	13 3/8"
8"	15 1/8"
9"	17"
10"	18 7/8"
11"	20 3/4"
12"	22 5/8"
13"	24 1/2"
14"	26 3/8"
15"	28 5/8"
16"	32"
17"	33 7/8"
18"	35 3/4"
19"	36 5/8"
20"	37 5/8"



Inches of Reduction = D_2 - D_1





		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN	CJS	2009
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

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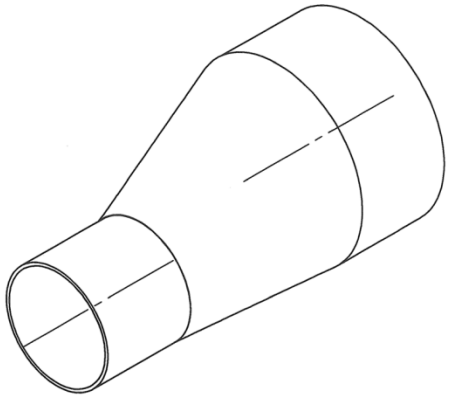
Spunstrand Inc.

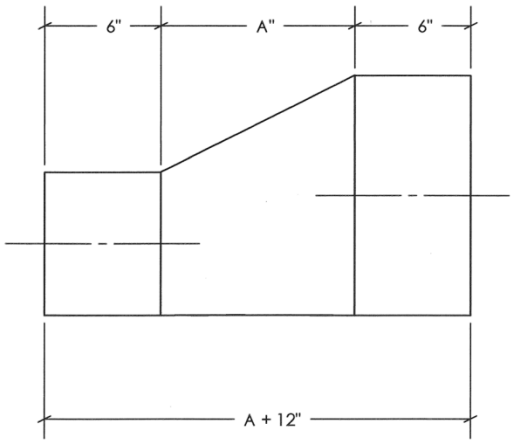
Concentric Reducer

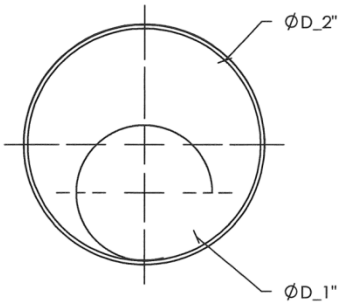
SIZE	DWG. NO.	REV.
A	Industrial FRP	

Inches of Reduction	A
1"	4 1/4"
2"	8"
3"	11 3/4"
4"	15 1/2"
5"	19 1/4"
6"	23"
7"	26 3/4"
8"	30 1/4"
9"	34"
10"	37 3/4"
11"	41 1/2"
12"	45 1/4"
13"	49"
14"	52 3/4"
15"	57 1/4"
16"	64"
17"	67 3/4"
18"	69 1/4"
19"	71 1/2"
20"	75 1/4"



Inches of Reduction = D_2 - D_1





		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE	*Spunstrand Inc.*
			DRAWN	CJS	2009	
			CHECKED			**Eccentric Reducer**
			ENG APPR.			
			MFG APPR.			
		MATERIAL	Q.A.			
			COMMENTS:			
NEXT ASSY	USED ON	FINISH				SIZE A · DWG. NO. Industrial FRP · REV.
APPLICATION		DO NOT SCALE DRAWING				

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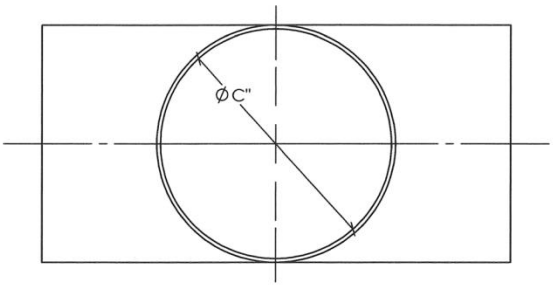
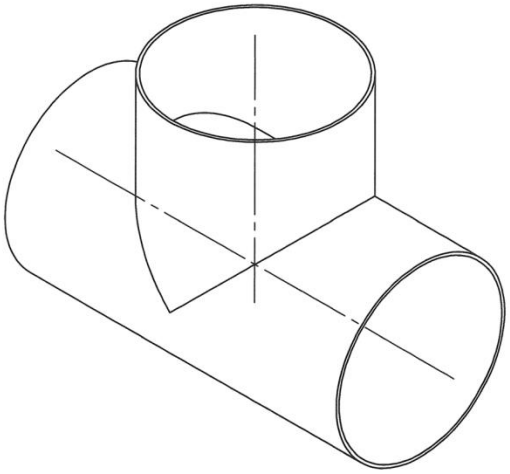
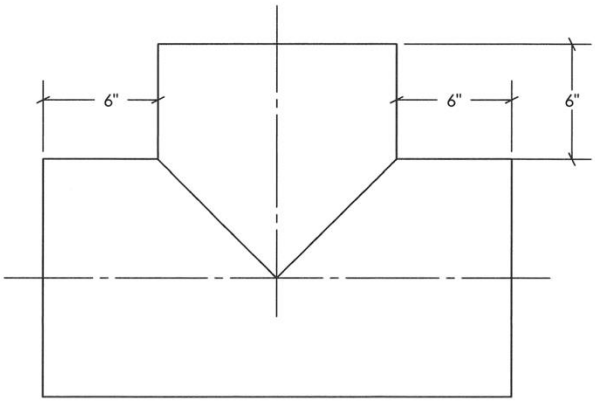
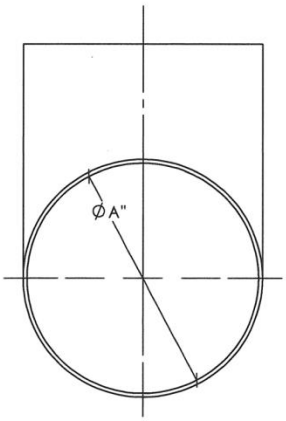




A x C





		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE	*Spunstrand Inc.*
			DRAWN	CJS	2009	
			CHECKED			**Tee**
			ENG APPR.			
			MFG APPR.			
		MATERIAL	Q.A.			
			COMMENTS:			
NEXT ASSY	USED ON	FINISH				SIZE A · DWG. NO. Industrial FRP · REV.
APPLICATION		DO NOT SCALE DRAWING				

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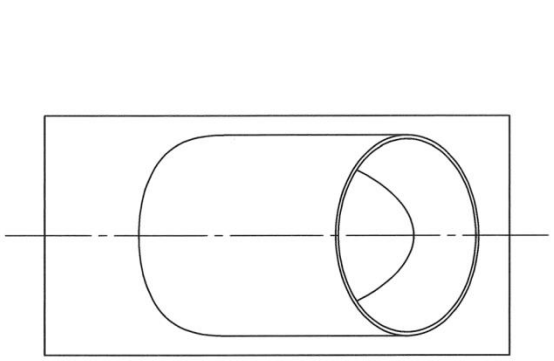
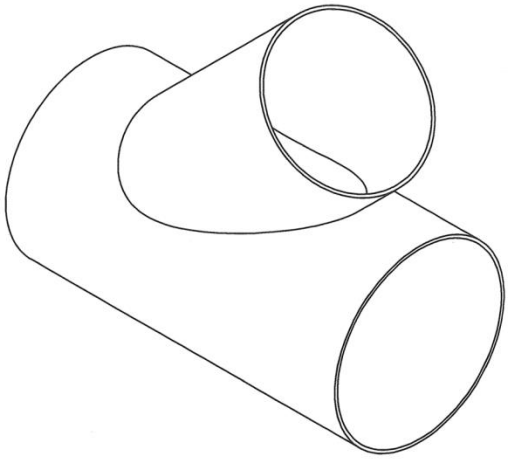
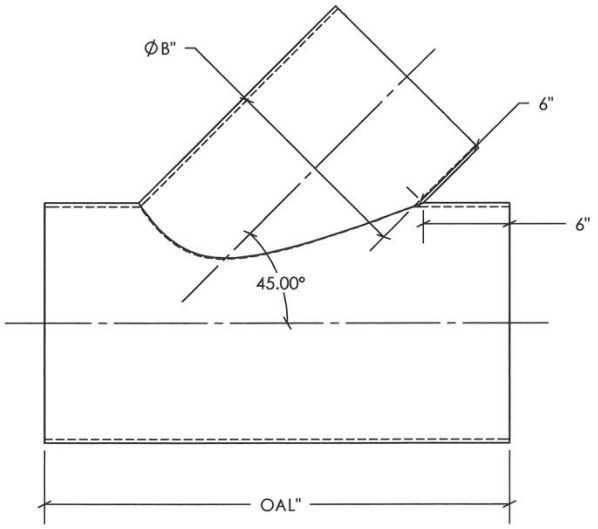
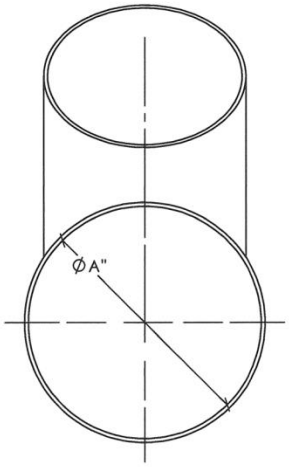




A x B





		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE	*Spunstrand Inc.*
			DRAWN	CJS	2009	
			CHECKED			
			ENG APPR.			**45deg Lateral**
			MFG APPR.			
			Q.A.			
		MATERIAL	COMMENTS:			
NEXT ASSY	USED ON	FINISH				SIZE A · DWG. NO. Industrial FRP · REV.
APPLICATION		DO NOT SCALE DRAWING				

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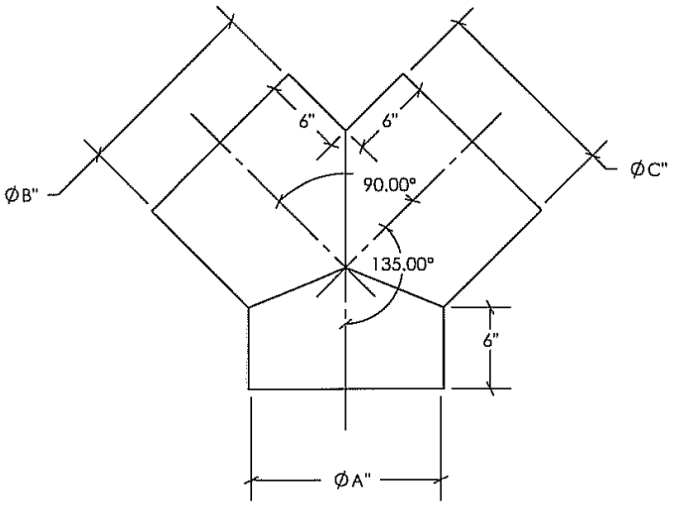
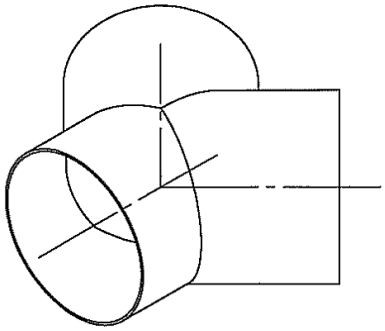
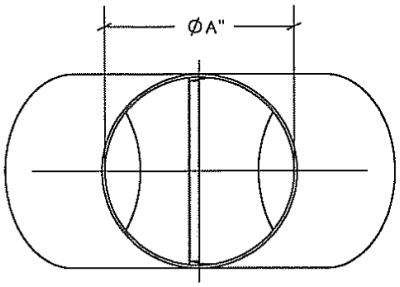
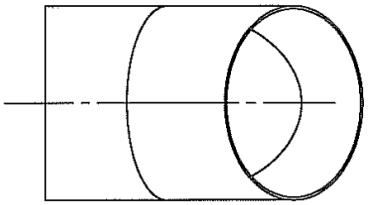




A x B x C





		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN	CJS	2009
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL	Q.A.		
NEXT ASSY	USED ON	FINISH	COMMENTS:		
APPLICATION		DO NOT SCALE DRAWING			

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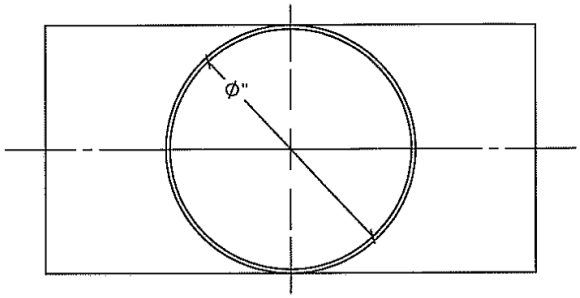
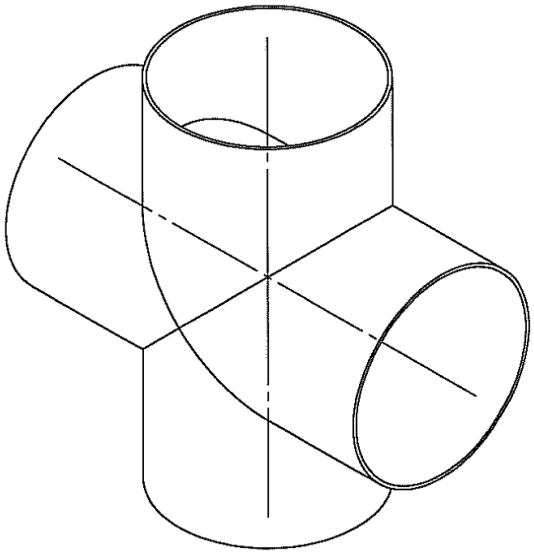
Spunstrand Inc.

True Wye

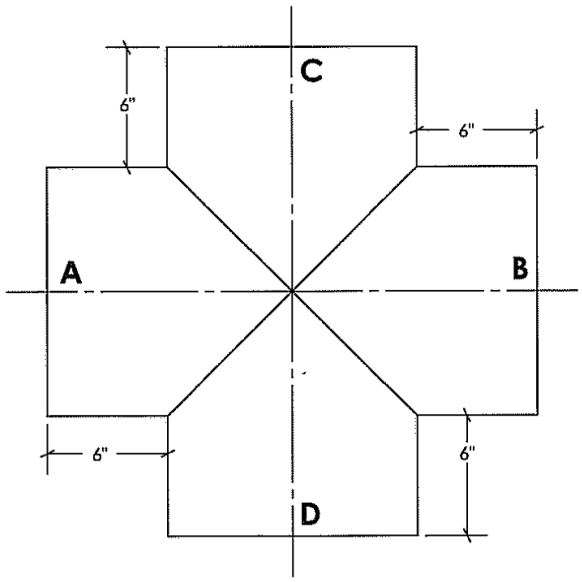
SIZE	DWG. NO.	REV.
A	Industrial FRP	

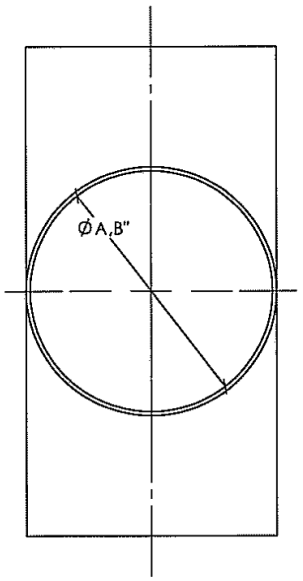




A x B x C x D

A & B must be equal diameter (Primary Air Flow)
C diameter must be equal to or less then A,B
D diameter must be equal to or less then A,B





Reducing Crosses Available by Request

		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL± ANGULAR: MACH± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN	CJS	2009
			CHECKED		
			ENG APPR.		
			MFG APPR.		
		MATERIAL	Q.A.		
			COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

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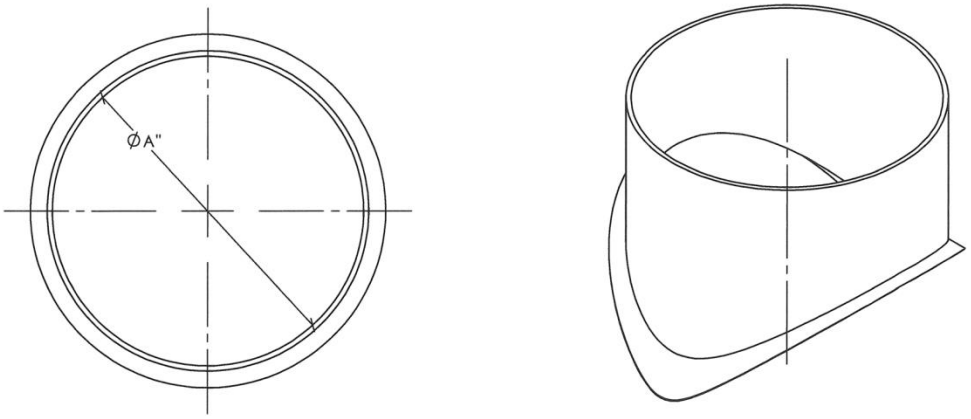
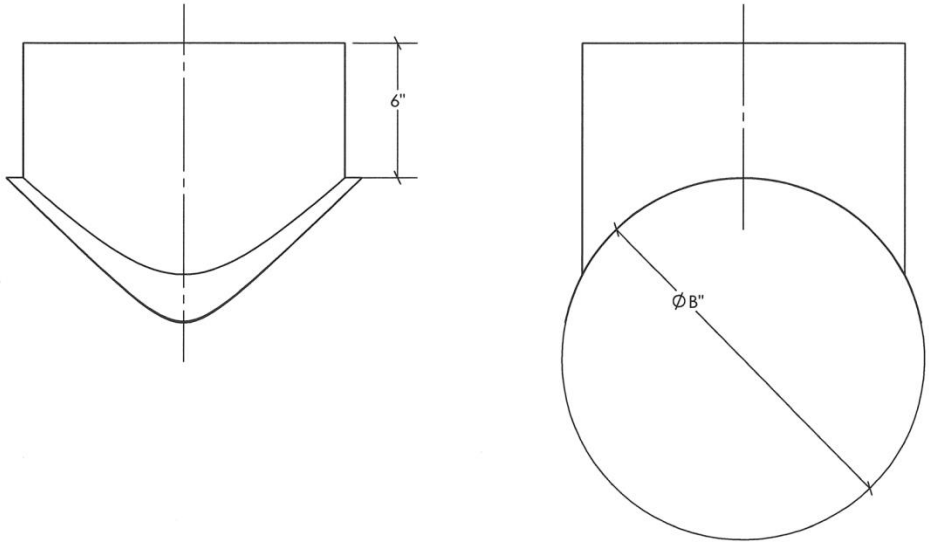
Spunstrand Inc.

Cross

SIZE	DWG. NO.	REV.
A	Industrial FRP	



A onto B



		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE
			DRAWN	CJS	2009
			CHECKED		
			ENG APPR.		
			MFG APPR.		
			Q.A.		
		MATERIAL	COMMENTS:		
NEXT ASSY	USED ON	FINISH			
APPLICATION		DO NOT SCALE DRAWING			

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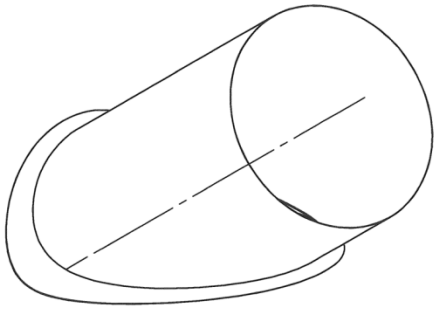
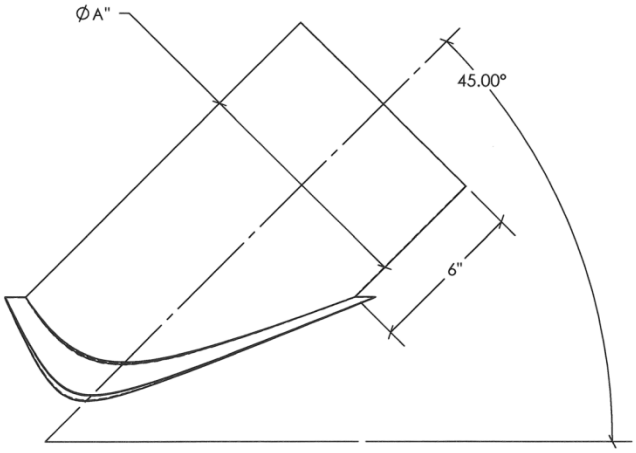
Spunstrand Inc.

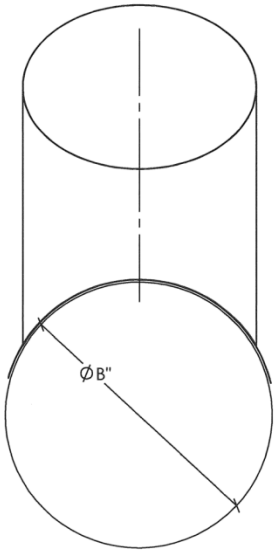
90deg Saddle Tap

SIZE	DWG. NO.	REV.
A	Industrial FRP	

A onto B







		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE	*Spunstrand Inc.*
			DRAWN	CJS	2009	
			CHECKED			**45deg Saddle Tap**
			ENG APPR.			
			MFG APPR.			
		MATERIAL	Q.A.			
			COMMENTS:			
NEXT ASSY	USED ON	FINISH				SIZE A · DWG. NO. Industrial FRP · REV.
APPLICATION		DO NOT SCALE DRAWING				

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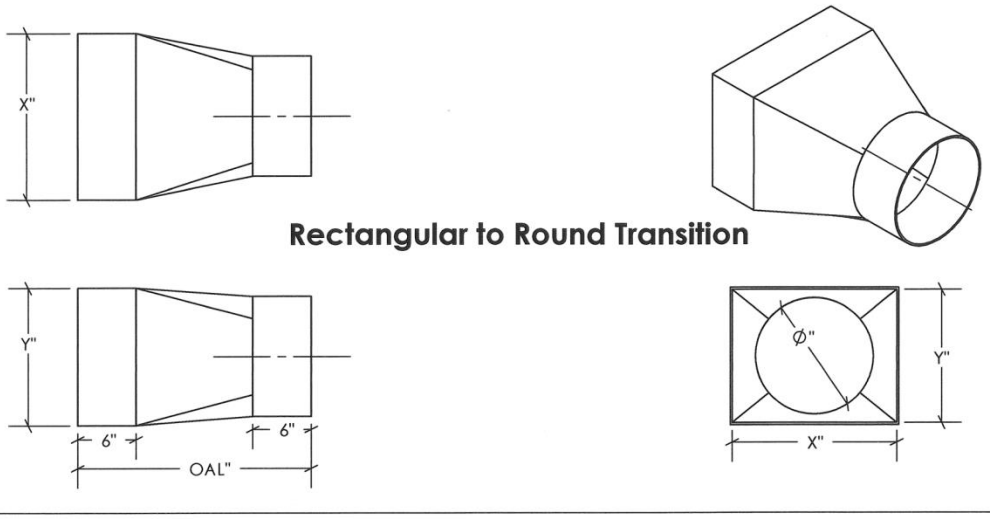
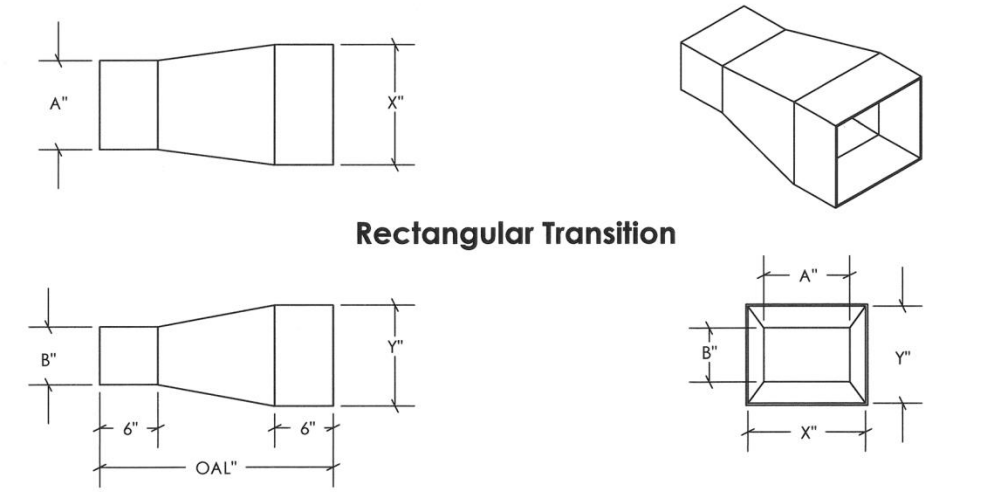
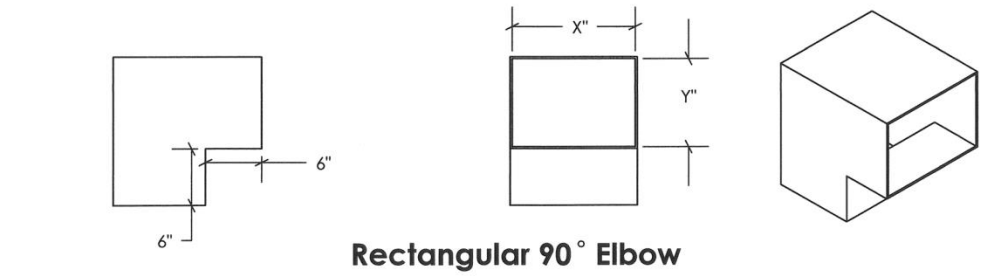


Rectangular to Round Transition



Rectangular Transition



Rectangular 90° Elbow

		DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ± ANGULAR: MACH ± BEND ± TWO PLACE DECIMAL ± THREE PLACE DECIMAL ±		NAME	DATE	*Spunstrand Inc.*
			DRAWN	CJS	2009	
			CHECKED			
			ENG APPR.			
			MFG APPR.			**Rectangular Fittings**
			Q.A.			
		MATERIAL	COMMENTS:			
NEXT ASSY	USED ON	FINISH				SIZE A · DWG. NO. Industrial FRP · REV.
APPLICATION		DO NOT SCALE DRAWING				

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MECHANICAL AND PHYSICAL PROPERTIES

Values for Spunstrand® Inc. air duct are approximate as they will vary with thickness, glass content and orientation of reinforcing.

Thermal Conductivity (K Value) + 1.7 BTU / HR / FT^2 / °F / in.

Specific Gravity = 1.4 to 1.9

Thermal Coeff. of expansion = 9 to 14 x 10^{-6} in. / in. / °F

Barcol Hardness = 40 to 55

Izod Impact Strength = 18 to 22 ft-lb / in. of notch

Heat Distortion Temp = 210 °F at 260 PSI

Compressive Strength = 15,000 to 25,000 PSI

Tensile Strength = 9,000 to 12,000 PSI

Flexural Strength = 14,000 to 20,000 PSI

Flexural Modulus = 700,000 to 900,000 PSI

Water Absorption = 0.18% at 24 hrs ambient temp.

SPUNSTRAND® INC. PLASTICS GLOSSARY

Barcol Hardness - A comparative gauge of resistance to indentation.

Compressive Strength - The crushing load at failure applied to a specimen per unit area of the resistance surface of the specimen.

Deflection Temperature - (Heat Distortion) - The temperature at which a specimen will deflect a given distance at a given load under prescribed conditions of test. See ASTM D-648.

Elasticity - That property of plastics materials by virtue of which they tend to recover their original size and shape after deformation.

Flash Point - Temperature of combustible material at which there is sufficient vaporization to support combustion of the material.

Flexural Strength - The pressure in pounds necessary to break a given sample when applied to the center of the sample which has been supported at its end.

Hoop Stress - The tensile stress, usually in pounds per square inch in the circumferential orientation in the wall of the pipe when the pipe contains a gas or liquid under pressure.

Longitudinal Stress - The stress imposed on the long axis of any shape. It can either be a compressive or tensile stress.

Modulus - The load in pounds per square inch of initial cross-sectional area necessary to produce a stated percentage elongation which is used in the physical description of plastics (stiffness).

Modulus of Elasticity - The ratio of the stress per square inch to the elongation per inch due to this stress.

Specific Gravity - Ratio of the mass of a body to the mass of an equal volume of water at a specified temperature.

Tensile Strength - The capacity of a material to resist a force tending to stretch it. It is the load per square inch of original cross-sectional area supported at the moment of rupture by a piece of test sample on being elongated.

Thermal Expansion - The increase in length of a dimension under the influence of an increase in temperature.

Thermosetting - Plastic materials undergo a chemical change and harden permanently when heated in processing. Additional heating will not soften these materials.

Water Absorption - (Perm Rating) - The percentages by weight or water absorbed by a sample immersed in water. Dependent upon area exposed and time of exposure.

Viscosity - Internal friction of a liquid because of its resistance to shear, agitation or flow.

Abbreviations - FRP Fiberglass Reinforced Plastic
RTRP Reinforced Thermosetting Resin Plastic