# FRE® SPECIFICATION FOR LOW SMOKE / HIGH TEMPERATURE APPLICATIONS

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## Section 1: General

### 1.1 Description

This specification outlines the requirements for the design, construction and performance of BreathSaver® rigid non-metallic fiberglass conduits and fittings.

### 1.2 Product application & use

Conduits and fittings shall be suitable for use in non-hazardous locations and applications not subject to physical damage, such as tunnels, subways, confined locations where smoke and flame resistance are critical.

### 1.3 Materials

Conduits and fittings shall consist of continuous E or E-CR glass roving encapsulated in an internally steam cured, corrosion resistant phenolic resin system pigmented with UV inhibiting carbon black dispersed homogeneously manufactured for use at temperatures ranging from –40 °F (-40 °C) to 525 °F (274 °C). Resin system substitution shall not be permitted.

Phenolic resin system shall be impervious to a wide spectrum of chemicals and conduit shall contain by weight less than 0.2 % halogens as chlorine and shall not contain other toxic materials in excess of trace levels limits compliant with OSHA requirements.

## Section 2: General Requirements

### 2.1 Sizes & wall thicknesses

Conduits and fittings shall be manufactured with nominal wall thicknesses as outlined below:

**IPS**

| Diameter | | Wall thickness | |
|---|---|---|---|
| in | mm | in | mm |
| 1 | 27 | 0.066 | 1.7 |
| 1¼ | 35 | 0.066 | 1.7 |
| 1½ | 41 | 0.066 | 1.7 |

**ID**

| Diameter | | Wall thickness | |
|---|---|---|---|
| in | mm | in | mm |
| 2 | 53 | 0.070 | 1.8 |
| 2½ | 63 | 0.070 | 1.8 |
| 3 | 78 | 0.070 | 1.8 |
| 4 | 103 | 0.070 | 1.8 |
| 5 | 129 | 0.095 | 2.4 |
| 6 | 155 | 0.095 | 2.4 |

### 2.2 Joining Method

Each length of conduit is supplied with an integral inside tapered bell on one end and spigot on the other end. All joints shall be adhesive bonded inside a tapered bell end of even socket depth through out the raceway. Adhesive shall be supplied by the manufacturer of the conduit and shall have a minimum joint pull out load of 1 000 lb. (454 kg) per inch diameter trade size.

### 2.3 Fittings

All fittings, adapters and elbows shall be constructed of the same filament wound materials as the conduit and shall have a socket depth and an inside tapered bell design consistent with the conduit.

## Section 3: Requirements

3.1 Workmanship

Conduits and fittings shall be free from defects and commercially practicable in color, opacity, density and other physical properties. The exterior surface finish shall be smooth per acceptable industry practices.

3.2 Marking

Conduits and fittings shall be marked at least once with a suitable identifying mark printed on the outside of the product. Such marking shall contain:
(1) RTRC (2) for use -40 °C to 274 °C (-40 °F to 525 °F) or other applicable temperature (3) trade size (4) manufacturer's name or trademark (5) AG (6) part number (7) degrees and radii (elbows only) (8) date of manufacture.

## Section 4: Conduit system properties

4.1 Physical Properties

| | Test Results | Test protocol |
|---|---|---|
| Glass Content | 68% ± 3% | API 15LR |
| Specific Gravity | 1.70 – 1.75 g/cm$^3$ | ASTM D792 |
| Barcol Hardness | 50 ± 2 | ASTM D2583 |
| Water Absorption | < 1.5% | CSA C22.2 No. 2515 |
| U.V. Resistance | > 3500 Hrs (Xenon Arc) | ASTM D570 |

4.2 Flame & Smoke Properties

| | Test Results | | Test protocol |
|---|---|---|---|
| Flame Spread | 15 | (Asbestos: 0) (Red Oak: 100) | ASTM E84 |
| Flame Spread Index | 2 | (max: 35) | ASTM E162 |
| Smoke Optical Density @ 4 minutes | 2 | (max: 200) | ASTM E662 |
| Light Absorption | 0% | (no smoke generated) | SAV 242 |
| Emissions $NO^2$ | 2 ppm | (max: 100 ppm) | SMP 800C |
| Emissions $SO^2$ | < 1 ppm | (max: 500 ppm) | SMP 800C |
| Emissions HCI | < 1 ppm | (max: 100 ppm) | SMP 800C |
| Emissions HF | < 1 ppm | (max: 100 ppm) | SMP 800C |
| Emissions HBr | < 1 ppm | (max: 100 ppm) | SMP 800C |
| Emissions HCN | < 1 ppm | (max: 100 ppm) | SMP 800C |
| Emissions CO | 330 ppm | (max: 3 500ppm) | SMP 800C |
| Emissions $CO^2$ | 9 400 ppm | (max: 90 000ppm) | SMP 800C |

4.3 Electrical Properties

| | Test Results | Test protocol |
|---|---|---|
| Dielectric Strength | 150 volts/mil | ASTM D149 |
| Dielectric Breakdown Voltage | 21.5 kV | ASTM D149 |

4.4 Surface finish

| | |
|---|---|
| Exterior (average) | <2000 microinches (50.8 micrometers) |
| Interior (average) | <250 microinches (6.4 micrometers) |
| Color | Black (standard) |

4.5 Thermal Properties

| | Test Results | Test protocol |
|---|---|---|
| Coefficient of Thermal Expansion | 0.51 E-$^5$ in./in./°F (0.927 E-$^5$m./m./°C) | ASTM D696 |
| Thermal Conductivity | 1.67 Btu.in/ft$^2$.h. °F (0.240W/ m.K) | ASTM D335 |
| Thermal Resistivity | 0.6°F. ft$^2$.h/Btu.in (4.17 mK/W) | ASTM D335 |
| Heat Deflection Temperature (HDT) | >482°F (>250°C) | ASTM D648 |

## Section 5: Specification

Conduits and fittings shall comply to FRE's own specification as described above.

## Section 6: Manufacturers

Conduits and fittings shall be manufactured by FRE Composites. No substitute will be accepted.