

**Subject:** Comparison of Polywater® Foam Sealant Type FST™ Performance to Other Common Field Duct Block Products

## **Background and Purpose:**



Polywater® Foam Sealant Type FST (shown on the left) creates a permanent water and air block. A comparison was done with other duct block systems commonly used in the field. Performance measurements included water and air sealing capacity as well as strength of the seal (removal resistance).

## **Products Tested:**

### **Polywater® Foam Sealant Type FST**

Polywater® Foam Sealant FST is a two-part, “blown” urethane foam. It cures to a strong, rigid closed-cell structure. It has excellent wetting and adhesion to metal, concrete and plastic surfaces. It provides superior resistance to water, acid and base, grease and most organic compounds because it is crosslinked and has a high percentage of closed cells. The FST sealant is mixed in a 1/1 ratio through a static mixer during its application from a side-by-side cartridge system.

- 99% closed-cell contents
- Two-part, high expansion
- Chemically resistant
- High strength, blocks water and gases

### **One-Part Insulating Foam Sealant**

One-part insulating foams (often called canned foams) are packaged in an aerosol using flammable propellants. These foams are primarily used for insulation and as small gap and crack fillers. The sealant blows (foams) as it is dispensed from the can, and this provides a good vertical cling. The expanded foam is low density, with a high expansion ratio. The foams are one-part, and only cure on contact with ambient moisture, either from air or moisture-containing surfaces such as wood.

- Easy to use - immediate foaming does not require blocks or dams
- One-part, requires ambient moisture for cure – inside may not fully cure in thick coatings
- Low closed-cell content

## Duct Seal Putty

Duct seal putties are clay based molding material. These non-drying putties are kneaded and pressed into place. They are not recommended for outdoor use. The putties become harder and more difficult to knead in cold weather. Duct seal putties do not cure or set up and may flow or sag over time.

- Easy to use, molds into holes and gaps
- Non-curable, may sag over time
- Non-conducting

### Testing and Results:

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## 1. Installation Methods and Testing

### 1.1 Installation Instructions and Method

#### Polywater® FST™ Foam Sealant

The FST Foam was injected into the duct according to the instructions. Both conduit and cables were cleaned with an HP-158ID Preparation Wipe. A foam strip dam was wrapped in and around the cable(s) and inserted 5 inches into the conduit. Another dam was placed at the end of the conduit, leaving a 3-inch space between the dams. The two-part FST Foam sealant was injected through a static mixer into the open space and allowed to foam and cure for two hours.

#### One-Part Insulating Foam Sealant

The insulating foam sealants do not have specific instructions for duct sealing, so the general use instructions were adapted. Both conduit and cables were cleaned and dried before use. The foam sealant can was shaken for 30 to 60 seconds, and the foam was sprayed directly into conduit. For the water blockage test, the foam was added to an

approximate depth of six inches. For the pull-out testing, approximately 12 inches of foam was added.

*Usage Limitations:*

This end use is non-standard for this type of product. The general instructions recommended that insulating foam sealant not be applied in bead sizes greater than 3 inches or into “excessively deep cavities where ambient moisture is unavailable for foam curing.” The one part insulating foam sealants did not consistently cure and harden when injected into conduits.

**Duct Seal Putty**

Duct seal putty was used as directed. The putty compound was kneaded, formed and pushed into the duct opening. In this testing, the compound was pressed into the conduit to a depth of one inch. Care was taken to eliminate any cracks or crevasses in the final seal.

*Usage Limitations:*

Duct seal putties are intended to seal conduit openings against drafts, dust, moisture and noise. These compounds are not intended for outdoor use. Unlike the foam products, duct seal putties do not react and cure. These compounds do not harden over time, and remain relatively soft.

**1.2 Curing Properties**

	<b>Set Time</b>	<b>Cure Time</b>	<b>Expansion Ratio</b>	<b>Closed-cell Content</b>
FST Foam Sealant	15 Minutes	20 Minutes	10X	>99%
One-Part Insulating Foam Sealant	6-9 Minutes (Outside tack free)	12 Hours (Partial Cure)	20X	>12%
Duct Seal Putty	Immediate	No cure	No Expansion	NA

**2.0 Performance Properties**

**2.1 Water Blocking**

**One-Part Insulating Foam Sealant and Duct Seal Putty**

In this testing, the Insulating Foam Sealant was injected into a 2-foot section of PVC duct to an approximate depth of 6 inches. The duct seal putty was pressed into a 2-foot section of PVC duct to a depth of one inch. The conduit was hung vertically and water

was added to the duct in increments of one inch. The depth of water when leakage occurred was recorded as the water-head pressure the seal could withstand.

### **Polywater® Foam Sealant Type FST™**

Polywater® Foam Sealant holds much higher levels of water-head pressure. Testing on this foam required higher pressure and had a modified design.

In this test, American Polywater's Foam Sealant (FST) was injected into a duct according to the instructions to a depth of 3 inches. A small amount (approximately 8 ounces) of colored water was loaded into the vertical duct above the foam. Air pressure was placed on the system to create a water-head. 7.25 psi air pressure is approximately 50 kPa or 5 meters (16.4 feet) of water-head pressure. The whole system was placed in a bucket of clear water. (Figure 1). Seal failure can be detected by the appearance of colored water. Because Polywater's Foam Sealant is a light yellow color, the method of failure can also be determined by following the color migration.

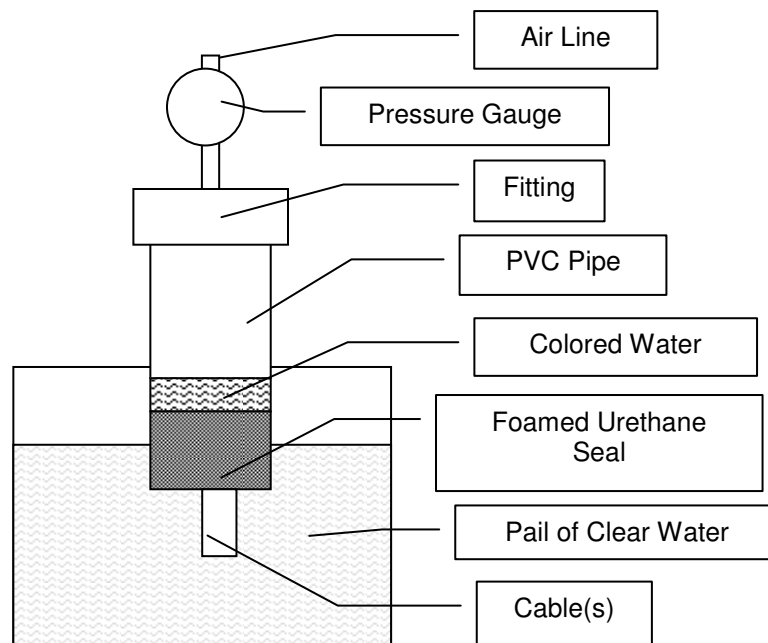


Figure 1

	<b>Length of Test</b>	<b>Water-head Seal Capacity</b>
<b>FST Foam Sealant</b>	30 days	16.4 feet
<b>One Part Insulating Foam Sealant</b>	24 hours	0.25 foot
<b>Duct Seal Putty</b>	1 week	1 foot

## **Polywater® Foam Sealant Type FST™, Multiple Cables**

The Polywater® FST foam was tested under additional, more extreme conditions. A 2-inch Schedule 40 PVC duct and three polyethylene jacketed cables were sealed. Polywater® Foam Sealant was injected to a 3-inch thickness according to the instructions. The duct was in a horizontal position during the foaming process.

The conduit was hung vertically and the cables were bent and pulled to stress the sealant bond.

<b>FST Foam Sealant Condition</b>	<b>Length of Test</b>	<b>Water-head Seal Capacity</b>
<b>Three cables in system (basic)</b>	15 Minutes	40 psi (92 feet waterhead)
<b>Same cables are bent at a 45° angle and held for 5 minutes in two directions</b>	15 Minutes	40 psi (92 feet waterhead)
<b>Same cables are pulled with 15 lbs. axial force for 4 hours</b>	15 Minutes	40 psi (92 feet waterhead)

### **2.2 Air Pressure Stop**

In this test, the duct sealants were installed as described in Section 1.1. Clear, 2-inch schedule 40 PVC duct was used. The duct was swabbed with a Polywater® HP-158ID solvent wipe prior to sealant installation. Polywater® Foam Sealant was injected to a depth of 3 inches, the insulating foam sealant to a depth of 6 inches, and the duct seal putty to a depth of 1 inch.

A balloon was placed over the end of the duct and an air fitting was placed on the other end of the duct. Air pressure was placed on the system to create a pressurized system. (See Figure 2.) Seal failure was detected when the balloon filled and expanded. The duct block was step-up pressurized to 5 psi, 10 psi, 20 psi and 30 psi with a holding period of 168 hours at each pressure.

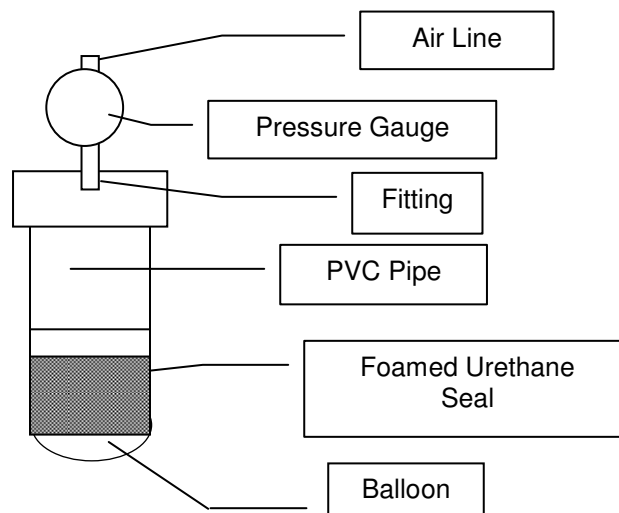


Figure 2

	<b>Length of Test</b>	<b>Air Pressure Seal Capacity</b>
<b>FST Foam Sealant</b>	4 steps 168 hours each	>30 psi
<b>One-Part Insulating Foam Sealant</b>	Immediate Leakage	<1 psi
<b>Duct Seal Putty</b>	Immediate Leakage	<1 psi

### 2.3 Cable Pull-out and Strength of Seal

In this test, three wires were sealed into a clear, 2-inch schedule 40 PVC conduit using the sealants as described in 1.1. Care was taken to inject or mold the compound into the spaces between each wire. The conduit section was then clamped into an Instron tensile testing machine. Cables were pulled out (speed of 2 in/min) of the foam individually when possible. Maximum pull-out force was recorded. Results are the average of three tests each on 2 AWG THHN copper cable and 4/0 XHHW aluminum cable.

	<b>Cable Type</b>	<b>Average Pull-Out Force (lb<sub>f</sub>)</b>
<b>FST Foam Sealant</b>	2 AWG THHN	171
<b>FST Foam Sealant</b>	4/0 XHHW	320
<b>One-Part Insulating Foam Sealant</b>	4/0 XHHW	86*
<b>Duct Seal Compound</b>	Not Applicable	Not Applicable

*\* For the One-Part Insulating Foam Sealant, all three cables came out together. The values reported for FST Foam Sealant represents an average pull tension for each of three cables.*

### 3.0 Service Life

#### 3.1 Integrity of Seal and Sag Testing

After duct sealant compound was injected into ducts as described in Section 1.1, the seals were allowed to age for 6 months. Any deformation was measured. Seals were sliced open for inspection.

	<b>Description of Seal</b>
<b>FST Foam Sealant</b>	Permanent, structural block. Remains intact with good adhesion to conduit wall and cable material. Resistant to uv, water, and chemicals.
<b>One-Part Insulating Foam Sealant (Canned Foam)</b>	Rigid, blocking foam. Cure is inconsistent in duct application. Patches of soft, uncured material found, showing flow character and voids.
<b>Duct Seal Putty</b>	Soft, malleable putty. Material shows sagging and deformation.

**Discussion:**

When used properly Polywater’s FST™ Foam Sealant can hold a water-head pressure up to 30 psi or 60 feet of water head. It has high closed-cell content and will seal air under pressure. The foam sealant will seal between multiple cables and tolerates cable movement and stress. The FST foam, applied in sufficient thickness, is impervious to water, as is the adhesive bond to both the PVC or HDPE conduit and PE cable jacket.

One-Part Insulating Foam Sealants and Duct Seal Putties show poor performance. They do not block water and air or prevent cable removal.

**Appendix 1 – Products Used in Testing**

- Dow® Great Stuff™ Window and Door
- Dow® Great Stuff™ Gap and Crack
- Dow® Fill N Seal
- Dap®Tex® Multi-Purpose Foam Sealant
- GB® Duct Seal Compound
- EPD Duct Seal Compound

**Topic Related Links**

[FST™ Foam Duct Sealant](#)

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