



June 2005

Thickness of Spray Polyurethane Foam Affects the R-Value

The thicker the spray polyurethane foam (SPF) is, the greater the RSI per 25 mm. The RSI of 150mm of SPF is not the RSI of 25 mm times six. The actual RSI will actually be greater. To understand this, we need to examine how the RSI is determined for all insulations.

First of all there are two types of insulations used in buildings. One type is a fibrous type which mainly uses air to provide the insulation and the other type encapsulates a gas which has an insulation value which is greater than air.

If you look at the first type of insulations, you will find them all around the insulating value of air. Fiberglass, rock wool, cellulose, etc all have an insulation value of about RSI 0.5 per 25 mm. The specific type of insulation and the manufacturing process will vary the actual number, but normally less than 0.01 RSI per 25 mm. For example, glass is not a good insulator in a solid form, but if you melt it and spin the liquid glass like cotton candy, it produces fibers which can be used for insulation. The reason that the insulation value of solid glass jumps when it becomes fiberglass is that you are now measuring the insulating value of the air between the glass fibers. This concept applies to all fibrous insulations.

> "The thicker the SPF the greater the RSI per 25mm."

Foamed plastic insulations use a blowing agent as part of the liquid mixture used to make sprayed polyurethane foam insulation. The blowing agent provides two functions. The first function is to gasify at a certain temperature to produce tiny bubbles or cells. As part of the reaction which takes places, the cells are produced and then the plastic around the cell hardens. The result is a rigid foamed plastic insulation made up of cells which have trapped the gas which produced the cell. The insulation value of the foamed plastic is tied to the thermal conductivity of the gas trapped in the cells. It would not be unusual for the RSI of freshly sprayed polyurethane foam to be 1.2 per 25mm. At this time, the RSI is the value per 25mm times the thickness. As spray polyurethane foam cools off, loosing the heat caused by the exothermic reaction, the gas within the bubbles cools and creates a slight vacuum.

At this point the thermal conductivity is still about the same as a vacuum also provides an insulation value (think vacuum thermos for your coffee). Over time, air which touches the surface of the SPF is drawn into the cell to balance the pressure.

Once inside the cell, the gas now becomes a mixture of the blowing agent and air and the thermal conductivity increased (RSI goes down). The outside layer of cells is the first to have this dilution happen. Over time additional layers will be subject to the same process. If the foam is exposed on both sides, this process will start from both sides and work toward the middle. As the time it takes for this process to happen to each layer, the thicker the foam, the longer it will take for the center to be reached. As a result of this

CANADIAN URETHANE FOAM CONTRACTORS ASSOCIATION INC.
ASSOCIATION CANADIENNE DES ENTREPRENEURS EN MOUSSE DE POLYURÉTHANE INC.
P.O. Box 3214, Winnipeg, Manitoba, R3B 0S5 • Phone: 1-860-GO-SPRAY (467-7729) • cufca@cufca.ca





SPF which is 600 mm thick will have a greater RSI per 25 mm when compared to a 25 mm specimen sprayed at the same time as it takes time for this process to move through the material.

To measure the average RSI that SPF will have it has been suggested that a 15 year average be used. The reason for this is that the RSI per 25mm will drop the most very early on in the aging process and then level out. Laboratory tests have shown that the five year RSI is very close to the 15 year value. The RSI of material tested at its full intended thickness after a five year period have been accepted by evaluation agencies as the RSI which the manufacturer can claim.

For manufacturers who do not want to wait for five years to determine the RSI they can claim can use the CAN/ULC S770 Long Term Thermal Resistance test method to predict the RSI at five years. In Canada, there is a requirement of the CAN/ULC S705.1 Material Standard for SPF that this test method be used to determine the RSI claimed by the manufacturer. The manufacturer must conduct this test on a number of thicknesses and declare the results.

This test is conducted with the SPF being exposed on both sides. The “skin” formed when SPF is installed on a substrate and when layers of SPF is installed will decrease the dilution process and provide a higher RSI than what the S774 test method will show. The thickness of the skins will vary depending on what material the substrate is and the temperature of the substrate. Research work has not been done yet to quantify what the increase would be.

When specifying the thickness of the foam, keep in mind that the greater the thickness, the greater the RSI per 25 mm. Check the manufacturer’s documentation to get the exact RSI you will receive at the thickness you intend to install.

CANADIAN URETHANE FOAM CONTRACTORS ASSOCIATION INC.
ASSOCIATION CANADIENNE DES ENTREPRENEURS EN MOUSSE DE POLYURÉTHANE INC.
P.O. Box 3214, Winnipeg, Manitoba, R3B 0S5 • Phone: 1-860-GO-SPRAY (467-7729) • cufca@cufca.ca