

Closed-Cell Versus Open-Cell Polyurethane Spray Foam

Polyurethane spray foam is often categorized as either "open-cell" or "closed-cell". There are several major differences between the two types, leading to advantages and disadvantages for both, depending on the desired application requirements. In addition, polyurethane spray foam is an extremely versatile material that is available in a variety of final physical properties and densities, so it is necessary for the end-user to have an understanding of these differences, and to choose the spray foam system that is best suited for the particular application requirements.

The purpose of this article is to provide a summary of the advantages and disadvantages of open-cell and closed-cell polyurethane spray foam;

Closed-cell polyurethane spray foam is among the most efficient insulating materials commercially available, with R-values commonly around 6.0 per inch.. Closed-cell foam incorporates an insulating gas that is retained within the cells (foam "blowing agent"), which leads to the highly efficient insulating properties of the material. In the U.S., insulation is measured in "R-Value" (R= resistance to heat flow), and closed-cell polyurethane spray foam has among the highest R-Values of any commercially available insulation. In addition, the closed-cell nature of this foam provides for a highly effective air barrier, low moisture vapor permeability (often referred to as the "Perm" rating), and excellent resistance to water . The most common foam density for closed-cell polyurethane foam is approximately 2.0 pounds per cubic feet. Years of research and commercial experience has shown that the 1.75 – 2.25 lb./ft³ density range provides the optimum insulating and strength characteristics for most building applications. Closed-cell polyurethane foams are usually characterized by their rigidity and strength, in addition to the high R-Value. Also, studies show that wall racking strength can be doubled or tripled when closed cell foam is applied.

Open-cell polyurethane spray foam, on the other hand, is usually found in densities ranging from 0.4 to 1.2 lbs./ft³. One of the advantages that these lower densities provide is a more economical yield, since foam density is directly related to yield (lower density = higher yield). Although the R-value of open-cell foams is slightly more than half that of closed-cell foams, usually around 3.5 per inch, these products can still provide excellent thermal insulating and air barrier properties.. Open cell foam is more permeable to moisture vapor, with perm ratings of approximately 10.0 per 4 – 5 inches thickness (up to 50 perms at one inch). However, the foam allows for a very controlled diffusion of moisture vapor whose consistency can be managed by the builder / architect. Open cell foams are incredibly effective as a sound barrier, having about twice the sound resistance in normal frequency ranges as closed-cell foam. Other characteristics of open-cell polyurethane foam usually include a softer, "spongier" appearance, as well as lower strength and rigidity than closed-cell foams.

Applications that typically use open-celled foam include residential construction insulation, under roof trusses for "conditioned attics" (especially in the South and Southwest U.S.), and for sound deadening in media rooms, etc. Closed-cell foam, while also useful in residential construction insulation, is used in a variety of commercial, industrial and residential applications because of the excellent strength and insulating properties described here.

In a "bullet point" list, the comparison of closed-cell to open-cell polyurethane foams is as follows;

Closed - Cell	Open-Cell
Highest insulating "R-Value" per inch (greater than 6.0)	Good insulation value (R=3.5)
Low vapor permeability (low perm)	Higher vapor permeability, but controlled
Air barrier	Economical yield
Increases wall strength	Air barrier
Resists water (is a WRB - "Water Resistive Barrier")	Best sound absorption in normal noise frequency ranges
Absorbs sound, especially bass tones	Low density (0.4-1.2 lbs./ft3)
Medium density (1.75-2.25 lbs./ft3)	