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To Perm or not to Perm, That is the Question Or What is the Reality of a Perm Rating?

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Major problems in buildings are created by getting water into the building envelope and not drying out. Water in the building envelope can lead to rot, corrosion, mold, mildew, structural degradation, health issues for occupants and the list goes on. This problem is increasing which has led to a stampede of people focusing on the permeance of materials. Some wanted a low permeance material to keep water from getting in and others wanting a high permeance of material to let the water out.

You need to keep permeance (water vapor transmission rate) in perspective. If you only worry about permeance of materials you are worrying about drops of water and ignoring the buckets of water. The water vapor transmission rate deals with drops of water but water movement by air leakage deals with buckets of water.

The intent of this article is to allow you to realize just what it is that we are speaking about when the discussion turns to “perms”. In answering the question, a perm rating is one of the not-so-useful measurement factors of an air barrier system, emphasis on system (whole building). Perm ratings are based on the testing being done according to ASTM E96 both Method A & B with Method A being the desiccant method and Method B being the water method. So, just what is a perm?

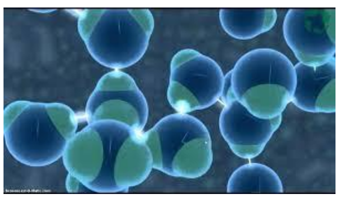
A perm is simply a unit of measure for water vapor that will permeate through a given area of a material over a period of time based on a static vapor pressure difference between the two atmospheres on each side of the material or assembly. So, to put it differently when the vapor pressure (combination of relatively humidity and temperature) is different on one side of a material than on the other side, the water molecules in the air (water vapor) want to work their way through the material and the direction of movement is always from high water vapor pressure to low water vapor pressure.

The vapor pressure difference depends on the temperature and relative humidity outside as compared to the temperate and relative humidity on the interior. In cold climates, the interior conditions are warm and moist, and the outside is cold and dry. The water molecules that is in the air inside the building and want to work their way through the building materials to the outside. The exact same process happens in hot and humid climates but just in the opposite direction. The water molecules on the outside want to work their way through the building materials to get inside.

So, let's go back to what is a perm. Sure, it's a unit of measurement, but how much water are we really talking about?

Quantity of Water by Water Vapor Transmission vs Air Leakage

Water Vapor Transmission



We measure the water vapor transmission rate in nanograms, which are 1 billionth of a gram. One ounce of water equals *28.3495 grams* – remember we measure the rate in nanograms.

A perm is defined as - 1 perm equals 1 grain/hour/ft²/inch of mercury

To give you a sense of scale about how much water is transferred through a material over time, we asked Oak Ridge National Laboratory to calculate the water that would transferred through a material when tested to ASTM E96 which would have a permeance of 0.1 Perms, 1.0 Perms and 10 Perms.

Perms	Ounces of water per ***YEAR*** / 10.7 ft² (approximately one stud cavity 16" by 96"
0.1	0.166
1	1.66
10	16.60
20	33.20

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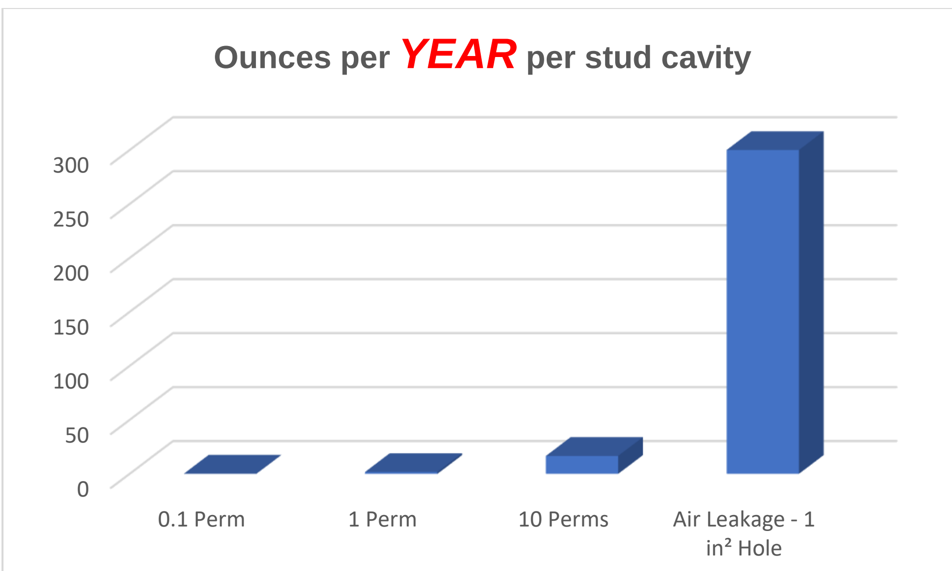
Air Transport

Compare this to the amount of water that would go into the same sheet of exterior gypsum if you have a hole with an area of 1 in² in that sheet (about the size of the openings in an electrical box). This relatively small area, only 0.02% of the area, air can move approximately 300 ounces (19 quarts) of water through that hole.

Comparing Water Vapor Permeance to Water Transport by Air Leakage



Testing for Water Vapor Transmission

It is important to understand how materials are tested to determine their water vapor transmission rate. The most common standard is *ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials* or Internationally it is

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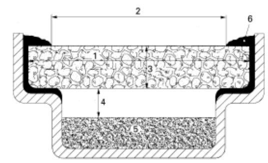
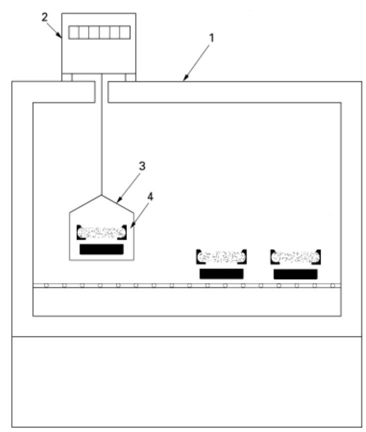
ISO 12572:2016 Hydrothermal performance of building materials and products -- Determination of water vapor transmission properties – Cup method.



Now in this test method, there is what is called the “desiccant method” and the “water method”. You take a circular glass dish which normally is about eight inches in diameter. For the dry cup method, you but a desiccant in the dish. For the wet cup method, you put water in the dish. You then put your material over the mouth of the dish and seal it with a paraffin wax and bees wax combination. You don’t want any water vapor to escape out of the dish other than going through the material. This creates an atmosphere of either 0% relative humidity or 100% relative humidity on the side of the material that is inside the dish.

Now to produce a water vapor pressure across the material, you put it in an oven which will maintain a constant 50% relative humidity at a temperature of 73.4 °F (23 °C).



You can calculate how much water is transferred in or out of the dish over time. If you are testing for the desiccant method, the desiccant will absorb the water that transfers through the material and will increase in weight. For the water method, the weight of the water will decrease as the water moves through the material and escapes out of the dish.

The point of this article is simply to point out that the amount of water that enters a building assembly due to water vapor transmission is exceedingly small. Information is available to show that as you reduce air leakage rates in building assemblies, the potential for moisture problems is reduced and if you have no air leakage, the moisture problems are almost eliminated for some types of buildings in specific locations.

Our buildings are becoming more complicated to design and construct and the old “rules of thumb” cannot give us the information we need to understand the performance of materials after they are installed. Nor can you any longer take one point of data and design an air barrier assembly. Work is being done to produce better modeling, to better characterize materials and research is being done to better understand how various materials perform under real life conditions. We need all of this to produce the buildings we need for the future.