Providing compete construction specifications documentation, systems and performance descriptions, and risk and quality advisory services.

Conspectus's Tech Tips received the national Communications Award from the Construction Specifications Institute.

ABSTRACT:
Be careful when using manufacturer's data to reporting product performance. Check the values and the units of measure. Be sure the units are correct and the value consistent with what should be expected.

FILING:
UniFormat™
B1010 - Floor Construction
B1020 - Roof Construction
B2010 - Exterior Walls

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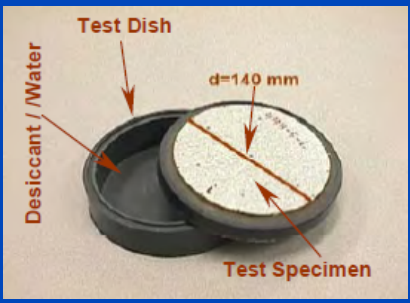
07 26 00 - Vapor Retarders

KEYWORDS:
Water Vapor Transmission, Permeability, Permeance

REFERENCES:
ASTM E96 - Standard Test Method for Water Vapor Transmission of Materials



Example specimen and test apparatus that is placed into an environmental chamber to measure WVT.

Water Vapor Transmission

By David Stutzman, AIA, CSI, CCS, SCIP, LEED AP

Background

Water vapor transmission through building materials is one property that is often reported incorrectly with erroneous units of measure that make the information suspect.
An architect asked us to review a substitution submittal for a spray foam insulation material that is sold as a fill material to improve the thermal performance of concrete masonry units. The data sheet listed only four material properties, including Water Vapor Transmission (WVT).
The data sheet claimed WVT was tested according to ASTM E96 and reported the results as 6.631 perms per inch. And there it was - the erroneous unit of measure. A typo? Perhaps. Nevertheless, it was something that got past the technical reviewer.
Since foam insulation is offered as an air barrier and sometimes as a vapor retarder, WVT may be an important consideration when selecting the material.
If the foam was 2 inches thick, would its performance be 13 perms? By the data given, it should be, but it is doubtful this is true.
What did this test result really mean? Nothing until the unit of measure could be verified.

Additional Manufacturer's Data

The sample specification found on the manufacturer's website did not include WVT as a property that should be specified. A different product data sheet on the website reported 6.631 perms per inch, as the permeance, not WVT. This second data sheet also reported 4.655 grains/hr•ft^2 as the tested value for WVT.
This only added more confusion and required more research into the material properties.
This is only the most recent example, not the first, and certainly not the last demonstrating how confusing this material property really is. If the manufacturers cannot report their data correctly, how are architects able to rely on the data for building design?

Standardized Testing

The industry standard test for Water Vapor Transmission is ASTM E96. The test is used to report three values:

- Water Vapor Transmission (material property)
- Permeance (performance)
- Permeability (material property)

It is important to understand what these reported values are and what units of measure are used for each. But first… some background on the test standard, itself.
ASTM E96 is designed to test thin sheet products such as paper and plastic as well as board products such as gypsum, plaster, fiberboard, wood, and plastic. The maximum specimen thickness is 1-1/4 inches, unless the product is a board produced as a laminate such as foamed plastic with natural skins on each face.
The test may be performed using one of two methods: the Desiccant Method or the Water Method. In addition, two service conditions may be used: one side wetted or one side with low humidity and the opposite side with high humidity.

The test may be performed using one of two methods: the Desiccant Method or the Water Method. In addition, two service conditions may be used: one side wetted or one side with low humidity and the opposite side with high humidity.
ASTM E96 includes the following six procedures establishing standard test conditions that have been determined to be useful for determining WVT. Most building materials are tested and reported by Procedure A. The lower temperature is tested in a chamber at 50% RH and the greater temperature is tested at 90% RH.

- Procedure A: Desiccant Method at 73.4 deg F
- Procedure B: Water Method at 73.4 deg F
- Procedure BW: Inverted Water Method at 73.4 deg F (water contacting the specimen)
- Procedure C: Desiccant method at 90 deg F
- Procedure D: Water Method at 90 deg F
- Procedure E: Desiccant Method at 100 deg F

Results from each procedure will differ. If the test conditions are critical, the procedure must be specified.

Test Results

During the test, the specimen is monitored for weight change in grains (grams) indicating the water vapor that passed through the test material, the total time for the test in hours, and the area in square feet (meters) of the specimen. WVT is calculated:

WVT = G/tA grains/h•ft^2 (g/h•m^2)

Then permeance can be calculated, dividing WVT by the vapor pressure difference between the two sides of the test material in inches mercury (mm mercury).

Permeance = WVT/Δp Perm (g/Pa•s•m^2)

Because the values for the metric measure are so small, they are often reported using nanograms (one-billionth of a gram) rather than grams to avoid the need for scientific notation.

And finally, to determine permeability, the performance of the material, multiply the Permeance by the material thickness in inches (meters).

Permeability = Permeance x thickness Perm inch (g/Pa•s•m)

Conclusion

What the manufacturer in this case should have reported remains unknown and therefore unusable. Permeance is the test result that is most often used to compare performance of specific products. This value is for the time rate of water vapor transmission through a material. The values represent the speed at which water vapor will pass through a material at a particular thickness. Pay attention to the published units as well as the values. Values without units are meaningless, and easily ignored. Values with the wrong units are even worse because they may imply a performance that is far superior compared to reality.
When in doubt, ask the manufacturer; ask Conspectus.
Thank you Willis W. "Big Daddy" Wertz. My college professor started every structures class by writing the same three structural formulas plus the word **UNITS** on the blackboard three days a week for four years. **It sunk in.**

Conversions

Multiply	By	To Obtain
Water Vapor Transmission (WVT)		
g/h·m^2	1.43	grains/h·ft^2
grains/h·ft^2	0.697	g/h·m^2
Permeance		
g/Pa·s·m^2	1.75 x 10^7	1 Perm (inch-pound)
1 Perm (inch-pound)	5.72 x 10^{-8}	g/Pa·s·m^2
Permeability		
g/Pa·s·m	6.88 x 10^8	1 Perm inch
1 Perm inch	1.45 x 10^{-9}	g/Pa·s·m

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