

K-Flex USA Explains Permeability and Permeance

Water vapor permeability and water vapor permeance are both measures of a material’s ability to resist penetration of moisture from the air. As defined by ASTM Terminology C168:

Water vapor permeability – the time rate of water vapor transmission through unit area of flat material of unit thickness induced by unit vapor pressure difference between two specific surfaces, under specified temperature and humidity conditions.

Water vapor permeance – the time rate of water vapor transmission through unit area of flat material or construction induced by unit vapor pressure difference between two specific surfaces, under specified temperature and humidity conditions.

Water vapor transmission rate – the steady water vapor flow in unit time through unit area of a body, normal to specific parallel surfaces, under specific conditions of temperature and humidity at each surface.

Permeability is measured in units of perm – inches and is used to compare materials that are typically used in a variety of thicknesses (1/4” or greater). Permeance is measured in units of perms and is used to describe thinner materials (i.e. jacketing products) that are used in the field in the exact thickness the material is tested at.

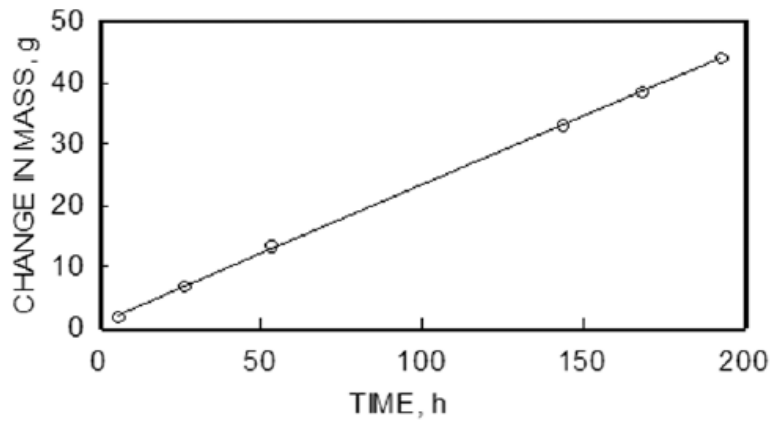
In regards to units used to measure moisture penetration resistance, permeability is used to calculate the permeance at any given thickness. A material with a permeability listed as 1.0 perm – inch would have a permeance of 1.33 at 3/4” thickness ($1.0 / .75 = 1.33$). For moisture penetration resistance values, the smaller the number, the better the value.

Derived moisture penetration resistance results can be converted from one term to the other using appropriate conversion factors (referenced in the table below).

Metric Units and Conversion Factors		
Multiply	by	To Obtain (same test condition)
<i>WVT</i>		
$g/h \cdot m^2$	1.43	grains/h·ft ²
grains/h·ft ²	0.697	$g/h \cdot m^2$
<i>Permeance</i>		
$g/Pa \cdot s \cdot m^2$	1.75×10^7	1 Perm (inch-pound)
1 Perm (inch-pound)	5.72×10^{-8}	$g/Pa \cdot s \cdot m^2$
<i>Permeability</i>		
$g/Pa \cdot s \cdot m$	6.88×10^8	1 Perm inch
1 Perm inch	1.45×10^{-9}	$g/Pa \cdot s \cdot m$

A common test method to measure this property is ASTM E 96: *Standard Test Methods for Water Vapor Transmission of Materials*. There are two test methods called out in the standard: wet cup and dry cup. Both methods start by conditioning, measuring the thickness and weighing the samples. For the Water / wet cup method, the sample is placed over a pan with water in it and the edges are sealed. For the Dessicant / dry cup method, the sample is placed over a pan with a desiccant in it and the edges are sealed. The pan is then placed in an environmental chamber at a specified temperature and humidity until the weight gain or weight loss (the samples are weighed daily) has reached equilibrium (as shown in the chart below). At this time, the permeability or permeance of the material can be established.





In summary, there are several ways to describe a material's ability to resist penetration of moisture from the air. When comparing products or determining if a material meets a specification requirement, one must pay careful attention to the units of measure and the specific test method.