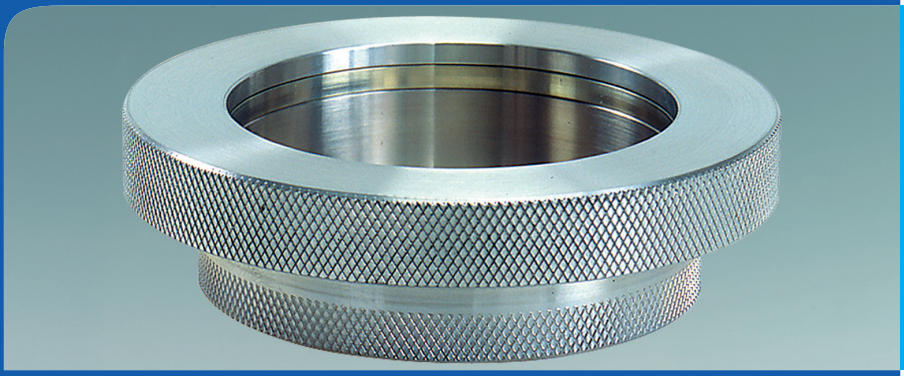
Measure what you see.

BYK-Gardner Permeability Cup



Operating Instructions

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BYK-Gardner
Permeability-Cup

Operating Instructions

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Description

This cup was developed by Dr. W.R.R. Park and will perform the same function as the Payne Permeability Cup. That is, the vapor permeability of any film material such as paint, plastic, varnish, cloth or coated papers can be conveniently determined using this device. This improved cup consists of three main parts:

- shallow flanged cup
- a flat retaining ring mounted on eccentric pins on the threaded flange of the cup
- a threaded ring cover.

Both the threaded cup and threaded cover are knurled to prevent slipping when clamping and unclamping the test sample. The film under test is clamped tightly between the rubber gasket and the flat retaining ring, covered with the polyethylene gasket, and held in a gas-tight seal when the ring cover is screwed down tight.

The water vapor permeability is obtained in one of two ways:

1. A desiccant such as silica gel, calcium chloride or phosphorous pentoxide is placed in the cup before the film is clamped in place. The cups is mounted above an aqueous salt solution contained in a sealed desiccator. The vapor pressure of this salt solution can be varied by changing the salt concentration. A salt solution must be used since it is important that the vapor pressure of the liquid be less than that of pure water at the test temperature, or else condensation will occur on the desiccator walls on the permeability cup itself. Any condensation would interfere with accurate weighing. At intervals, the cup is weighed to determine how much through the exposed

section of film.. Knowing the film thickness, area of film, elapsed time, and the difference in water vapor pressure on both sides of the film, a value of the permeability of the film can be determined in terms of the number of milligrams of water which permeate through 1 cm^2 of film, 1 mm thick in 24 hours, at a given temperature and at a given vapor pressure differential.

2. The procedure can be reversed. The desiccator then holds the desiccant and the aqueous salt solution of known vapor pressure is placed inside the cup. Again, it is important to use a solution rather than pure water, or condensation will occur on the surface of the test film. This would alter the permeability values because the permeability of films to liquid water is usually much different than that towards water vapor.

The use of the BYK-Gardner cup is not limited to water alone. By using an active absorbent, such as charco) or silica gel, the cup can be used to determine permeability towards organic vapors, using either of the two techniques described above. In place of salt solution, it is recommended that a dilute polymer solution be used so that the organic solute will not affect the final results. Any other non-volatile organic solute can also be used to lower the solution vapor pressure. In working with organic vapors, it is advisable to condition the cup and the film in an atmosphere containing the vapor to be studied. Likewise, when water permeability measurements have to be highly accurate, both the cup and the film should be allowed to equilibrate under some standard set of conditions. (For example, 20°C, 50% relative humidity, for 24 to 48 hours before use.)

Where an adsorbent is specific for a given gas (e.g., ascarite readily adsords carbon dioxide), the permeability of films to this gas can also be determined by placing adsorbent in the cup and keeping the cup in an atmosphere of the gas in question.

Because the rate of vapor or gas permeation is very dependent on temperature, the more precise the temperature control during the test period, the more accurate and reproducible will be the test results.

SAMPLE PREPARATION:

Uniform unsupported films of lacquer, enamel or varnish can be obtained by coating polished tinplate with those materials, allowing to cure, then stripping by mercury amalgamation of the tinplate. The method of application should be stated in all cases and should be the same for materials which are to be compared directly.

Coating materials too brittle to be handled as free films should be coated on a porous support, such as a dializer parchment, paper or glass cloth. The desired number of coats should be applied allowing the correct drying time for‘ each coat. The drying time and the manner of drying should be reported. The time interval between drying and testing can be varied depending on the information desired, but this interval should be recorded.

Operation

Remove the cover and retaining ring from the cup. Use the ring as a template, placing it on the surface of the sample to be tested. Cut out with a razor blade a circular disc of exactly the same diameter as the ring. The disc of sample can now be weighed, then mounted between the rubber gasket and the ring covered with the plastic gasket and placed on top of the flanged cup which holds a few grains of desiccant, or 10 ml of aqueous salt solution. The assembly is now slipped over the pins. During tightening of the ring cover, the retaining ring prevents any shear forces from operating on the film sample. The threaded cover is then put on and tightened with hand pressure. This is sufficient to give a gas-tight seal.

Now weight the loaded cup on an analytical balance and place in a desiccator containing the desired adsorbent or solution and reweigh it at intervals of 1 to 24 hours, depending on how rapidly the cup gains or loses weight.

Paper, plastic or cloth to be tested in an uncoated condition can be cut without any preliminary treatment. The thickness of this sample disc that is cut out can be measured with a sensitive micrometer or calculated as outlined below.

CALCULATION OF SAMPLE THICKNESS:

The ratio of exposed film area to be tested (10.0 cm2) to the total area of the sample disc (26.4 cm2) is a constant equal to 0.380.
The weight ratio of the exposed film to the total film is in the same proportion.

In the case of supported films, a disc of the uncoated support shall be cut in the manner

described and weighed accurately. A disc of the coated support shall also be cut and weighed in the same fashion. To obtain the actual weight of the portion tested, subtract the weight of the uncoated support from the coated support and multiply this difference by 0.380.

In the case of self-supported materials, all that is necessary is to weigh a cut disc and multiply by 0.380.

The film thickness in millimeters can be obtained by dividing the actual weight in grams of the area being tested (10.0 cm-) by the specific gravity of the film (g/ml).

NEW DEVELOPMENT:

The Federation of Paint and Varnish Production Clubs Standard No. Lm-I covering moisture permeability of paint and varnish films was based on work done by the New York Paint and Varnish Production Club in 1937, using the Fisher-Payne Permeability Cup. ASTM Committee D-I developed a „Standard Method of Test for Moisture Vapor Permeability of Organic Coating Pilms“ that used the Gardner Permeability Cup with an enlarged opening of 25 cm2 exposed area that still can be weighed easily on an analytical balance. The increase in area from 10.0 em? to 25.0 em> permits a greater transfer of moisture vapor in a shorter period of time, and thereby improves the precision of the method.

RESULTS:

Specific moisture vapor permeability is defined as the number of milligrams of water which has permeated through 1 em> of film, 1 mm in thickness, in 24 hours under specified conditions

of temperature and vapor pressure differential. The temperature at which the test is made should be stated. The 24 hour loss or gain in weight in grams of the cup, multiplied by the film thickness millimeters, multiplied by 100 will then equal specific permeability.