A COMPARISON OF ASTM TEST STANDARDS F3299 VS. F1249

Easily compare both ASTM methods and choose which one is right for your specific application.

Questions answered in this technical note

- What are the differences between F3299 and F1249?
- Does F3299 replace F1249?
- Why would I choose one standard over the other?
- What are the proper applications for each standard?
- What are the practical considerations when choosing either F3299 or F1249?
  - New standards. Old instruments. What should I do?
  - What are the downtime, labor and sensor costs associated with each standard?
  - What are the calibration frequency requirements for the sensors referred to in each standard?

What is ASTM F3299?

ASTM F3299 is a standard test method for measuring water vapor transmission rate (WVTR) through plastic film sheeting using an electrolytic detection sensor (Coulometric P_2O_5 sensor).

According to this test method's description, F3299 is applicable to sheet and film consisting of single and multilayer synthetic or natural polymers and foils, including coated materials.

ASTM F1249
WVTR TEST METHOD

What is ASTM F1249?

ASTM F1249 is a standard test method for measuring water vapor transmission rate through plastic film sheeting using a modulated infrared sensor (adopted in 1990).

According to this test method's description, F1249 is suitable to test flexible barrier films and sheets consisting of single and multilayer natural or synthetic polymers and foils, including coated materials.

When looking at the description for each of the above standards, it appears that they can both be applied to almost the same applications.

So, why should I choose to use one standard over the other. What are the benefits?

The sensor technology referenced in each test method is the major difference between the two standards, and each sensor has their specific advantages and disadvantages (see the comparison table on pg. 4). The table shows that using the AQUATRAN® 3 (compliant with F3299) will give you the ability to test WVTR levels down to 10^{-5}, whereas F1249 uses a sensor that requires annual calibration, but works well for WVTR levels between 10^{-3} to 10^{3}. It is imperative to match the WVTR range of your samples, to the WVTR range of your instrument, and then look carefully at the useful life time of the sensor. Your goal should be to pick the instrument with the highest sensitivity (lowest Limit of Detection (LOD)) that you will foreseeably need, and ensure that your sensor's lifetime has a rating of at least 1-2 years. Sensors that have a lifetime shorter than 1 year may create inaccurate results, as performance deterioration over the sensor's lifetime can result in erroneous measurements. By selecting the right WVTR range, and longest lasting sensor, you maximize your measurement accuracy, repeatability, test range, sensor's useful life, cost and the ease of measurement.

For example, the MOCON® AQUATRAN Model 3 WVTR measurement instrument (ASTM F3299) targets ultra-high barrier materials that are engineered to push the envelope of permeation detection limits to extremely low levels. This sensor also lasts 1-2 years. Typical applications at these low LODs include testing flexible films for organic light-emitting diode (OLED) displays, solar panels and similar demanding applications, which require accurate and extremely sensitive instrumentation to confirm barrier performance attributes.

For those materials which exhibit moderate to low barrier properties, it is suitable to choose the modulated IR sensor method (ASTM F1249) that is equipped in the MOCON PERMATRAN-W® 3/34. The best features of this instrument are a very long sensor life span (4-5 years), useful WVTR range of 10^{-3} to 10^{3}, along with its automated operational features.

In summary, when selecting a WVTR permeation instrument, make sure to match the WVTR Range of your materials, with the WVTR Range of the instrument; and then confirm that the sensor has specified at least a 1-2 year life time, preferably 5+ years.

If my barrier material has a moderate WVTR range, should I choose ASTM F1249 (modulated IR sensor) or ASTM F3299 (P_2O_5 sensor)?

When WVTR levels of your barrier materials are not within the ultra-low WVTR range, they can transmit significant moisture. In a P_2O_5 sensor, the measurement capacity of the sensor is consumed and the sensor is depleted as it is exposed to moisture. Thus, for moderate barriers, using an IR sensor is a better choice because it has a longer useful lifetime over the WVTR range of moderate barrier materials. The best feature of the IR sensor is its high accuracy and long sensor life. The modulated IR sensor can easily handle moderate to relatively high WVTR level, for a wide range of WVTR measurements from 0.005 to 1000 g/(m^2 · day).

ASTM F3299
WVTR TEST METHOD

AQUATRAN Model 3 WVTR Permeation Analyzer

Does F3299 replace F1249?

No. Each test method has their own ideal applications: ASTM F3299 is best for 10^{-5} to 10^{-3} g/(cm^2 · day) applications; ASTM F1249 is best for 10^{-3} to 10^{3} g/(cm^2 · day) applications.

In addition, the method description of the new ASTM F3299 corresponds directly to that of ISO 15106-3, so ASTM F3299 is not technically new to the market, just new to ASTM. In fact, the MOCON AQUATRAN series of WVTR testing instruments has complied with ISO 15106-3 since 2006. So, ASTM F3299 is simply another WVTR test method added to a group of established WVTR Test Methods including ISO 15106-3, ASTM F1249, ASTM E-398, etc.

What else should I consider when choosing between F1249 and F3299?

A few other considerations would be:

- Sensor cost effectiveness (sensor down time, sensor costs, etc.)
- Calibration frequency

Make sure to ask any instrument supplier to provide the following details about their specific sensor(s):

1. Useful lifetime
2. Calibration frequency
3. Replacement sensor costs
4. Change-out, calibration and setup time
5. Repeatability at the lower LOD (preferably by you supplying a sample film for testing). A good permeation instrument for your materials will have long uptime, and high repeatability at the lowest LOD.

F3299 is a new standard, and I have old instruments, what should I do?

There is no need to get new permeation instruments for F3299 if you're already using ASTM F1249. ASTM F1249 is still valid, and in fact best suited for 10^{-3} to 10^{3} g/(cm^2 · day) barrier materials. However, if you still have questions, please speak with one of our Permeation Specialists who can help guide you to the best instrument for your application.

On the next page is a summary comparing each test method by feature. This table highlights the major differences between the two standards.

COMPARISON SUMMARY OF ASTM F3299 VS. F1249

TECHNICAL NOTE

FEATURES	ASTM F3299	ASTM F1249
Sensor Type	Coulometric P_2O_5 Sensor	Modulated IR Sensor
Sensor Properties	Absolute, Linear	Not an absolute sensor
Calibration Frequency	Calibration is not needed	Needs calibration annually, at different WVTR levels
Lower WVTR Test Range	Down to 5 x 10^{-5} g/(m² · day)	Down to 0.005 g/(m² · day)
Upper WVTR Test Range	Up to 50 g/(m² · day)	Up to 1000 g/(m² · day)
Repeatability	± 0.00005 g/(m² · day) or 1%	± 0.005 g/(m² · day) or 1%
Moisture Specificity	Specific to moisture only	May see other substances if IR sensor is not correctly tuned to the H_2O IR wave length
Sensor Life	Consumable, P_2O_5 sensor life shorter than that of IR Sensor	Long sensor life: 4-5 years
Affects of temperature, pressure, flow and vibration on the sensor	Sensor performance not affected	Affected, need good control of temperature, pressure, flow and vibration
Associated Standard(s)	ISO 15106-3	ISO 15106-2

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