

On the Authority of Differential-pressure Method --Trace the Data of Equal-pressure Method in ASTM D 3985

Abstract: based on its introduction to the definition of traceability and the source of referential material in gas permeability testing methods, this article discusses the fundamental position of differential-pressure method in gas permeability testing. It points out that test data of equal-pressure method can be traced back to differential-pressure method.

Key words: standard material, traceability, differential-pressure method, equal-pressure method, calibration

In Equal-pressure method gas permeability test standard ASTM D3985, it is specified that calibrations should use referential material provided by NIST. However, many standard executors do not fully understand the material of such referential medium and the method to obtain its standard value. This article presents a detailed introduction to the traceability of referential material as well as the referential material adopted in ASTM equal-pressure method gas permeability test standards. It also analyzes the position of each test method in gas permeability test field.

1. About Traceability

The term traceability means that a measurement or the value of measured standard can link with primary standard of measuring through a continuous comparison chain with a defined uncertainty. With the peculiarity of traceability, all quantity values of the same kind are traceable to their source, or can be traced back to the same primary standard of measurement(national standard or international standard) once being calibrated in accordance with this comparison chain, which guarantees the accuracy and consistency technically. Otherwise, multiple sources will inevitably results in technical and management disorder.

The traceability concept of referential material highlights the meaning of 'well-established standard method' in determining measured value. In measured systems, the uncertainty of provided referential value can facilitate users understanding reliability transferred by standard material. As the value of standard material is set to directly establish standard value and this setting is the key of traceability of referential materials, the first thing to be considered in developing referential materials is to determine the way in which standard value is set. Generally, the commonly recognized method of that property will be adopted.

2. Referential Materials Adopted in Gas Permeability Testing of Equal-pressure Method

2.1 Referential Material Adopted in ASTM D 3985

in ASTM D 3985 , NIST referential material is mentioned for several times in ASTM D 3985 and is descried in the 'significance and use' item as below : The oxygen transmission rate of a standard reference material as determined manometrically by NIST, is in good agreement with the values obtained in the coulometric interlaboratory test using material from the same manufacturing lot. In the description part of JIS K 7126-1987 Testing Method for Gas Transmission Rate through Plastic Films and Sheetings, item eight contains such explanation. 'In ASTM D3985, SRM 1470 provided by NBS is recommended as standard referential material '. Therefore, it can be believed that SRM 1470, with its traceability provided by NBS, is what ASTM D 3985 used as standard material.

2.1 SRM 1470

SRM 1470: POLYESTER FILM FOR OXYGEN GAS TRANSMISSION MEASUREMENTS Issued by United States Department of Commerce/National Bureau of Standards, NBS SPECIAL PUBLICATION 260-58 presents detailed introduction to basic information of SRM 1470 as well as its application:

This SRM takes the form of 23 μ m thick sheets of poly (ethylene terephthalate) film.

The NBS computer-controlled manometric permeation measuring facility was employed for the collection of the data.

The permeance is a function of the following quantities which must be measured: **1. The rate of pressure rise 2. The downstream cell volume 3. The effective area of gas transmission 4. The inlet reservoir pressure** 5. The absolute temperature

This Standard Reference Material is intended for use in the measurement of the oxygen gas transmission rate of thin polymeric films using manometric, volumetric, or coulometric methods.

From these documents we can conclude that SRM 1470 is 23 μ m thick PET film. Its standard value is obtained through differential-pressure method and is used for manometric, volumetric, or coulometric methods to compare with standard value. According to the description of NIST, it can be obviously seen that test data of the material used for traceability is obtained with differential-pressure method.

One thing to be noted here is that NBS (National Bureau of Standards,) ,namely NIST (National Institute of Standards and Technology,) , is established in 1901 and change its name to NIST in 1988. The information of SRM 1470 is issued in 1979. That is why the name employed by SRM is still NBS.

3. Discuss the Position of Each Method from its Traceability of Standard Material

Among the standard materials adopted in gas permeability testing, SRM 1470 recommended by NIST is known to be the most widely used one. That is why the method in which standard value of SRM 1470 is obtained enjoys such a commonality. It is clearly stated in the description part of SRM 1470 that its standard value is obtained with differential-pressure method. Therefore, SRM 1470 can be more appropriate described as the standard material 'provide by NIST with its standard value traceable to differential- pressure method'

As is stated previously, in developing standard material, selecting the method to set standard value is the critical point of traceability. Generally, the authority method of that property will be selected. According to the method selection of SRM 1470 we can see that the fundamental position of differential-pressure method in gas permeability testing is unassailable.

In conclusion, differential-pressure method is the basic method in gas permeability testing. Equal-pressure method instruments can only use single data of standard material 'traceable to the standard value of differential-pressure method' to partly evaluate their data system.