

not more than 1 of the 10 test containers and exceeds 30 mg per day per L in none of them.

**Polypropylene Containers**— Fit the containers with impervious seals obtained by heat-sealing the bottles with an aluminum foil – polyethylene laminate or other suitable seal. Test the containers as described under *Multiple-Unit Containers for Capsules and Tablets*. The containers meet the requirements if the moisture permeability exceeds 15 mg per day per L in not more than 1 of the 10 test containers and exceeds 25 mg per day per L in none of them.

### Single-Unit Containers and Unit-Dose Containers for Capsules and Tablets

To permit an informed judgment regarding the suitability of the packaging for a particular type of product, the following procedure and classification scheme are provided for evaluating the moisture-permeation characteristics of single-unit and unit-dose containers. Inasmuch as equipment and operator performance may affect the moisture permeation of a container formed or closed, the moisture-permeation characteristics of the packaging system being utilized shall be determined.

**Desiccant**— Dry suitable desiccant pellets<sup>3</sup> at 110° for 1 hour prior to use. Use pellets weighing approximately 400 mg each and having a diameter of approximately 8 mm. [NOTE—If necessary due to limited unit-dose container size, pellets weighing less than 400 mg each and having a diameter of less than 8 mm may be used. ]

### Procedure—

**Method 1**— Seal not fewer than 10 unit-dose containers with 1 pellet in each, and seal 10 additional, empty unit-dose containers to provide the controls, using finger cots or padded forceps to handle the sealed containers. Number the containers, and record the individual weights<sup>4</sup> to the nearest mg. Weigh the controls as a unit, and divide the total weight by the number of controls to obtain the average. Store all of the containers at 75 ± 3% relative humidity and at a temperature of 23 ± 2°. [NOTE—A saturated system of 35 g of sodium chloride with each 100 mL of water placed in the bottom of a desiccator maintains the specified humidity. Other methods may be employed to maintain these conditions. ] After a 24-hour interval, and at each multiple thereof (see *Results*), remove the containers from the chamber, and allow them to equilibrate for 15 to 60 minutes in the weighing area. Again record the weight of the individual containers and the combined controls in the same manner. [NOTE—If any indicating pellets turn pink during this procedure, or if the pellet weight increase exceeds 10%, terminate the test, and regard only earlier determinations as valid. ] Return the containers to the humidity chamber. Calculate the rate of moisture permeation, in mg per day, of each container taken by the formula:

$$(1/N)[(W_F - W_I) - (C_F - C_I)]$$



in which  $N$  is the number of days expired in the test period (beginning after the initial 24-hour equilibration period);  $(W_F - W_I)$  is the difference, in mg, between the final and initial weights of each test container; and  $(C_F - C_I)$  is the difference, in mg, between the average final and average initial weights of the controls, the data being calculated to two significant figures. [NOTE—Where the permeations measured are less than 5 mg per day, and where the controls are observed to reach equilibrium within 7 days, the individual permeations may be determined more accurately by using the 7-day test container and control container weights as  $W_I$  and  $C_I$ , respectively, in the calculation. In this case, a suitable test interval for *Class A* (see *Results*) would be not less than 28 days following the initial 7-day equilibration period (a total of 35 days).]

**Method II**— Use this procedure for packs (e.g., punch-out cards) that incorporate a number of separately sealed unit-dose containers or blisters. Seal a sufficient number of packs, such that not fewer than 4 packs and a total of not fewer than 10 unit-dose containers or blisters filled with 1 pellet in each unit are tested. Seal a corresponding number of empty packs, each pack containing the same number of unit-dose containers or blisters as used in the test packs, to provide the controls. Store all of the containers at  $75 \pm 3\%$  relative humidity and at a temperature of  $23 \pm 2^\circ$ . [NOTE—A saturated system of 35 g of sodium chloride with each 100 mL of water placed in the bottom of a desiccator maintains the specified humidity. Other methods may be employed to maintain these conditions.] After 24 hours, and at each multiple thereof (see *Results*), remove the packs from the chamber, and allow them to equilibrate for about 45 minutes. Record the weights of the individual packs, and return them to the chamber. Weigh the control packs as a unit, and divide the total weight by the number of control packs to obtain the average empty pack weight. [NOTE—If any indicating pellets turn pink during the procedure, or if the average pellet weight increase in any pack exceeds 10%, terminate the test, and regard only earlier determinations as valid.] Calculate the average rate of moisture permeation, in mg per day, for each unit-dose container or blister in each pack taken by the formula:

$$(1/NX)[(W_F - W_I) - (C_F - C_I)]$$

in which  $N$  is the number of days expired in the test period (beginning after the initial 24-hour equilibration period);  $X$  is the number of separately sealed units per pack;  $(W_F - W_I)$  is the difference, in mg, between the final and initial weights of each test pack; and  $(C_F - C_I)$  is the difference, in mg, between the average final and average initial weights of the control packs, the rates being calculated to two significant figures.

**Results**— The individual unit-dose containers as tested in *Method I* are designated *Class A* if not more than 1 of 10 containers tested exceeds 0.5 mg per day in moisture permeation rate and none exceeds 1 mg per day; they are designated *Class B* if not more than 1 of 10 containers tested exceeds 5 mg per day and none exceeds 10 mg per day;

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they are designated *Class C* if not more than 1 of 10 containers tested exceeds 20 mg per day and none exceeds 40 mg per day; and they are designated *Class D* if the containers tested meet none of the moisture permeation rate requirements.

The packs as tested in *Method II* are designated *Class A* if no pack tested exceeds 0.5 mg per day in average blister moisture permeation rate; they are designated *Class B* if no pack tested exceeds 5 mg per day in average blister moisture permeation rate; they are designated *Class C* if no pack tested exceeds 20 mg per day in average blister moisture permeation rate; and they are designated *Class D* if the packs tested meet none of the above average blister moisture permeation rate requirements.

With the use of the *Desiccant* described herein, as stated for *Method I* and *Method II*, after every 24 hours, the test and control containers or packs are weighed; and suitable test intervals for the final weighings,  $W_F$  and  $C_F$ , are as follows: 24 hours for *Class D*; 48 hours for *Class C*; 7 days for *Class B*; and not less than 28 days for *Class A*.

### Multiple-Unit Containers and Unit-Dose Containers for Liquids

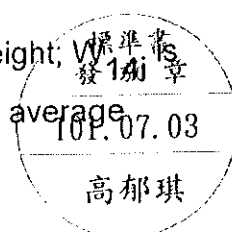
The standards and tests provided in this section measure the functional and performance characteristics of bottles used to package aqueous products by measuring the liquid water weight loss as a percent of the contents. This test can also be used to demonstrate performance or functional comparability. [NOTE—Throughout the following procedure, determine the weights of individual container - closure systems (bottle, innerseal if used, and closure) both as tare weights and fill weights, to the nearest 0.1 mg if the bottle capacity is less than 200 mL; to the nearest mg if the bottle capacity is 200 mL or more but less than 1000 mL; or to the nearest centigram (10 mg) if the bottle capacity is 1000 mL or more. ]

**Procedure**— Select 12 bottles of a uniform size and type, and clean the sealing surfaces with a lint-free cloth. Fit each bottle with a seal, closure liner (if applicable), and closure. Number each container - closure system, and record the tare weight.

Remove the closures and, using a pipet, fill 10 bottles with water to the fill capacity. Fill 2 containers with glass beads to the same approximate weight of the filled test containers. If using screw closures, apply a torque that is within the range specified in *Table 1*, and store the sealed containers at a temperature of  $25 \pm 2^\circ$  and a relative humidity of  $40 \pm 2\%$ . After  $336 \pm 1$  hours (14 days), record the weight of the individual containers, and calculate the water weight loss rate, in percent per year, for each bottle taken by the formula:

$$\frac{(W_{1i} - W_T) - (W_{14i} - W_T) - (WC_1 - WC_{14})}{(W_{1i} - W_T)} \times \frac{365}{14} = \text{Percent per year}$$

in which  $W_{1i}$  is the initial weight of each individual bottle (i);  $W_T$  is the tare weight;  $W_{14i}$  is the weight of each individual bottle (i) at 14 days; and  $(WC_1 - WC_{14})$  is the average



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weight change of the controls from initial to 14 days.

The containers so tested meet the requirements and are tight containers if the percentage of water weight loss does not exceed 2.5% per year in not more than 1 of the 10 test containers and does not exceeds 5.0% per year in none of them.

### LIGHT TRANSMISSION TEST

**Apparatus**<sup>5</sup>—Use a spectrophotometer of suitable sensitivity and accuracy, adapted for measuring the amount of light transmitted by either transparent or translucent glass or plastic materials used for pharmaceutical containers. In addition, the spectrophotometer is capable of measuring and recording light transmitted in diffused as well as parallel rays.

**Procedure**— Select sections to represent the average wall thickness. Cut circular sections from two or more areas of the container and trim them as necessary to give segments of a size convenient for mounting in the spectrophotometer. After cutting, wash and dry each specimen, taking care to avoid scratching the surfaces. If the specimen is too small to cover the opening in the specimen holder, mask the uncovered portion of the opening with opaque paper or masking tape, provided that the length of the specimen is greater than that of the slit in the spectrophotometer. Immediately before mounting in the specimen holder, wipe the specimen with lens tissue. Mount the specimen with the aid of a tacky wax, or by other convenient means, taking care to avoid leaving fingerprints or other marks on the surfaces through which light must pass. Place the section in the spectrophotometer with its cylindrical axis parallel to the plane of the slit and approximately centered with respect to the slit. When properly placed, the light beam is normal to the surface of the section and reflection losses are at a minimum. Continuously measure the transmittance of the section with reference to air in the spectral region of interest with a recording instrument or at intervals of about 20 nm with a manual instrument, in the region of 290 to 450 nm.

**Limits**— The observed light transmission does not exceed the limits given in *Table 2* for containers intended for parenteral use.

**Table 2. Limits for Plastic Classes I – VI and  
Glass Types I, II, and III**

	Maximum Percentage of Light Transmission at Any Wavelength between 290 and 450 nm	
Nominal Size (in mL)	Flame-sealed Containers	Closure-sealed Containers
1	50	25
2	45	20
5	40	15



10	35	13
20	30	12
50	15	10

[NOTE—Any container of a size intermediate to those listed above exhibits a transmission not greater than that of the next larger size container listed in the table. For containers larger than 50 mL, the limits for 50 mL apply.]

The observed light transmission for plastic containers for products intended for oral or topical administration does not exceed 10% at any wavelength in the range from 290 to 450 nm.

<sup>1</sup> Suitable 4- to 8-mesh, anhydrous calcium chloride is available commercially as Item JT1313-1 from VWR International. Consult the VWR International catalog for ordering information or call 1-800-234-9300.

<sup>2</sup> A suitable laminate for sealing has, as the container layer, polyethylene of not less than 0.025 mm (0.001 inch) and a second layer of aluminum foil of not less than 0.018 mm (0.0007 inch), with additional layers of suitable backing materials. A suitable seal can be obtained also by using glass plates and a sealing wax consisting of 60% of refined amorphous wax and 40% of refined crystalline paraffin wax.

<sup>3</sup> Suitable moisture-indicating desiccant pellets are available commercially from sources such as Medical Packaging, Inc., 470 Route 31, Ringoes, NJ 08551-1409 [Telephone 800-257-5282; in NJ, 609-466-8991; FAX 609-466-3775], as Indicating Desiccant Pellets, Item No. TK-1002.

<sup>4</sup> Accurate comparisons of Class A containers may require test periods in excess of 28 days if weighings are performed on a Class A prescription balance (see *Prescription Balances and Volumetric Apparatus* (1176)). The use of an analytical balance on which weights can be recorded to 4 or 5 decimal places may permit more precise characterization between containers and/or shorter test periods.

<sup>5</sup> For further detail regarding apparatus and procedures, reference may be made to the following publications of the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959: "Standard Method of Test for Haze and Luminous Transmittance of Transparent Plastics," ASTM Method D1003-07; "Tentative Method of Test for Luminous Reflectance, Transmittance and Color of System" ASTM Method E308-06.

**Auxiliary Information**— Please check for your question in the FAQs before contacting USP.

Topic/Question	Contact	Expert Committee
General Chapter	Desmond G. Hunt, Ph.D. Senior Scientific Liaison 1-301-816-8341	(GCPS2010) General Chapters - Packaging Storage and Distribution

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