International Standard 7459

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Glass containers — Thermal shock resistance and thermal shock endurance — Test methods

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

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Glass containers — Thermal shock resistance and thermal shock endurance — Test methods

1 Scope

This International Standard specifies test methods for determining the thermal shock resistance and thermal shock endurance of glass containers.

2 Field of application

This International Standard applies to containers made from soda-lime-silica glass.

This International Standard does not apply to the determination of those properties of laboratory glassware not made from soda-lime-silica glass nor items of laboratory glassware which are not containers (see ISO 718).

3 Reference

ISO 718, *Laboratory glassware — Methods for thermal shock tests.*

4 Definitions

For the purpose of this International Standard, the following definitions apply.

4.1 soda-lime-silica glass: Glass in which the major constituents, silica, soda and lime, form about 96 % of the composition.

4.2 container: A general term applied to glass bottles and jars.

4.3 thermal shock: A sudden change in temperature applied to containers.

4.4 thermal shock resistance: The actual temperature change, or thermal shock, measured in degrees Celsius, which a container can withstand without breaking.

4.5 thermal shock endurance: An interpolated thermal shock resistance value at which 50 % of the containers will probably fail.

5 Apparatus

5.1 Cold water bath, comprising a bath or tank capable of containing at least 8 l of water for each kilogram of glass tested at one time. It shall be fitted with a water circulator, a thermometer and a thermostatic control capable of maintaining the water temperature to within ± 1 °C of a specified lower temperature, t_2, within the range of 22 ± 5 °C. (See note to 8.3.)

5.2 Hot water bath, comprising a bath or tank capable of containing at least 8 l of water for each kilogram of glass being tested at one time. It shall be fitted with a water circulator, a thermometer and a thermostatically controlled heater capable of maintaining the water temperature to within ± 1 °C of a specified upper temperature, t_1.

5.3 Basket, made out of or coated with an inert material which will not scratch or scuff the containers. The basket shall be capable of holding the containers upright and separate, and shall be fitted with a perforated lid to prevent the containers from floating when immersed. For the multiple testing of containers, it may be combined with an automatic device for immersing the basket of containers in the hot bath (5.2) and transferring it to the cold bath (5.1).

6 Sampling

The test shall be performed on a predetermined number of containers.

The containers used for the test shall not have been subjected to any other mechanical or thermal test procedure which could adversely affect their thermal shock resistance.

The samples shall be selected to provide the information which is required from the particular test.

7 Procedure

7.1 Allow the containers to reach ambient temperature and, throughout the test, the apparatus shall be protected from draughts.

7.2 Fill the cold bath (5.1) with water to a volume equal to at least 8 l for each kilogram of glass to be tested and to a depth sufficient for complete immersion of the containers plus at least 50 mm. Adjust the water temperature to within ± 1 °C of the specified lower temperature, t_2.

7.3 Fill the hot bath (5.2) with at least the same volume of water as in 7.2, then heat and maintain the temperature to within ± 1°C of the specified upper temperature, t_1.

7.4 Place the empty containers in the basket (5.3) so that they are held upright and separate, then fasten the lid and immerse the basket in the hot bath, until the containers are completely filled with water and the tops of their finishes are at least 50 mm below the water level. If necessary, adjust the heat control to maintain the bath temperature to within ± 1 °C of the specified upper temperature, t_1, and keep the containers immersed at this temperature for 5 min.

7.5 Transfer the basket with the filled containers, either mechanically or manually, within 15 ± 1 s, from the hot bath to the cold bath so that the containers are completely immersed. Keep the containers immersed for 30 s, then remove the basket and its contents from the cold bath.

7.6 Determine as soon as possible the number of containers which have failed the test, by inspecting each one for cracks or breakage.

8 Thermal shock resistance

8.1 Pass test

A sample shall be deemed to have passed the test if no more than the agreed number are cracked or broken, after being subjected to an agreed thermal shock of $t_1 - t_2$.

8.2 Progressive test to a specified percentage of breakages

Containers which pass the test shall be repeatedly tested, as described in clause 7, but with increasing $t_1 - t_2$ values, until a specified percentage of the containers fail the test.

NOTE — Normally, the difference between t_2 and t_1 is increased in 5 °C increments.

8.3 Total progressive test

Containers which pass the test, described in clause 7, shall be tested in accordance with 8.2, until all the containers fail the test.

NOTE — If the test has not been concluded by the time the temperature of the hot water bath reaches 95 °C, the test should be continued by lowering the temperature of the cold water bath.

8.4 High-level test

Containers shall be tested in accordance with clause 7, but at a temperature difference, $t_1 - t_2$, sufficiently high to cause an agreed percentage to fail in a single test.

9 Thermal shock endurance

The containers shall be tested in accordance with the total progressive test, described in 8.3, and the number of failures at each temperature difference shall be recorded.

The thermal endurance, which is the probable temperature difference at which 50 % of the containers would have failed, is determined from a graph of the cumulative percentage of failures against the temperature difference at which the containers failed.

10 Test report

The test report shall include the following:

a) the reference of this International Standard;

b) the number of containers in the sample tested and sampling method;

c) the temperature of the cold bath;

d) the test results:

1) for the pass test, in accordance with 8.1:

— the temperature difference, $t_1 - t_2$,

— the number of containers which failed the test,

— the specification limit and whether the samples passed the test;

2) for the progressive test, in accordance with 8.2:

— the highest temperature difference, $t_1 - t_2$, at which no failure occurred,

— the number of containers which failed at each temperature difference,

— the temperature difference needed to achieve the predetermined percentage of failures, expressed to the nearest increment step;

3) for the total progressive test, in accordance with 8.3:

— the temperature differences used in the test,

— the number of containers which failed at each temperature difference,

— the mean temperature difference of the failure;

4) for the high-level test, in accordance with 8.4:

— the temperature difference used in the test,

— the percentage of containers which failed at that temperature difference;

5) for the thermal shock endurance test, in accordance with clause 9:

— the temperature difference at which 50 % of the sample would have failed.