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**Vitreous and porcelain enamels —  
Enamelled cooking utensils —  
Determination of resistance to thermal  
shock**

*Émaux vitrifiés — Ustensiles de cuisson émaillés — Détermination de la  
résistance aux chocs thermiques*



## Foreword

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International Standard ISO 2747 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 6, *Vitreous and porcelain enamels*.

This second edition cancels and replaces the first edition (ISO 2747:1973), which has been technically revised.

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# Vitreous and porcelain enamels — Enamelled cooking utensils — Determination of resistance to thermal shock

## 1 Scope

This International Standard specifies a method of determining, by successive thermal shock tests, the behaviour of vitreous and porcelain enamelled cooking utensils and similar articles under sudden changes of temperature (resistance to thermal shock).

## 2 Definitions

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

**2.1 thermal shock test:** Series of operations commencing with the pouring of cold water into the heated test specimen and ending when the thermal shock temperature for the subsequent thermal shock test has been reached.

**2.2 thermal shock temperature:** Temperature to which the test specimen is heated before being chilled with cold water.

**2.3 thermal shock resistance:** Difference between the thermal shock temperature and the water temperature at which the test specimen shows the first damage on chilling or during subsequent heating.

**2.4 damage:** Chipping or tension cracks in the enamel visible at a distance of 250 mm by normal sight or made visible by using coloured penetrating fluids.

## 3 Principle

A series of single thermal shock tests is conducted with a temperature increase of 20 °C between each thermal shock obtained by heating the test specimen from the outside and then chilling it inside with water at 20 °C.

For the first test, the thermal shock temperature amounts to 200 °C. The test ends when the first visible damage occurs.

## 4 Apparatus

**4.1 Electric hot-plate**, capable of being continuously temperature controlled, and of diameter and maximum output as given in table 1.

**Table 1 - Hot-plates to be used to heat specimens**

| Internal diameter<br>of specimen<br><br>mm | Hot-plate      |                     |
|--------------------------------------------|----------------|---------------------|
|                                            | Diameter<br>mm | Maximum output<br>W |
| Up to 180                                  | 145            | 1 000 ± 100         |
| Over 180 and up to 220                     | 180            | 1 500 ± 150         |
| Over 220                                   | 220            | 2 000 ± 200         |

For testing specimens with an uneven base, the hot-plate shall be surmounted by a ring filled with copper grit of grain size 0,100 mm to 0,125 mm.

**4.2 Temperature measuring device**, quickly indicating, accurate to 2 °C.

**4.3 Thermometer** for measuring the temperature of the water.

**4.4 Chamois leather, paper towel or laboratory tissue.**

**4.5 Water receptacle.**

**4.6 Stop-watch.**

## 5 Test specimens and sampling

**5.1** Use the utensils to be tested as test specimens without any modification.

**5.2** The test specimens shall be representative of the entire consignment. The sampling plan shall be agreed upon between the interested parties.

**5.3** At least three test specimens shall be tested.

## 6 Procedure

### 6.1 General specifications

NOTE — Annex A outlines the reasons underlying the selection of the test conditions specified in this International Standard.

For each thermal shock test, fill the test specimens with water at a temperature of 20 °C ± 1 °C, to a depth of 30 mm if possible. If it is not possible to fill the specimens to a depth of 30 mm, report the actual depth in the test report. Ensure that more water is available at 20 °C ± 1 °C (see 6.2.1).

Heat the test specimens using the preheated electric hot-plate (4.1), operated at its maximum output. Ensure that the maximum output is such that the test temperature is achieved no earlier than 5 min after commencement of heating.

Measure the temperature inside at the base of the test specimen at a distance of a quarter of the internal diameter from the side of the test specimen.

## 6.2 First thermal shock test

**6.2.1** When a temperature of  $200\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  (the thermal shock temperature) is reached, fill the test specimen to a depth of 30 mm with the water at  $20\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$  in one pouring. After  $5\text{ s} \pm 1\text{ s}$  remove the test specimen from the hot-plate, fill it completely with water at a temperature of  $20\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$  and cool rapidly by placing it in water also at a temperature of  $20\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ . When the test specimen reaches room temperature ( $23\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ ) pour out the water, dry the test specimen with the chamois leather, the paper towel or the laboratory tissue (4.4) and examine it for damage (2.4).

**6.2.2** If there is no damage, heat the test specimen to  $220\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  (the thermal shock temperature of the second thermal shock test).

If damage occurs during heating, the test is finished. In this case, take the temperature of  $200\text{ }^{\circ}\text{C}$  as the thermal shock temperature. For testing further test specimens, choose a temperature lower than  $200\text{ }^{\circ}\text{C}$  for the first test and state this in the test report.

## 6.3 Second and further tests

**6.3.1** If the test specimen comes through the first test undamaged, repeat the test at a temperature of  $220\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ . Carry out the second test as described in 6.2.1. The temperature shall be now  $240\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  when heating up according to 6.2.2. If any damage occurs, the test is finished and the thermal shock temperature is then taken as being  $220\text{ }^{\circ}\text{C}$ .

**6.3.2** If no damage occurs, carry out further tests as described with a temperature increase of  $20\text{ }^{\circ}\text{C}$  between successive tests until damage occurs.

## 7 Expression of results

### 7.1 Average thermal shock temperature

Calculate the arithmetic average thermal shock temperature from the thermal shock temperatures of the individual test specimens at which the first damage is observed.

If one of the individual values of three tests differs by more than  $50\text{ }^{\circ}\text{C}$  from the average thermal shock temperature, conduct two further tests. Then calculate the arithmetic average of the five values.

### 7.2 Average thermal shock resistance

Calculate the average thermal shock resistance by subtracting the water temperature ( $20\text{ }^{\circ}\text{C}$ ) from the average thermal shock temperature calculated in accordance with 7.1.

## 8 Test report

The test report shall include the following information:

- a) reference to this International Standard, i. e. "determined in accordance with ISO 2747 : 1998";
- b) a description of the test specimen (shape, internal diameter, thickness of enamel, volume, mass, labelling);
- c) the sampling plan used;
- d) the number of test specimens tested;
- e) the diameter and maximum output of the hot-plate and whether a surmounting ring was used;
- f) the thermal shock temperature at which the enamel first showed damage (individual and average values);
- g) the average thermal shock resistance;
- h) the type of damage to the enamel and, if necessary, a photograph of the damage;
- i) the depth of water used for thermal shock if it was not possible to fill the test specimen to a depth of 30 mm.

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