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ISO RECOMMENDATION
R 175

PLASTICS

DETERMINATION OF THE RESISTANCE OF PLASTICS TO CHEMICAL SUBSTANCES

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BRIEF HISTORY

The ISO Recommendation R 175, *Determination of the Resistance of Plastics to Chemical Substances*, was drawn up by Technical Committee ISO/TC 61, *Plastics*, the Secretariat of which is held by the American Standards Association, Incorporated (ASA).

Work on this matter which the Technical Committee had begun since 1954, came to an end in 1956, with the adoption of a proposal as a Draft ISO Recommendation.

On 28 November 1958, the Draft ISO Recommendation (No. 190) was distributed to all the ISO Member Bodies and was approved, subject to some editorial amendments, by the following Member Bodies:

Australia	Israel	Sweden
Bulgaria	Italy	Switzerland
Burma	Japan	Turkey
Czechoslovakia	Netherlands	United Kingdom
France	Poland	U.S.A.
Germany	Portugal	U.S.S.R.
Hungary	Romania	
India	Spain	

Two Member Bodies opposed the approval of the Draft:
Austria, Belgium.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in February 1961, to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 175 February 1961

PLASTICS

DETERMINATION OF THE RESISTANCE OF PLASTICS TO CHEMICAL SUBSTANCES

1. SCOPE

1.1 This ISO Recommendation describes the procedure for measuring the change of weight and dimensions of plastics after immersion in chemical substances.

This method of test is intended for the testing of all organic plastics materials, such as cast, extruded, calendered, moulded, laminated products, both flexible and rigid, sheet, rod and tube materials with thickness not less than 0.1 mm.

1.2 This method is suitable, in particular, for the determination of the loss of plasticizers and other extractable components from plastics, after immersion in volatile chemicals.

2. SIGNIFICANCE OF TEST

2.1 This is an empirical test method, only suitable for the comparison of different plastics after immersion in chemical substances, in liquid form or in solution.

2.2 The choice of the reagents, of the temperature and of the duration of tests is necessarily arbitrary; the list of reagents reported below should serve primarily as a guide to investigators wishing to compare the relative resistance to chemicals of various plastics and to have a first assessment of their behaviour in respect of certain groups of chemical substances.

2.3 In order to have a more accurate knowledge about the behaviour of a particular plastic material in a practical application, it will be necessary to fit to this special need the particular reagents and concentrations employed, the duration and the temperature of the test and any other experimental factor.

3. APPARATUS

The apparatus consists of the following:

3.1 *Balance*, to weigh to 1 mg. A balance to weigh to 0.1 mg, for weighing specimens of less than 1 g.

3.2 *Micrometers*, for measuring to 0.01 mm.

3.3 *Containers*. Jars or beakers; the dimensions should be proportionate to the specimens; one container should be provided for each specimen.

4. TEST SPECIMENS

Test specimens, according to the material from which they will be obtained, should have following forms and dimensions:

4.1 *From moulding materials.* The specimen should be in the form of a disk, 50 ± 1 mm in diameter and 3 ± 0.2 mm in thickness and should be moulded to shape under the conditions recommended by the manufacturer of the material (or under the conditions given in the relevant specification for the material).

4.2 *From extrusion compounds.* The specimen should be in the form of a disk, 50 ± 1 mm in diameter and 3 ± 0.2 mm in thickness and should be cut from a moulded sheet prepared under the conditions recommended by the manufacturer (or under the conditions given in the relevant specification for the material).

4.3 *From sheets.* The specimen should be cut from the sheet in the form of a square of side 50 ± 1 mm, its thickness being the thickness of the sheet. The cut edges should be smoothed.

4.4 *From rods.* The specimen should be 50 ± 1 mm long for rods up to a maximum linear dimension of the cross section of 50 mm. For larger rods, a specimen should be machined, which does not exceed the dimension of 50 mm in any direction. Cut surfaces should be smooth.

4.5 *From tubes.* The specimen should be 50 ± 1 mm long for tubes up to a maximum linear dimension of the cross section of 50 mm. For larger tubes, a specimen 50 ± 1 mm long and 50 ± 1 mm wide should be cut from the wall of the tube; if the wall thickness exceeds 50 mm, it should be reduced to approximately 50 mm.

Comparison of values is possible, however, only when test specimens of identical dimensions are used.

5. CONDITIONING

The test specimens should be conditioned according to the relevant ISO Recommendation *.

6. PROCEDURE

6.1 At least two specimens of each kind of material should be tested. Each specimen should be weighed, after conditioning, to the nearest 0.001 g. The thickness of each specimen at the center and the linear dimensions (length and width or two diameters at right angle) should be measured to the nearest 0.01 mm.

6.2 Place each specimen in a separate container, totally immersed in the reagent (in such a position that it will be completely surrounded by the liquid).

Rigid specimens may be placed on edge, so that they are supported at an angle by the bottom and side wall of the container. Nonrigid specimens, such as plasticized vinyl films and the like, shall be suspended freely in the liquid, in a vertical position; in some cases, it may be necessary to attach to them small weights, if the density of the liquid is high.

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* The ISO Recommendation relating to standard atmospheres for conditioning and testing plastics materials is being prepared.

6.3 The amount of reagents used should be proportionate to the container and to the specimen. In the case of nonextractable materials, a quantity of liquid equal to 60 to 100 cm^3 may be sufficient. In the cases where an extraction of plasticizers or other soluble matter takes place, the quantity of liquid should be approximately 8 cm^3 per square centimeter of surface of the test specimen, counting the area of both sides of the specimen and of its edges; for standard specimens, a quantity of liquid of at least 400 cm^3 is suggested, in order to avoid too great an increase in concentration of the extracted material in the chemical itself during the test.

6.4 Cover the containers and keep at test temperature for the specified time. Care should be taken to ensure that liquids are at the specified temperature before the immersion of the specimens. The test temperature is chosen from the Standard Laboratory Atmospheres, unless otherwise agreed.

6.5 The standard duration of the test is of seven days. For extraction tests of thin sheets a shorter duration is recommended.

NOTES

1. In many cases, additional information may be gained by weighing and measuring after several successive intervals of time.

   The test liquids should be stirred, for instance, by slow rotation of the containers, at least every 24 hours.

   The specimens should be removed from the liquids and quickly rinsed in running water or other suitable liquid, wiped with a dry cloth or absorbent tissue and weighed immediately in a weighing bottle. The dimensions should be remeasured at the same places on the specimen.

2. Specimens tested in acids, alkalis or any aqueous solution should be quickly rinsed with water; specimens tested in nonvolatile, nonwatersoluble organic liquids should be rinsed with a nonaggressive, but volatile solvent, such as ligroin; specimens tested in volatile solvents like acetone, alcohol, etc., need no rinsing.

   In cases where it is required to determine the extraction of plasticizers or other components by volatile solvents, the specimens must be dried, reconditioned and weighed again, since the removal of soluble matter is often balanced by the absorption of the reagent.

   Drying and reconditioning should be sufficient for the complete removal of the test solvent or reagent and for the reestablishment, in the specimen, of the initial humidity conditions.

   Drying is generally carried out in oven at a higher temperature than ambient temperature.

   However, temperature and duration of drying should be indicated for each individual case.

3. If it is suspected that the above indicated drying conditions tend to remove any volatile original constituent from the test specimen, a control sample should be dried at the same time and under the same conditions as the test specimen.

7. REAGENTS

A list of chemical reagents is proposed, including the most representative in the main categories of pure chemical compounds and of industrial products.

The products indicated are intended " technically pure "; the concentrations of the solutions are in mass.

Chemical products technically pure

Products	Concentration per cent	Products	Concentration per cent
Sulphuric acid	3	Sodium carbonate	2
Sulphuric acid	30	Sodium carbonate	20
Concentrated sulphuric acid ρ* 1.84		Ammonium hydroxide	10
Nitric acid	10	Ammonium hydroxide ρ* 0.90	
Nitric acid	40	Hydrogen peroxide	3 (12 vol.)
Nitric acid ρ* 1.41		Hydrogen peroxide	30 (120 vol.)
Hydrochloric acid	10	Acetone	100
Hydrochloric acid ρ* 1.19		Diethyl ether	100
Chromic acid	40	Ethyl acetate	100
Hydrofluoric acid	40	Ethanol	50
Acetic acid	5	Ethanol	96
Acetic acid	100	Methanol	100
Citric acid	10	Ethylene dichloride	100
Oleic acid	100	Carbon tetrachloride	100
Sodium hydroxide	1	Heptane b.p.** 90 to 100 °C	100
Sodium hydroxide	10	Benzene	100
Sodium hydroxide	60	Toluene	100
Sodium chloride	10	Phenol	5
Sodium hypochlorite	10	Aniline	100

* ρ = density.

** b.p. = boiling point.

Various industrial products

Mineral oil (heavy grade) density: 0.875 - 0.905
Transformer oil
Olive oil (edible)
Cottonseed oil (edible)
Kerosene
Gasoline
Gasoline with a given content of aromatics
Soap solution (1%) (dehydrated pure white soap flakes)
Solution of one or more tensio-active products
Turpentine

NOTE. Specific grade or composition as agreed upon between vendor and purchaser.