INTERNATIONAL STANDARD

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Plastics — Determination of the effects of exposure to damp heat, water spray and salt mist

Plastiques — Détermination des effets d'une exposition à la chaleur humide, au brouillard d'eau et au brouillard salin

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4611 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 6, *Ageing, chemical and environmental resistance*.

This third edition cancels and replaces the second edition (ISO 4611:1987), of which it constitutes a minor revision, the main purpose of which was to update the normative references.

0 Introduction

0.1 Various test methods are available for the exposure of plastics to different aggressive agents acting in a combined and simultaneous fashion, such as natural weathering. Other test methods are available for the purpose of a separate evaluation of the action of individual aggressive agents. Among the latter there are, for example, tests for the resistance to specific chemicals and to radiation in a definite spectral range.

For some applications, it may be desirable to evaluate the behaviour of the materials in a hot damp atmosphere just below the saturation limit of water vapour, as well as in the presence of the liquid phase.

In these conditions, not only water absorption or leaching of some ingredients of the composition may be observed but also degradation phenomena due to hydrolysis, exudation of plasticizers, etc.

It may also be desirable sometimes to evaluate the behaviour of materials in the presence of a highly corrosive electrolyte, such as a sodium chloride solution (salt mist), which is the principal aggressive agent present in marine environments and of particular importance in the case of nautical applications. It is well known that sodium chloride has no noticeable action on the polymers that are the basic components of plastics, and that salt solutions, owing to their higher osmotic pressure, are normally absorbed by plastics to a lesser degree than pure water, but it cannot be assumed *a priori* that they have no action on composite materials, containing fillers, reinforcing components or pigments, for instance.

Furthermore, the evaluation of the effect of salt mist can be very important for finished or semi-finished articles which, while basically consisting of plastics materials, do contain some metallic elements, such as moulded-in inserts, thin laminated foils, surface coatings applied by electro-plating or other procedures, or, lastly, metal cores sheathed with plastics by extrusion or by dipping in pastes or fluidized-bed powders.

0.2 Methods and equipment for obtaining reproducible aggressive environments of the above types are well known and have been described by International Standards relevant to other materials and IEC (International Electrotechnical Commission) standards relevant to electrical and electronic components. The same equipment and procedures described in these standards can also be employed for plastics, with appropriate care and adjustments.

0.3 The present International Standard is intended to provide general guidance only, on the choice of suitable equipment and procedures for obtaining the exposure conditions described above and for the preparation of test specimens. It also only gives general guidance on the properties to be evaluated. Specific details are given in the various ISO and IEC publications.

For the expression of results, the present International Standard follows, as far as possible, the same criteria adopted in the existing test methods for the exposure to chemicals (see ISO 175) and to natural weathering or artificial light (see ISO 4582).

0.4 These tests are intended to yield data about the effects of the described exposures on the materials; however, a direct correlation between the experimental results and the behaviour in service is not to be inferred.

Plastics — Determination of the effects of exposure to damp heat, water spray and salt mist

1 Scope

1.1 This International Standard specifies the conditions of exposure of plastics to

— damp heat;

— water spray;

— salt mist;

and the methods for the evaluation of the change in some significant characteristics after given exposure stages.

1.2 This International Standard is, in general, suitable for all plastics in the form of standard test specimens, and finished articles or parts thereof.

1.3 This International Standard considers separately methods for the determination of

— change in mass;

— change in dimensions and appearance;

— change in physical properties.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

IEC 60068-2-30, *Environmental testing — Part 2-30: Tests — Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-78, *Environmental testing — Part 2-78: Tests — Test Cab: Damp heat, steady state*

3 Principle

One or more properties are determined before and after given periods of exposure in the specified environmental conditions, and any change in appearance is observed. If required, the determination of one or more properties may be carried out after exposure and a subsequent drying treatment or a reconditioning treatment carried out with the aim of obtaining the same state of equilibrium with atmospheric humidity as that of the initial specimens.

4 General test conditions

4.1 Environmental conditions and equipment

NOTE Annex E of ISO 9142:2003 describes test conditions similar to those used in this International Standard.

4.1.1 Damp heat

4.1.1.1 General

The preferred test conditions are those described by the IEC publications referred to in 4.1.1.2 and 4.1.1.3. Different temperature and/or humidity conditions may be specified, however, in the relevant product specifications or by agreement between the interested parties.

4.1.1.2 Steady-state test

A suitable test method is specified in IEC 60068-2-78.

The following conditions are specified:

Temperature: (40 ± 2) °C

Relative humidity: (93 ± 3) %

4.1.1.3 Cyclic test

If a cyclic test is required, the conditions specified in IEC 60068-2-30 can be adopted.

This IEC publication specifies 12 h + 12 h cycles with temperature change from

(25 ± 3) °C

to

a) (40 ± 2) °C

b) (55 ± 2) °C

Relative humidity is maintained at (93 ± 3) % at the higher temperature and not less than 95 % during the rest of the cycle.

NOTE For composite temperature/humidity cycles, with the addition of a number of excursions to sub-zero temperatures, some guidance can be found in IEC 60068-2-38.

4.1.2 Water spray

The main difference between this exposure condition and that for damp heat/steady state (see 4.1.1) is the constant presence of the liquid phase, in the form of small water droplets.

Suitable equipment for obtaining these conditions is substantially identical to that for the salt mist exposure (see 4.1.3) and is described in the relevant specifications.

Distilled or deionized water, having a pH between 6 and 7, shall be used instead of the salt solution.

The temperature in the test enclosure shall be (40 ± 2) °C.

4.1.3 Salt mist

Suitable equipment and procedure for the exposure to salt mist (or salt spray) are described in ISO 9227.

The general operating conditions are as follows:

Temperature inside the cabinet	(35 ± 2) °C
Sodium chloride solution:	
— concentration	(50 ± 5) g/l
— pH	6,5 to 7,2

The solution is prepared by dissolving sodium chloride of recognized analytical grade in distilled or deionized water. The purity requirements are specified in ISO 9227.

Quantity of “mist” collected over a period of 24 h on a horizontal collecting area of 8 000 mm^2	1 ml/h to 2 ml/h

These conditions also comply with IEC 60068-2-11.

NOTE In this test, the 35 °C temperature value has been retained, even though this value is not included among those recommended in ISO 3205, because it is specified in the ISO 9227 test referred to and by the majority of existing national standards.

4.2 Duration of tests

The test duration shall be as specified in the relevant standard or as agreed upon by the interested parties, with reference to the intended application.

It is recommended that the time periods be chosen from the following standard scale:

24 h, 48 h, 96 h, 144 h, 168 h

and, for long periods:

1 week, 2 weeks, 4 weeks, 8 weeks, 16 weeks, 26 weeks, 52 weeks, 78 weeks.

4.3 Test specimens

See 5.2, 6.2 and 7.2.

4.4 Conditioning

Unless otherwise agreed by the interested parties, the test specimens shall be conditioned before testing for at least 86 h at (23 ± 2) °C and (50 ± 5) % r.h.

NOTE For certain materials which are known to approach rapidly, or on the contrary very slowly, the state of equilibrium of temperature and, above all, of humidity, shorter or longer conditioning periods may be specified in the particular specifications concerning them (see Annex A).