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Reinforcement products — Determination of moisture content

Produits de renfort — Détermination du taux d'humidité

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Foreword

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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.

International Standard ISO 3344 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 13, *Composites and reinforcement fibres*.

This second edition cancels and replaces the first edition (ISO 3344:1977), which has been technically revised.

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Reinforcement products — Determination of moisture content

1 Scope

This International Standard specifies a method for the determination of the moisture content of reinforcement products, such as continuous-filament yarn, staple-fibre yarn, rovings, chopped strands, mats, fabrics and other forms of reinforcement made from textile glass, carbon or aramid fibres.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 291:—[1], *Plastics — Standard atmospheres for conditioning and testing.*

3 Definition

For the purposes of this International Standard, the following definition applies:

3.1 moisture content: The mass of water contained in a product, determined by a specified method and expressed as a percentage of the mass of the moist product.

4 Principle

A test specimen is weighed at ambient temperature, before and after drying at a temperature of 105 °C.

5 Apparatus

5.1 Forced-circulation oven, with an air-change rate of 20 to 50 times per hour and capable of maintaining a temperature of 105 °C ± 3 °C or the chosen temperature to within ± 3 °C (see clause 4).

5.2 Desiccator, containing a suitable drying agent (for example silica gel, calcium chloride or phosphorus pentoxide).

5.3 Specimen holder, made of heat-resistant material, allowing the maximum air flow round the specimen and from which there is no loss of material. This may be a porcelain crucible, an unoxidisable metal wire basket, etc.

NOTE — One holder may be used to hold several specimens if they can be transferred from the holder to the oven without loss of material.

1) To be published. (Revision of ISO 291:1977)

5.4 Stainless-steel tweezers, for handling the specimen and specimen holder.

5.5 Balance, accurate to 0,1 mg.

5.6 Polished metal template and **suitable cutting tool**, e.g. a knife, scissors or a rotary cutting disc (for fabrics and mats).

These two items may be replaced by a punch.

5.7 Stoppered weighing bottle, for weighing aramid yarn and when the specimen is expected to have a moisture content higher than 0,2 % (for example, specimens taken from the centre of a package or wet chopped strands).

6 Selection and number of test specimens

6.1 Selection of specimens

Unless indicated otherwise in the product specification or by the person requesting the determination, take the specimens as described below:

6.1.1 Continuous-filament yarn, spun yarn, rovings

The way in which the test specimens are taken is intended to enable the moisture content in the surface layers of the wound package to be checked.

Unwind and discard the outer layers, then, for each specimen, take a length of the wound package with a mass of at least 5 g, but preferably between 15 g and 30 g.

In cases when the moisture content of the wound package is liable to increase towards the centre, the product specification, or the person requesting the determination, may stipulate that the determination be carried out on one or more specimens taken at one or more specified locations within the package. Care should be taken to avoid injury when cutting into a package in order to reach the specimen position at the centre. Weigh specimens taken in this way as quickly as possible. For this purpose, the specimen may be placed in a previously weighed weighing bottle (5.7).

6.1.2 Chopped strands and milled fibres

Each specimen shall have a mass of at least 5 g, but preferably between 15 g and 30 g.

6.1.3 Woven fabrics

Take a piece of fabric of sufficient size to allow specimens of area 100 cm^2 to be obtained. If the mass of the specimen is less than 5 g, either take larger specimens or use several adjacent 100 cm^2 specimens.

Specimens may have the same dimensions as those used for the determination of the mass per unit area.

Do not take specimens at a distance of less than 10 mm from the edges or selvedges of the fabric. If the specimen has to be folded, this shall not impede good air circulation round the whole specimen. It is recommended that specimens be cut out using a template and cutting tool, or with a punch (see 5.6), so as to avoid losing material.

6.1.4 Mats

The recommended specimen shape is that specified for the determination of the mass per unit area, i.e. a square cut out using a template of side 316 mm $\pm$ 1 mm. Other specimen shapes may be stipulated in the product specification or by the person requesting the determination.

6.2 Number of specimens

Unless indicated otherwise, the number of specimens taken from each elementary unit[2] or laboratory sample[3] shall be as specified in table 1.

Table 1

Reinforcement product	Number of specimens
Continuous or discontinuous filaments Rovings	1 specimen
Chopped strands Milled fibres	1 specimen
Woven fabrics Mats	3 specimens per metre width, spaced evenly across the width

The product specification or the person requesting the determination may stipulate that the determination be performed on a (specified) higher number of specimens which are generally taken from adjacent positions in the elementary unit or laboratory sample.

Moreover, it may be stipulated that the determination be repeated at different places within the elementary unit or laboratory sample.

7 Conditioning and test atmosphere

For products which are expected to have a moisture content below 0,2 %, condition the elementary unit or laboratory sample in a standard atmosphere as defined in ISO 291 for a time sufficient to reach equilibrium, usually a minimum of 6 h.

For products with a moisture content in excess of 0,2 %, carry out the determination rapidly after sampling, storing the elementary units or laboratory samples in a hermetically sealed container.

The material may be brought to standard temperature in the container prior to testing, but shall be sealed against moisture loss.

In addition, the sample shall, if applicable, be remixed within the container just prior to testing to avoid erroneous results which occur due to layering of the moisture within the material.

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2) The elementary unit (as defined in ISO 1886:1990, *Reinforcement fibres — Sampling plans applicable to received batches*) is the smallest normally commercially available entity of a given product.

3) A laboratory sample is a part of the elementary unit from which the specimen(s) will be selected for the test. A laboratory sample is taken when it is impractical to bring the elementary unit into the test laboratory.

8 Procedure

The procedure described below is written for the case when the specimen is weighed in its holder. In the case when the specimen is weighed alone, proceed directly to 8.2 bearing in mind that the specimen is taken from the holder to weigh it and placed back in the holder using tweezers. Ensure that the specimens are placed in their holder at a location which can be identified throughout the procedure, and so that they do not touch each other.

8.1 Weighing the specimen holder

Stabilize the mass of the holder (5.3) by placing it in the oven (5.1), maintained, to within ± 3 °C, a temperature of 105 °C or, if the reinforcement product is known to contain volatile matter other than water which may escape at 105 °C, a lower temperature is chosen. However, the drying temperature chosen may be not below 50 °C. Handle the holder with tweezers (5.4).

Allow the holder to cool in the desiccator (5.2) to the appropriate standard temperature as defined in ISO 291.

Weigh the holder to the nearest 0,1 mg, recording the mass, in grams, as m_0.

8.2 Initial mass of specimen

Immediately after cutting out the specimen, place it in the holder.

Weigh the specimen and holder together to the nearest 0,1 mg, recording the mass, in grams, as m_1.

8.3 Final (dry) mass

Place the specimen and holder together in the oven maintained at a temperature of 105 °C ± 3 °C or at the chosen temperature ± 3 °C (see 8.1). Ensure that no specimen comes into contact with the sides of the oven. Use the tweezers to handle the specimens. Heat the specimen for at least 1 h to allow the mass of the specimen to reach a constant value.

On removal from the oven, immediately place the specimen in its holder in the desiccator for a minimum of 30 min, the desiccator being placed in a room at standard temperature (see ISO 291).

Weigh the test specimen plus holder together to the nearest 0,1 mg, recording the mass, in grams, as m_2.

9 Expression of results

Calculate the moisture content of each specimen H, as a percentage by mass, using the equation

$$H = \frac{m_1 - m_2}{m_1 - m_0} \times 100$$

where

m_0 is the mass, in grams, of the holder (this will be zero if the specimen is weighed without the holder;

m_1 is the initial mass, in grams, of the undried specimen (with or without holder);

m_2 is the final mass, in grams, of the dried specimen (with or without holder).

The result of the determination will be either the result obtained for one specimen (if only one specimen is examined per determination) or the average of the results obtained for each specimen taken for the determination.

10 Precision

The precision of this test method is not known because interlaboratory data are not available. Interlaboratory data are being obtained and a precision statement will be added at the next revision.

11 Test report

The test report shall include the following information:

a) a reference to this International Standard;

b) all details necessary for identification of the reinforcement product examined (as per the designation provided in the applicable product specification);

c) the dimensions and mass of each specimen;

d) the number of specimens examined;

e) the individual result of each determination and, if required, the results for each specimen;

f) details of any operation not specified in this International Standard, as well as any incident liable to have had an effect on the results.

g) the date of the test.

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Descriptors: plastics, reinforced plastics, reinforcing materials, textile glass fibres, carbon fibres, aramid fibres, reinforcement (structures), rovings, strands, mats, fabrics, tests, determination of content, humidity.

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