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Plastics piping systems — Glass-reinforced plastics (GRP) components — Determination of the amounts of constituents

National foreword

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 6, *Reinforced plastics pipes and fittings for all applications*.

This second edition cancels and replaces the first edition (ISO 7510:1997), which has been technically revised.

The main changes compared to the previous edition are as follows:

— modified the title;

— clarified accuracy statements;

— eliminated specific sample size;

— referenced ISO 3126 for dimension determination;

— allowed use of test specimens taken from mechanical property test samples.

INTERNATIONAL STANDARD ISO 7510:2017(E)

Plastics piping systems — Glass-reinforced plastics (GRP) components — Determination of the amounts of constituents

1 Scope

This document specifies a method for the determination of constituent materials of a test sample cut from a glass-reinforced plastics (GRP) component intended for use in a piping system. It includes determination of resin, glass, aggregate and filler contents.

It is also applicable to the determination of the type and arrangement of the reinforcements. If used to determine the amounts of constituent materials in layered constructions it may be necessary to separate the laminate layers by cutting or splitting and testing each separately.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3126, *Plastics piping systems — Plastics components — Determination of dimensions*

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

4 Principle

A test piece of known size and mass is ignited to burn off the resin, and the residue analysed by separating and weighing the constituents [loss on ignition (LOI) is a common term for such testing]. If the construction includes organic reinforcements, such as surfacing veils, or processing aids, such as thermoplastic mesh or filaments, these will be burned off with the resin. Typically such materials if used are in small amounts and will not introduce significant error in the determination of raw material contents. Also, organic materials used in glass fibre reinforcement sizing or binder will be burned off. The amounts of such materials are very small.

NOTE 1 In the case of filled laminates, especially those containing fillers of small particle size (including thixotropic agents), accurate analysis of the constituents can prove difficult. This is because of the difficulty in separating such fillers from the other constituents and the risk of some filler being lost during combustion.

This test method can be used to determine and monitor the fibre architecture of the laminate layers used in the piping component.

NOTE 2 It is assumed that the following testing parameters are set by the referring standard:

a) whether or not the types of glass fibre reinforcement in the constituent layers is to be determined;

b) whether or not the glass content of each layer is to be determined;

c) whether or not the aggregate and filler contents are to be determined, and whether to do so for each layer.

This document is used to measure and describe the behaviour of composite material to heat under controlled conditions, but does not by itself incorporate all the factors required for fire hazard or fire assessments of the composite materials under actual fire conditions. Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests. This document does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user to consult and establish appropriate safety and health practices in accordance with national regulations prior to use.

This test method does not apply to constructions that contain reinforcement materials that lose weight under the conditions of test or contain resins that do not decompose. The content of fillers that decompose under the conditions of test cannot be determined by this method and alternate procedures shall be employed.

5 Apparatus

The usual laboratory apparatus and, in particular, the following.

5.1 **Crucible**, of a suitable material and dimensions.

5.2 **Oven**, capable of maintaining a temperature of 105 °C to 110 °C.

5.3 **Electric muffle furnace**, or **microwave furnace**, capable of maintaining a temperature of 625 °C ± 20 °C or a temperature between 500 °C and 600 °C to an accuracy of ±20 °C.

5.4 **Bunsen burner** or **similar**.

5.5 **Desiccator**.

5.6 **Balance**, calibrated to an accuracy of 1 mg.

5.7 **Measuring devices** calibrated to an accuracy of 0,05 mm.

5.8 **Sieves**, of suitable mesh, as needed to separate fillers and aggregate.

5.9 **Spatulas, tweezers** and **sieves**, as needed to separate constituent materials.

6 Test piece

6.1 Dimensions

The test piece shall comprise the full thickness of the component from which the test piece was taken, unless individual layers are being investigated. The test piece shall have smooth edges and be free from dust. If reinforcement materials are to be classified by weight per unit area, then the test piece shall be rectangular.

The recommended sample size for components up to 30 mm wall thickness is approximately 40 mm × 40 mm multiplied by the thickness of the component. For components with a wall thickness exceeding 30 mm, samples of approximately 40 mm × 10 mm multiplied by the thickness of the component have been found acceptable. Other sample sizes are permitted by agreement.

Dimensional measurements as needed shall be in accordance with ISO 3126.

6.2 Number

The determination of the amounts of constituents shall be conducted in parallel on a minimum of two specimens taken from the same component. The result of the test shall be the average of the values of all specimens tested. For the case of the minimum two test specimens, if the difference between the values is greater than 5 %, then at least one more specimen shall be tested and the result is the average of the values of all specimens tested. All specimens shall be taken from the component in as close proximity to each other as possible.

It is permissible to use test pieces obtained from specimens that have been tested for mechanical properties such as circumferential or longitudinal tensile strength or pipe stiffness. Specimens obtained from these samples shall be dry and the fractured areas removed, leaving square, unfrayed faces, before being weighed and ignited.

7 Procedure

NOTE Routine conditioning of the test piece is not required.

7.1 If required, measure the longitudinal and circumferential dimensions of the test piece to the nearest 0,1 mm and calculate and record the area A, in square metres.

7.2 Heat the crucible (5.1) in the furnace (5.3) to (625 ± 20) °C for 15 min. Cool in the desiccator (5.5) and weigh to the nearest 10 mg. Record the mass in grams, as m_1.

7.3 If a test piece is derived from a component cured at temperatures of 105 °C or higher, the following procedure may be omitted (in which case, proceed to 7.4). Otherwise heat the test piece as follows.

Heat the crucible and test piece in the oven (5.2) to between 105 °C and 110 °C for 2 h. Cool the crucible and test piece in the desiccator and weigh to the nearest 10 mg.

Repeat the heating for periods of 30 min until the mass is constant to within 10 mg. Record this total mass, m_2, in grams. The mass of the sample is then $(m_2 - m_1)$.

7.4 Heat the crucible and test piece in a Bunsen flame (5.4), or in a muffle or microwave furnace, until the contents ignite. Maintain the temperature so that the test piece burns uniformly.

Take care to prevent the combustion proceeding so rapidly that there is a loss of non-combustible residue, such as filler.

CAUTION — Care should be taken to avoid breathing the potentially noxious vapours.

7.5 Heat the crucible and residue in the muffle or microwave furnace at (625 ± 20) °C, until all carbonaceous material has disappeared. Cool the crucible and residue in the desiccator and weigh these to the nearest 10 mg.

For components with glass or filler which will not withstand this calcination temperature, a temperature between 500 °C and 600 °C may be used, in accordance with the glass or filler specification. It is essential to maintain the chosen temperature constant to ±20 °C.

Repeat these operations until a mass constant to within 10 mg is obtained. Record the total mass, m_3, in grams.

NOTE The time taken for the carbonaceous residue to disappear is highly dependent on the test piece shape. It can be 6 h or more, but is usually much less.

7.6 If required, separate the residue, m_3, into its constituents as follows:

a) Separate the layers using tweezers or a spatula, noting the number of layers and their layout.

b) For each layer, separate its constituents by scraping, shaking, brushing and/or sieving.

c) If the quantity of filler is to be determined, then suitable analytical techniques should be employed to separate the filler from the other residue. An alternative procedure to mechanical separation of constituents is the use of an acid wash technique as given in ISO 1172 to determine filler content.

d) If required, separate the various types of glass reinforcement.

7.7 Determine the masses of each of the constituent materials to the nearest 10 mg.

8 Calculation and expression of results

8.1 Calculate the resin content of the total sample (LOI), expressed as a percentage by mass.

8.2 Calculate the total residue content, expressed as a percentage by mass.

8.3 If required, calculate the content of each constituent material in the residue as a percentage by mass.

8.4 If required, calculate the weight per unit area in grams per square metre of reinforcement materials.

9 Test report

The test report shall include the following information:

a) a reference to this document (i.e. ISO 7510);

b) the identification of the component tested;

c) the dimensions of each test piece and the orientation of each dimension, i.e. circumferential, longitudinal, thickness;

d) the test temperatures (see 7.5);

e) whether preliminary drying (see 7.3) was carried out;

f) the procedure used to determine filler content;

g) the percentage by mass of the constituents of the laminate;

h) if required, the weights of reinforcements in grams per square metre;

i) if required, the number of layers, and the type, disposition, layout and individual percentage by mass of each individual glass layer;

j) observations with regard to any irregularities noted during the test, such as excessively rapid combustion (see 7.4);

k) any factors which may have affected the results, such as any incidents or any operating details not specified in this document;

l) the date of the test.

Bibliography

[1] ISO 1172, *Textile-glass-reinforced plastics — Prepregs, moulding compounds and laminates — Determination of the textile-glass and mineral-filler content — Calcination methods*

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