INTERNATIONAL STANDARD

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Rigid cellular plastics — Determination of friability

Plastiques alvéolaires rigides — Détermination de la friabilité

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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 6187 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 10, *Cellular plastics*.

Rigid cellular plastics — Determination of friability

WARNING — This International Standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard specifies a method for the determination of the mass loss of rigid cellular plastics as a result of a combination of abrasion and impact produced by a laboratory tumbling mechanism.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 845:1988, *Cellular plastics and rubbers — Determination of apparent (bulk) density*.

3 Terms and definitions

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

3.1

cellular plastic

a plastic whose density is reduced by the presence of numerous small cavities (cells), interconnecting or not, dispersed throughout the mass

3.2

friability

the amount of cellular plastic that will crumble or crush into powder when in contact with another surface

4 Apparatus

4.1 Box

Use a cubical box of oak wood, having inside dimensions of 190 mm by 197 mm by 197 mm and mounted rigidly at the centre of one 197 mm by 197 mm end on a rotatable horizontal shaft so that the axis of the shaft is normal to the end face of the box. One side of the box shall be hinged as a door and shall be gasketed to be dust-tight. The box shaft shall be capable of being motor driven at a constant speed of (60 $\pm$ 2) revolutions per minute.

4.2 Cubes

Twenty-four laboratory-conditioned, solid $(19 \pm 0{,}8)$ mm oak cubes shall be placed in the box with the test specimens. The density of the oak cubes shall be approximately 650 kg/m^3.

Number each group of wood cubes 1 to 24. At the end of every 600-revolution test, remove one “used” cube (follow the number sequence and remove the oldest cube) and replace with a correspondingly numbered “new” cube. In this manner, cube wear is eliminated as an uncontrolled variable in the test method. When the corners of the wood cubes have been worn so that the radius of curvature is greater than 1,6 mm or the cubes have become altered so as not to be compatible with new cubes, they shall be discarded and new ones used. A conventional machinist's radius gauge may be used for checking the edge wear.

5 Test specimens

Using a fine-tooth saw, cut out three sets of twelve $(25 \pm 1{,}5)$ mm cubes.

Test twelve cubes at a time, cut from the same piece of the cellular plastic. When a flat product has special surfaces due to treatment or moulding, cut each cube to include such special surfaces as one face, except that the edges and corners of the product shall not be used.

Dry and condition specimens prior to testing, following applicable specifications for the product. If the material is adversely affected by oven temperatures, then condition the specimens for not less then 40 h at (23 ± 2) °C and (50 ± 5) % relative humidity before testing. In the absence of definite drying temperatures, dry the specimens in an oven at (70 ± 2) °C to constant mass, and hold in a desicator to cool to room temperature before testing. Where circumstances or requirements preclude compliance with these conditioning procedures, exceptions agreed upon by the purchaser and the manufacturer may be made, but they shall be specifically listed in the test report.

6 Procedure

Condition the test specimens and oak cubes at (23 ± 2) °C and (50 ± 5) % R.H. for a minimum of 6 h (it will not be necessary to condition the specimens for a further 6 h if they have already been conditioned for 40 h under these conditions — see clause 5).

Conduct the test in the standard laboratory atmosphere of (23 ± 2) °C and (50 ± 5) % relative humidity.

Weigh a set of twelve conditioned test specimens on a balance to within $\pm$ 1 %.

Place the twelve specimens together with the 24 oak cubes in the clean test box and secure the lid tightly.

Rotate the box at (60 $\pm$ 2) revolutions per minute for (600 $\pm$ 3) revolutions.

Immediately after the test period, carefully empty the contents of the box onto a 9,5 mm mesh screen and tap gently to remove dust and small particles. Carefully remove the specimens from the screen and weigh promptly.

Make three tests. Use a new set of test specimens for each test.

7 Calculation

Calculate the percent mass loss for each set of specimens using the following equation:

$$\% \text{ mass loss} = \frac{m_1 - m_2}{m_1} \times 100$$

where

m_1 is the original mass of the test specimens;

m_2 is the final mass of the specimens.

Calculate the average percent mass loss for the three sets of specimens, expressing the result to two significant figures.

8 Precision and bias

Precision — The precision of this test method is given in Table 1.

Repeatability — The difference between successive results obtained by the same operator with the same apparatus under constant operating conditions on identical test materials would exceed the values given for repeatability in Table 1 only in one case in twenty.

Reproducibility — The difference between two single and independent results obtained by different operators working in different laboratories on identical material would exceed the values given for reproducibility in Table 1 only in one case in twenty.

Bias — No information can be presented on the bias of the procedure in this test method because no material having an accepted reference value is available.

Table 1 — Precision

Material	Mass loss	Repeatability		Reproducibility	
(cellular plastic)	%	$\pm 2s_r$	$\pm 2s_r$	$\pm 2s_R$	$\pm 2s_R$
			%		%
A	0,11	0,34	310	0,40	360
B	1,0	0,65	65	0,83	83
C	5,3	1,6	31	4,2	79
D	31	2,6	8,2	8,5	27
E	49	4,5	9,1	11	23
F	50	5,3	11	11	22

s_r is the repeatability standard deviation.

s_R is the reproducibility standard deviation.

NOTE 1 The materials listed in this table include nominally 16 kg/m^3 expanded polystyrene, nominally 32 kg/m^3 extruded polystyrene, nominally 32 kg/m^3 polyurethane foam, nominal 32 kg/m^3 polyisocyanurate foam and commercial phenolic foam. The results are for materials used in the round-robin test only, which may not be commercially available. These materials were selected to provide a proper range of results, not to characterize the materials.

NOTE 2 Six laboratories participated. Each laboratory carried our three tests.

9 Test report

The test report shall include the following:

a) a reference to this International Standard;

b) a complete description of the material tested, including type, source and density determined in accordance with ISO 845, and special surfaces if any;

c) the conditioning and drying procedures followed, and any special conditions employed in the test;

d) the percent mass loss;

e) any comments on the mode and extent of abrasion, erosion, crumbling, cracking, etc.;

f) the date of the test.

Bibliography

[1] ASTM Research Report C16-1006, available from ASTM, 100 Barr Harbor Dr, West Conshohocken, PA 19428, USA.

[2] ISO 472:1999, *Plastics — Vocabulary*.