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Indian Standard

METHODS OF TEST FOR RIGID CELLULAR THERMAL INSULATION MATERIALS

PART 11 COMPRESSIVE STRENGTH

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INDIAN STANDARDS INSTITUTION
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METHODS OF TEST FOR RIGID CELLULAR THERMAL INSULATION MATERIALS

PAPT 11 COMPRESSIVE STRENGTH

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METHODS OF TEST FOR RIGID CELLULAR THERMAL INSULATION MATERIALS

PART 11 COMPRESSIVE STRENGTH

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 30 December 1985, after the draft finalized by the Thermal Insulation Materials Sectional Committee had been approved by the Chemical Division Council.

0.2 In the preparation of this standard, considerable assistance has been drawn from ISO 844-1978 'Cellular plastsics — Compression test of rigid materials', issued by International Organization for Standardization.

0.3 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard (Part 11) prescribes the method for the determination of compressive strength and corresponding relative deformation, and compressive stress at 10 percent relative deformation of rigid cellular thermal insulation materials.

2. TERMINOLOGY

2.1 For the purpose of this standard, the following definitions in addition to those given in IS : 3069-1965† shall apply.

2.1.1 *Relative Deformation*(ε) — Quotient of the reduction in thickness of the test specimen by its initial thickness expressed as percentage.

2.1.2 *Compressive Strength* (σm) — Quotient of the maximum compressive force (FM) reached when the relative deformation is less

*Rules for rounding off numerical values (*revised*).

†Glossary of terms, symbols and units relating to thermal insulation materials.

than 10 percent by the initial surface area of the cross section of the test specimen.

2.1.3 *Compressive Stress at 10 Percent Relative Deformation* (σ_{10}) — Quotient of the compressive force (F_{10}) at 10 percent relative deformation by the initial surface area of the cross-section of the test specimen.

3. PRINCIPLE

3.1 Rigid cellular material is subjected to increasing compression at a fixed rated up to 10 percent relative deformation over its entire area, and the maximum stress sustained by the test specimen is calculated. If this maximum occurs before 10 percent relative deformation is reached the result is reported as 'compressive strength' otherwise 'compressive stress at 10 percent relative deformation' is reported.

4. CONDITIONING

4.1 The test specimens shall be conditioned at $27 \pm 2°C$ and 65 ± 5 percent relative humidity for at least 16 hours. The test shall be carried out at an ambient temperature of $27 \pm 2°C$ immediately after conditioning.

5. APPARATUS

5.1 Any suitable compression testing machine, with the movable head capable of operating at a constant rate of motion, may be used. The dimensions of both the plattens shall be large than the test specimen. The machine should have the following:

a) Load indicating mechanism that will permit continuous measurement of force during compression to an accuracy of $\pm$ 1 percent of the compressive strength or compressive stress at 10 percent relative deformation, as the case may be; and

b) Deformation indicating mechanism that will permit continuous measurement of displacement of the movable head with an accuracy of $\pm$ 0·1 mm.

5.1.1 It is recommended that the testing machine be equipped with a device for continuously recording force and deformation graphically.

6. TEST SPECIMEN

6.1 The test specimen shall have a cross section area of 50 ± 1 mm $\times$ 50 ± 1 mm and a height of at least 25 mm, preferably 50 ± 1 mm. The test specimen shall be obtained from the sample by sawing without deformation of the cellular structure. The specimen shall be cut so that

direction of application of force is parallel to the direction of compression of the product in its intended use.

NOTE — When test specimens less than the standard thickness need to be tested, the results obtained will not necessarily be directly comparable with those obtained on standard specimens. Playing up of test specimen is not permissible.

6.2 A set of three test specimens shall be tested. When testing anisotropic materials, two sets of specimens shall be prepared having axes parallel to and normal to the direction of anisotropy.

7. PROCEDURE

7.1 Place the test specimen centrally between the two parallel plattens of the compression testing machine and compress it at a fixed rate, the value of which should be as near to one-tenth of the initial thickness of test specimens as possible, per minute until a relative deformation of 10 percent is reached. Note the value of force and corresponding relative deformation continuously during compression.

8. CALCULATION

8.1 Compressive Strength and Corresponding Relative Deformation

8.1.1 *Compressive Strength* — Calculate compressive strength (σ_M), in kilo Pascals, by the formula:

$$\sigma_M = 10^3 \times \frac{F_M}{S_O}$$

where

F_M = maximum force reached, newtons; and

S_O = initial area of the cross section of the test specimen, mm^2.

8.1.2 *Relative Deformation* — Calculate relative deformation (ε_M) by the formula:

$$\varepsilon_M = \frac{X_M}{h_O} \times 100, \text{ percent}$$

where

X_M = displacement corresponding to the maximum force reached, mm; and

h_O = initial thickness of the test specimen, mm.

8.2 Compressive Stress at 10 percent Relative Deformation — Calculate compressive stress at 10 percent relative deformation, σ_{10}, in kilo Pascals by the formula:

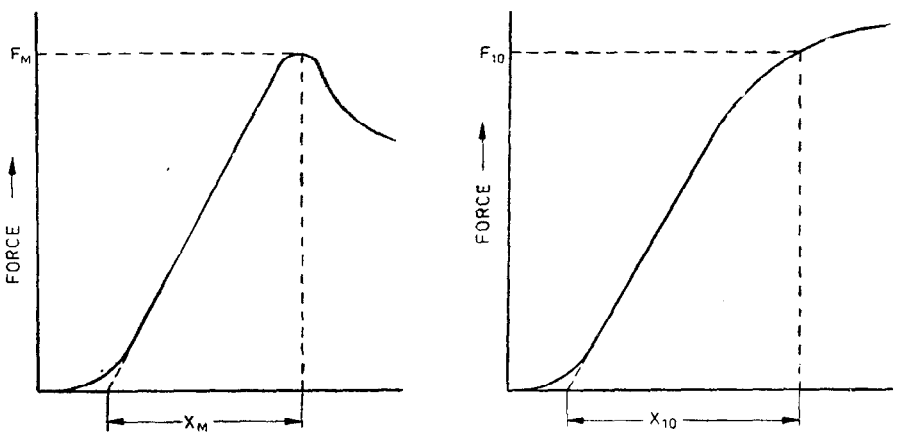
$$\sigma_{10} 10^3 \times \frac{F_{10}}{S_O}$$

where

F_{10} = force, corresponding to a relative deformation of 10 percent, N; and

S_O = initial area of the cross section of the test specimen, mm^2.

8.3 Zero deformation point shall be determined in both cases as indicated in Fig. 1.



F_M = maximum force
X_M = displacement for maximum force
F_{10} = force at 10 percent deformation
X_{10} = displacement for 10 percent deformation

FIG. 1 ZERO POINT DETERMINATION

9. REPORT

9.1 The report shall include the following:

a) Reference to this standard;

b) Identification of the material;

c) Dimensions of the test specimen, if other than standard;

d) Direction of application of force in relation to anisotropy, if any;

e) Average of the test results, shall be expressed as compressive strength and corresponding relative deformation; or compressive stress at 10 percent deformation;

f) Presence of any surface skins, and if so, location; and

g) Any deviation from the procedure specified in this standard.

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