International Standard

ISO 458/2

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Plastics — Determination of stiffness in torsion of flexible materials —
Part 2 : Application to plasticized compounds of homopolymers and copolymers of vinyl chloride

Plastiques — Détermination de la rigidité en torsion des plastiques souples — Partie 2 : Application aux compositions plastifiées d'homopolymères et de copolymères de chlorure de vinyle

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 458/2 was prepared by Technical Committee ISO/TC 61, *Plastics*.

International Standards ISO 458/1 and ISO 458/2 cancel and replace ISO Recommendation R 458-1965, of which they constitute a technical revision.

Plastics — Determination of stiffness in torsion of flexible materials —
Part 2 : Application to plasticized compounds of homopolymers and copolymers of vinyl chloride

0 Introduction

In the case of compositions based on plasticized polyvinyl chloride, all the curves for the logarithm of the stiffness in torsion as a function of temperature have a similar appearance, in the form of a reversed S. Each curve is essentially characterized by three regions :

  a) two extreme regions, where the change in the stiffness as a function of temperature occurs relatively slowly :

  1) a region of elevated values, corresponding to a high degree of rigidity, attributed by some authors to a loss of elastic properties. The value of the stiffness in torsion was taken arbitrarily by Clash and Berg[1] as 3,1 × 10⁹ dyn/cm²*,

  2) a region of low values, corresponding to a high degree of flexibility. In this case the corresponding stiffness in torsion has been arbitrarily taken as 42 kgf/cm²** representing an appropriate value for films having a sufficient degree of flexibility at normal use temperature to render them suitable for the production of curtains, drapes and waterproof materials;

  b) an intermediate region where the change in the stiffness is generally more rapid and where the curve exhibits an inflection. This region has been arbitrarily allotted the value of 233 kgf/cm²*** as stiffness in torsion.

With allowance for the precision of the tests, the characteristic values for the stiffness in torsion can therefore be represented as :

  300 MPa
  23 MPa
  4 MPa

1 Scope and field of application

This part of ISO 458 specifies a method for determining the temperatures corresponding to three conventional characteristic values for the stiffness in torsion of plasticized compounds of homopolymers and copolymers of vinyl chloride.

2 Reference

ISO 458/1, *Plastics — Determination of stiffness in torsion of flexible materials — Part 1 : General method.*

3 Principle

Use of ISO 458/1 for plasticized compounds of homopolymers and copolymers of vinyl chloride, consisting of determining, according to a special case of method A with an angle of deflection between 55° and 65°, the temperatures corresponding to three characteristic values of the stiffness in torsion (T), i.e. : 300 MPa, 23 MPa and 4 MPa.

4 Equipment

See ISO 458/1.

5 Test specimens

To construct a curve showing the same deformation of the test specimen at the characteristic points, the following test specimens are required :

  a) one test specimen (1) with thickness between 1,8 and 2 mm for determining the section of the curve in the region 300 MPa;

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[1] Clash, R.F., and Berg, R.M., Vinyl elastomers : low temperature flexibility behaviour, *Industrial and Eng. Chem.* **34**, pp. 1218-1222 (1942).

* 3,1 × 10⁹ dyn/cm² = 310 MPa

** 42 kgf/cm² = 4,1 MPa

*** 233 kgf/cm² = 22,8 MPa

b) one test specimen (2) with thickness between 2 and 5 mm for determining the section of the curve in the region 23 MPa;

c) one test specimen (3) with thickness between 4 and 5 mm for determining the section of the curve in the region 4 MPa.

All test specimens shall be 60 ± 2 mm in length and 6,2 to 6,4 mm in width.

NOTES

1 For the purpose of a rapid test it is possible to use a single test specimen between 4 and 5 mm thick for constructing the sections of the curve passing through the points 23 MPa and 4 MPa.

2 Certain properties of plastics and, in particular, the properties involved in this test method can change slightly on storage. It is therefore recommended to record the dates of preparation of test specimens, and in comparing samples to store the specimens for at least 48 h before testing.

6 Procedure

6.1 Selection of applied torque

Use the formula (see ISO 458/1 for definitions and units)

$$T = k \frac{M}{\theta}$$

to calculate the applied torques M_1, M_2, M_3 to be used with test specimens (1), (2), (3), respectively, to give an angle of deflection θ of 60° ± 5° for each of the three characteristic values of T :

T_1 = 300 MPa
T_2 = 23 MPa
T_3 =   4 MPa

6.2 Selection of temperatures

Select as the initial temperatures a multiple of 5 °C corresponding essentially to the maximum level of the stiffness value. In the absence of the required data, select – 40 °C.

6.3 Measurement

6.3.1 Follow the instructions of method A specified in ISO 458/1, with a 40 mm span, using test specimen (1) and the additional weights needed to obtain the applied torque M_1 as calculated in accordance with 6.1.

Record the temperature to the nearest 1 °C and the corresponding value of the angle of deflection to the nearest 1°.

If the angle of deflection is greater than 65°, proceed to a new test using a different test specimen, starting with a lower temperature.

If the angle of deflection is less than 55°, increase the temperature by 5 °C and proceed with the test.

Repeat the above operation so as to obtain at least three valid tests.

6.3.2 Repeat the same operations using test specimen (2) and applied torque M_2.

6.3.3 Repeat the same operations using test specimen (3) and applied torque M_3.

7 Expression of results

Plot the logarithm of the values of stiffness in torsion versus temperature. Note on the curve the temperatures corresponding to the three conventional characteristic stiffnesses in torsion : 300 MPa, 23 MPa and 4 MPa.

8 Test report

The test report shall include the following particulars :

a) a reference to this part of ISO 458;

b) the particulars specified in clause 8 of ISO 458/1;

c) temperatures corresponding to the three conventional characteristic values of stiffness in torsion of plasticized PVC compounds : 300 MPa, 23 MPa and 4 MPa.