

Physical testing of rubber —

Part A13: Method for determination of stiffness at low temperature (Gehman test)

ICS 83.060

Committees responsible for this British Standard

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- BP Chemicals Ltd.
- British Railways Board
- British Rubber Manufacturers' Association
- GAMBICA (BEAMA Ltd.)
- Institution of Mechanical Engineers
- Institution of Water and Environmental Management
- Malaysian Rubber Producers' Research Association
- Ministry of Defence
- RAPRA Technology Ltd.
- SATRA Footwear Technology Centre

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National foreword

This Part of BS 903 has been prepared under the direction of the Rubber Standards Policy Committee. It is identical with ISO 1432:1988, *Rubber, vulcanized or thermoplastic — Determination of low temperature stiffening (Gehman test)*, including Technical Corrigendum August 2003, published by the International Organization for Standardization (ISO).

This revision supersedes the 1983 edition of BS 903-A13, which is withdrawn, and which was identical to the 1982 edition of ISO 1432. The differences between the two editions are editorial in nature.

The title of BS 903 has been changed to “*Physical testing of rubber*” as many of the methods in the BS 903: Part A series are suitable for testing thermoplastic as well as vulcanized rubber. The change of title also anticipates the transfer of the methods in the Part B series to a separate standard for the chemical testing of rubber and the omission of the words “Methods for” anticipates the publication of a Part 0 “Introduction” and a “*Guide to the selection and use of methods of test*”. Amendments are not being issued to the other Parts of BS 903, but their titles are being changed when these Parts are revised.

Additional information. When the apparent torsional modulus is to be calculated (see 6.4) the width and thickness of the test piece are measured by the appropriate method described in BS 903 “*Methods of testing vulcanized rubber*” — Part A38: “*Determination of dimensions of test pieces and products for test purposes*”.

In UK practice, the standard laboratory temperature is 23 ± 2 °C (see 3.2.3).

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

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1 Scope

This International Standard specifies a static procedure, known as the Gehman test, for determining the relative stiffness characteristics of vulcanized or thermoplastic rubbers over a temperature range from room temperature to approximately $-150\text{ }^{\circ}\text{C}$.

2 Apparatus¹⁾

2.1 Torsion apparatus, one possible form of which is shown in Figure 1. It consists of a torsion head (A), capable of being turned 180° in a plane normal to the torsion wire (B). The top of the wire is fastened to the torsion head through a loosely fitting sleeve (C). The bottom of the wire is fastened to the test piece clamp stud (D) by means of a screw connector (E). A device for “friction-free” indication or recording of angle by mechanical or electrical means shall be provided permitting convenient and exact adjustment of the zero point; the apparatus shown in the figure has a pointer (F) and a movable protractor (G) which perform these functions. The indicating or recording system shall allow reading or recording of the angle of twist to the nearest degree. The torsion apparatus is clamped to a supporting stand (H). It is advantageous to make the vertical portion of the stand from material of poor thermal conductivity. The base of the stand shall be of stainless steel or other corrosion-resistant material.

2.2 Torsional wires (B), made of tempered spring wire, of length $65\text{ mm} \pm 8\text{ mm}$, and having torsional constants of $0,7\text{ mN}\cdot\text{m}$, $2,81\text{ mN}\cdot\text{m}$ and $11,24\text{ mN}\cdot\text{m}$.

In cases of dispute, the $2,81\text{ mN}\cdot\text{m}$ wire shall be used.

2.3 Test piece rack (I), made of material of poor thermal conductivity, for holding the test piece (J) in a vertical position in the heat transfer medium. The rack may be constructed to hold several test pieces²⁾. The rack is clamped to the stand (H).

Two clamps shall be provided for holding each test piece. The bottom clamp (K) shall be a fixed part of the test piece rack. The top clamp (L) acts as an extension of the test piece and shall not touch the rack³⁾. The top clamp is secured to a stud (D) which in turn is connected to the screw connector (E).

2.4 Temperature-measuring device, capable of measuring the temperature to within $1\text{ }^{\circ}\text{C}$ over the whole range of temperature over which the apparatus is to be used.

The sensitive element shall be positioned near a test piece equidistant from the top and bottom.

2.5 Heat-transfer medium, which may be liquid or gaseous. Any material which remains fluid at the test temperature and which will not affect materials being tested may be used. Among the liquids that have been found suitable for use at low temperatures are acetone, methanol, ethanol, butanol, silicone fluid and *n*-hexane. Air, carbon dioxide or nitrogen are commonly used gaseous media.

Vapours of liquid nitrogen are useful for testing at very low temperatures.

It should be noted that stiffness measurements in gaseous media may not give in each case the same results as the measurements made in liquid media.

2.6 Temperature control, capable of maintaining the temperature of the heat-transfer medium to within $\pm 1\text{ }^{\circ}\text{C}$.

2.7 Tank, for a liquid heat-transfer medium, or test chamber for a gaseous medium.

2.8 Stirrer, for liquids, or fan or blower, for gases, which ensures thorough circulation of the heat-transfer medium.

2.9 Stopwatch, or other timing device, calibrated in seconds.

¹⁾ The apparatus and its use are described in GEHMAN, S. D., WOODFORD, D. E., and WILKINSON, C. S., Low temperature characteristics of elastomers, *Ind. and Eng. Chem.*, **39** Sept. 1947:1108.

²⁾ Racks providing space for five or ten test pieces are commonly used.

³⁾ Clearance between the top of the test piece rack and the test piece clamp stud is ensured by inserting thin spacers between the two. Slotted laminated plastics of thickness about $1,3\text{ mm}$ and width about 12 mm have been found satisfactory. At low temperatures the test pieces stiffen in position and the spacers may be removed without losing the clearance.