METHODS OF TESTING VULCANIZED RUBBER

PART A25. DETERMINATION OF IMPACT BRITTLENESS TEMPERATURE

BS 903 : Part A25 : 1968

£1·
Price [illegible]- net

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THIS BRITISH STANDARD, having been approved by the Rubber Industry Standards Committee and endorsed by the Chairman of the Chemical Divisional Council, was published under the authority of the General Council on 14th November, 1968.

SBN: 580 00346 9

First published August, 1964.
First revision November, 1968.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

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The following BSI references relate to the work on this standard:
Committee references RUC/10 and RUC/10/4
Draft for comment 67/22646

CO-OPERATING ORGANIZATIONS

The Rubber Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government department and scientific and industrial organizations:

British Association of Synthetic Rubber Manufacturers
*Federation of British Rubber and Allied Manufacturers
*Institution of the Rubber Industry
*Ministry of Technology
Natural Rubber Bureau
*Natural Rubber Producers' Research Association
*Rubber and Plastics Research Association of Gt. Britain
Rubber Growers' Association
*Society of Motor Manufacturers and Traders Ltd.
Tyre Manufacturers Conference Ltd.

The Government department and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Railways Board
British Rubber and Resin Adhesive Manufacturers' Association
British Society of Rheology
Chemical Industries Association
Electrical Research Association
Institution of Mechanical Engineers
Institution of Mechanical Engineers (Automobile Divn.)
Institution of Municipal Engineers
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Ministry of Defence (Air Force Dept.)
Ministry of Defence (Army Dept.)
Ministry of Defence (Navy Dept.)
Ministry of Housing and Local Government
National College of Rubber Technology
National Physical Laboratory (Ministry of Technology)
Post Office
Royal Institute of Chemistry

BRITISH STANDARD METHODS OF

TESTING VULCANIZED RUBBER

Part A25. Determination of impact brittleness temperature

FOREWORD

This British Standard has been prepared under the authority of the Rubber Industry Standards Committee. It was originally published in August 1964 and is now being revised to bring it into line with the method being considered by Technical Committee ISO/TC 45 – ' Rubber ' – of the International Organization for Standardization (ISO).

METHOD

1. INTRODUCTION

Impact brittleness temperature, determined as described in this standard method, is not necessarily indicative of the service performance of a vulcanized rubber.

Brittleness temperatures of rubbers are empirical points, dependent to a large degree upon the test procedure and apparatus. In order to obtain reproducible measurements all pertinent test variables must be thoroughly defined. The procedure herein outlined defines those variables at present known to influence the brittleness temperature test.

2. DEFINITION

For the purposes of this British Standard the following definition applies:

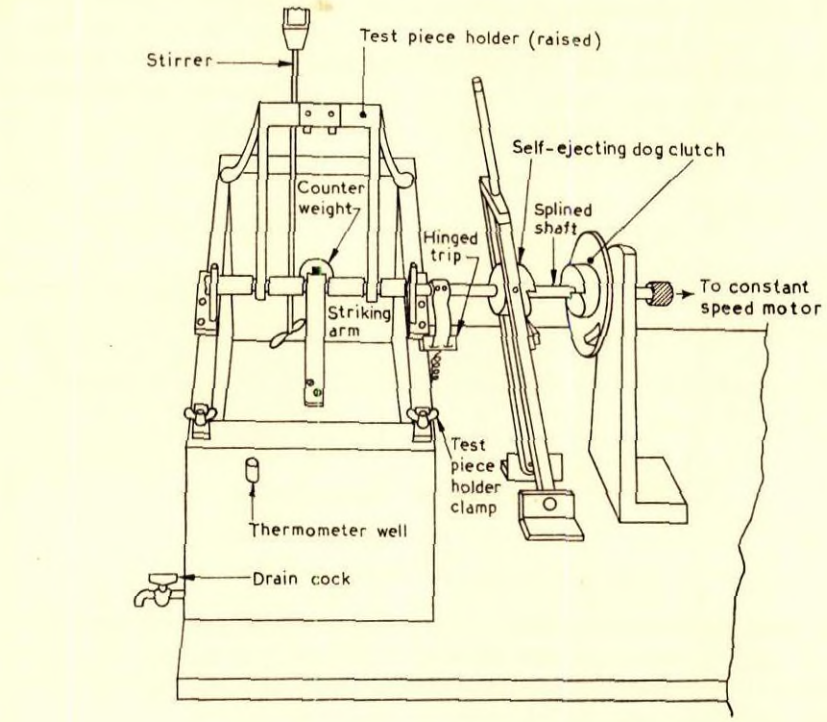
Impact brittleness temperature. The lowest temperature of non-failure of the appropriate number of test pieces tested under the specified conditions. Failure is defined as any crack, fissure or hole visible to the naked eye, or complete separation into two or more pieces.

3. APPARATUS

The apparatus consists of the following:

3.1 Test piece clamp and striking member. The clamp is designed to hold the test piece as a cantilever beam. The striking edge strikes the test pieces at right angles at a speed of 2·00 $\pm$ 0·15 m/s at impact and immediately after.

NOTE. A type of tester currently in use is shown in Fig. 1.



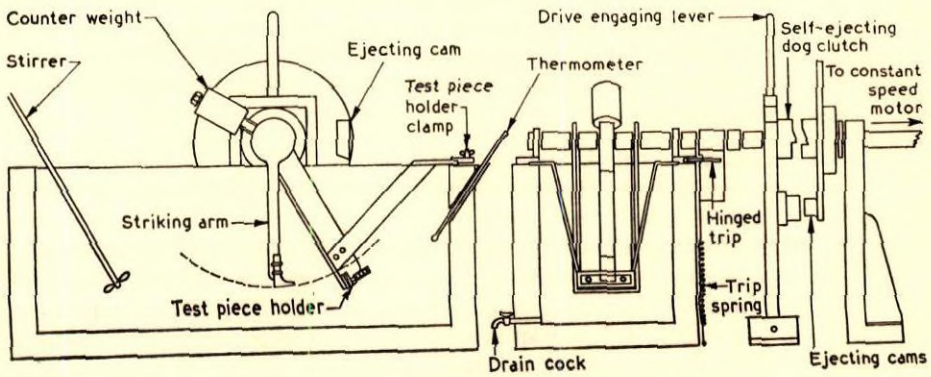


Fig. 1. An apparatus for impact brittleness temperature test (2 views)

The distance between the centre line of the striking edge and the clamp is 7·9 ± 0·3 mm at impact. The striking edge has a radius of 1·6 ± 0·1 mm. The striking arm and test piece clamp have a clearance of 6·4 ± 0·3 mm at, and immediately following impact. These dimensional requirements are illustrated in Fig. 2.

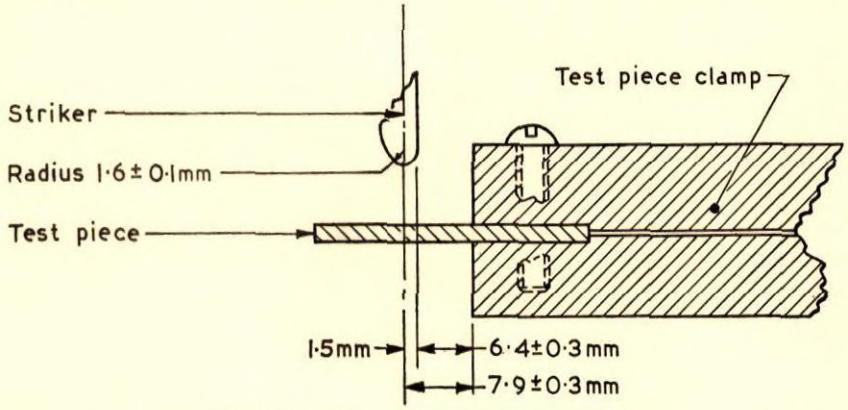


Fig. 2. Test piece and striker arrangement

3.2 Temperature measuring device. A temperature measuring device, accurate to ± 0·5 degC or better, is located as near the test pieces as possible. Copper *v.* constantan thermocouples, used in conjunction with a potentiometer, are highly satisfactory.

3.3 Heat-transfer medium. The heat-transfer medium may be either liquid or gaseous. Any material which remains fluid at the test temperature and which does not appreciably affect the materials being tested may be used. Among the liquids that have been found suitable for use at low temperatures are acetone, methyl alcohol, ethyl alcohol, butyl alcohol, silicone fluid and normal hexane. For temperatures down to −120°C methylcyclohexane and liquid nitrogen have been found to be satisfactory.

3.4 Temperature control. Suitable means should be provided for controlling the temperature of the heat-transfer medium within ± 1°C if it is air or within ± 0·5 degC if liquid.

Automatic regulation for a liquid medium may be obtained by means of a system consisting of an externally cooled tank connected to the test area with suitable tubing, a thermo-regulator, a pump, an electric immersion heater, and mercury switches. The regulator, alternately actuating both the pump and heater through the mercury switches, controls the amount of liquid coolant being pumped to the test area as well as the amount of heat coming from the heater.

Manual temperature control for liquid media may be accomplished with powdered dry ice (solid CO_2) and an electric immersion heater.

When using liquid nitrogen with methylcyclohexane a modified apparatus is required.

3.5 Tank or test chamber. A tank for liquid heat-transfer media or a test chamber for air is provided.

3.6 Stirrer. A stirrer for liquids or a fan or blower for air, which ensures thorough circulation of the heat-transfer medium, is provided.

4. TEST PIECE

The test piece is either (*a*) 40 ± 6 mm long, 6 ± 1 mm wide and 2 ± 0·2 mm thick or (*b*) of the type illustrated in Fig. 3. A minimum of 6 mm of the length (for type (*b*) test pieces, the tab end) is held in the clamp. For any one test either four of the type (*a*) or 10 of the type (*b*) test pieces shall be used.

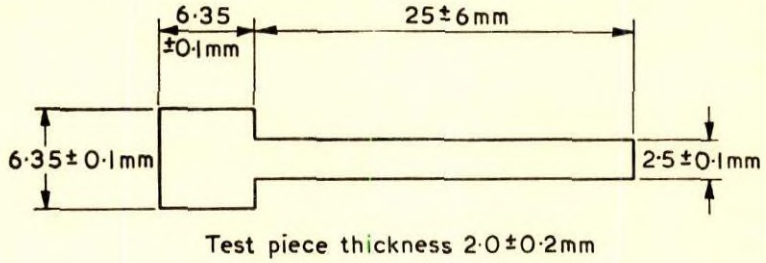


Fig. 3. Test piece

5. PROCEDURE

5.1 With liquid heat-transfer medium

5.1.1 Before a test is run, the liquid is brought to the starting temperature to be used. Sufficient liquid is placed in the tank to ensure 20–30 mm of liquid covering the test pieces.

5.1.2 The test pieces are mounted in the apparatus and immersed for 3·0 ± 0·5 minutes at the test temperature. For type (*a*) test pieces, four test pieces are used at each test temperature, and for type (*b*) test piece, 10 test pieces are used at each test temperature.

NOTE. Proper tightening of the clamp is of the utmost importance. The clamp should be tightened so that each test piece is held with approximately the same pressure.

5.1.3 After immersion for the specified time at the test temperature, the temperature is recorded and a single impact blow is delivered to the test pieces.

5.1.4 Each test piece is examined to determine whether or not it has failed. Failure is defined as any crack, fissure, or hole visible to the naked eye, or complete separation into two or more pieces. Where a test piece has not completely separated it shall be removed, allowed to warm to approximately room temperature and then bent to an angle of 90° in the same direction as the bend caused by the impact. It should then be examined for cracks at the bend.

5.1.5 New test pieces are used for each impact.

5.1.6 In establishing the lowest temperature of non-failure of a material the test shall be started at a temperature below the expected temperature of non-failure, and tests made on sets of test pieces at successively increasing temperatures in steps of 2 degC. A test shall be made at each temperature until no failure at one temperature is observed. This temperature is recorded as the impact brittleness temperature.

If the starting temperature is not known it may conveniently be determined by testing single test pieces at rising 10 degC intervals, beginning well below the expected temperature of non-failure, until no failure is obtained, the bath temperature being then decreased to the highest value at which a failure was observed.

5.2 *With air as heat-transfer medium*

5.2.1 Before a test is run, the test chamber and test apparatus are brought to thermal equilibrium at the desired temperature.

NOTE. The apparatus for use in a gaseous medium must be such that low temperatures will not affect the operation of the impact mechanism.

5.2.2 The test pieces shall be mounted and tested in accordance with the procedure described in 5.1.2 to 5.1.6 except that the test pieces should remain at the test temperature for one hour prior to being impacted.

NOTE. Conditioning periods longer than one hour may be used for studying crystallization and plasticizer-time effects.

6. REPORT

The report shall include:

(1) The impact brittleness temperature.
(2) Type of test piece.
(3) Heat transfer medium used.

*Printed in England by Gaylard & Son Ltd, London, S.E.*14