

METHODS FOR CREEP AND RUPTURE TESTING OF METALS

Part 1. Tensile rupture testing

BS 3500 : Part 1 : 1969

THIS BRITISH STANDARD, having been approved by the Mechanical Engineering Industry Standards Committee, was published under the authority of the Executive Board on 20 October, 1969.

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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.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

This standard makes reference to the following British Standards:

- BS 1041. Code for temperature measurement.
- BS 1610. Methods for the load verification of testing machines.
- BS 1826. Reference tables for platinum/rhodium v. platinum thermocouples.
- BS 1827. Reference tables for nickel/chromium v. nickel/aluminium thermocouples.
- BS 1828. Reference tables for copper v. constantan thermocouples.
- BS 1829. Reference tables for iron v. constantan thermocouples.
- BS 3846. Methods for calibration and grading of extensometers for testing of metals.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following BSI references relate to the work on this standard:
Committee references MEE/37 and MEE/37/13
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CO-OPERATING ORGANIZATIONS

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

- *Associated Offices' Technical Committee
- Association of Consulting Engineers
- Association of Mining Electrical and Mechanical Engineers
- Board of Trade
- British Chemical Plant Manufacturers' Association
- British Compressed Air Society
- *British Electrical and Allied Manufacturers' Association
- British Gear Manufacturers' Association
- British Internal Combustion Engine Manufacturers' Association
- British Mechanical Engineering Federation
- British Pump Manufacturers' Association
- *British Steel Industry
- Crown Agents for Oversea Governments and Administrations
- Department of Employment and Productivity (H.M. Factory Inspectorate)
- Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales
- Engineering Equipment Users' Association
- Gas Council
- Institute of Marine Engineers
- Institution of Civil Engineers
- Institution of Gas Engineers
- Institution of Heating and Ventilating Engineers
- Institution of Mechanical Engineers
- Institution of Mechanical Engineers (Automobile Division)
- Institution of Production Engineers
- Locomotive and Allied Manufacturers' Association of Great Britain
- London Transport Board
- Machine Tool Trades Association
- Ministry of Defence
- Ministry of Defence, Army Department
- Ministry of Power
- Ministry of Public Building and Works
- *Ministry of Technology
- Ministry of Technology—National Engineering Laboratory
- Ministry of Transport
- National Coal Board
- *National Physical Laboratory (Ministry of Technology)
- Royal Institute of British Architects.

The Government departments 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:

- Aluminium Federation
- British Cast Iron Research Association
- British Non-Ferrous Metals Research Association
- Electrical Research Association
- Institution of Engineering Inspection
- Institution of Production Engineers
- Ministry of Technology—Forest Products Laboratory
- Ministry of Defence, Navy Department
- Ministry of Technology—Building Research Station
- National Association of Drop Forgers and Stampers
- Scientific Instrument Manufacturers
- Spring Research Association
- Welding Institute

BRITISH STANDARD METHODS FOR CREEP AND RUPTURE TESTING OF METALS

Part 1. Tensile rupture testing

FOREWORD

This British Standard is one of a series dealing with creep and rupture testing of metals and is intended to facilitate the comparison of rupture properties of different metals and to unify testing procedures. The first edition of BS 3500 included separate parts (1 and 2) published in 1962, respectively covering uninterrupted and interrupted tensile rupture testing, and a further part (7), published in 1964, for notch tensile rupture testing.

In this revision, the opportunity has been taken to combine these parts into a new part so as to reduce the number of separate standards to which reference has to be made when carrying out rupture tests. Particular consideration has also been given to the requirements of the aircraft industry, which are at present covered in BS 4A4, Part 1, Section 3*, and to bringing the standard into line with current practice including the adoption of metric units. However, combining of the formerly separate parts does not imply that identical results are always obtained from the different types of test.

The standard covers methods of carrying out tensile rupture tests on plain and notched test pieces and also test pieces from tubes, in both single and multi-test-piece testing machines, for the establishment of rupture data for design and other purposes. Methods for the determination of creep strains are described in the new edition of Part 3 of BS 3500 in which the former Parts 3 and 4 have been combined. If the same test piece is used for both creep and rupture tests, reference should be made to the appropriate part of the standard for the procedure for determining creep strains. For production acceptance tests and tensile stress relaxation testing, reference should respectively be made to Parts 5 and 6 of BS 3500.

It is acknowledged that there are tests of long duration already in progress not conforming wholly with the requirements of this revised standard. The issue of this revised edition will not invalidate the results of such tests.

This part of BS 3500 meets the requirements of the corresponding ISO Recommendation† concerned with tensile rupture testing.

NOTE. Information concerning SI units is given in Supplement No. 1, 'Additional tables for SI conversions' to BS 350, 'Conversion factors and tables', and in PD 5686, 'The use of SI units'.

*BS 4A4, 'Test pieces and test methods for metallic material for aircraft', Part 1, Section 3, 'Uninterrupted creep and rupture tests'.

†ISO/R 206, 'Creep stress rupture testing of steel at elevated temperatures'.

METHOD OF TEST

1. SCOPE

1.1 This British Standard describes tests for the determination of the time to rupture of metal test pieces subjected throughout their duration to nominally constant tensile load and constant temperature conditions in single and multi-test-piece rupture testing machines for times in the range of 10 h to 100 000 h. It defines the properties to be determined and the terms used in describing tests and test pieces.

1.2 The standard applies to uninterrupted and interrupted tests (see 3.2) on test pieces of circular and rectangular cross section, and on test pieces of circular cross section having a notch and also on test pieces from tubes.

1.3 The standard may be applicable to rupture tests of shorter duration than 10 h and longer duration than 100 000 h, in which case the tolerances on the temperature and the soaking times may require further consideration.

1.4 Hereafter, for the purposes of this standard, 'by agreement' means that specific agreement has been reached between the purchaser and the supplier, and any inspecting authority concerned.

2. SYMBOLS AND DEFINITIONS

For the purposes of this British Standard, the following symbols and definitions apply:

2.1 Symbols. The symbols used are as follows (see Figs. 1 to 5):

Symbol	Description
d	Diameter of test section of test piece of circular cross section. Bore of tube, or inside diameter.
D	Outside diameter of tube.
D_n	Diameter of the parallel portion of a notched test piece of circular cross section.
d_n	Diameter of test piece at root of notch.
a	Thickness of test section of test piece. Thickness of strip test piece cut from tube.
b	Width of test section of test piece.
r_n	Notch root radius.
α	Notch angle.
K_t	Elastic stress concentration factor.
r	Transition radius.
L_o	Original gauge length.
L_c	Parallel length of unnotched test piece.
L_n	Parallel length of notched test piece including the width of the notch.
L_t	Total length.
L_u	Final gauge length.