BRITISH STANDARD

BS 3920:1973

Incorporating Amendments Nos. 1, 2 and 3

Derivation and verification of elevated temperature properties for steel products for pressure purposes —

Part 1: Method for deriving the minimum elevated temperature yield or proof stress properties when data on a minimum of 50 casts are available

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Co-operating organizations

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

British Cast Iron Research Association
British Constructional Steelwork Association
British Independent Steel Producers Association
British Ironfounders' Association
British Mechanical Engineering Confederation
British Steel Industry*
Concrete Society
Council of Iron Producers
Council of Ironfoundry Associations
Department of Employment
Department of Trade and Industry*
Engineering Equipment Users' Association
Federation of Civil Engineering Contractors
Greater London Council
Institute of British Foundrymen
Institute of Iron and Steel Wire Manufacturers
Institute of Marine Engineers
Institution of Mechanical Engineers*
Institution of Production Engineers
Institution of Structural Engineers
Lloyd's Register of Shipping*
Ministry of Defence
Ministry of Defence (Army Department)*
National Association of Drop Forgers and Stampers
National Physical Laboratory (Department of Trade and Industry)*
Oil Companies Materials Association*
Process Plant Association*
Royal Institute of British Architects
Shipbuilders and Repairers National Association
Society of Motor Manufacturers and Traders Ltd.
Stainless Steel Development Association
Steel Castings Research and Trade Association*
Tin Research Institute

The Government departments and the 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:

Associated Offices Technical Committee
British Electrical and Allied Manufacturers' Association
British Welded Steel Tube Manufacturers' Association
Electrical Research Association
Electricity Council. The Central Electricity Generating Board and the Area Boards in England and Wales
Water Tube Boilermakers' Association
Individual firms

This British Standard having been approved by the Iron and Steel Industry Standards Committee, was published under the authority of the Executive Board on 15 October 1973

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First revision as BS 3920:1973

The following BSI references relate to the work on this standard:
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Contents

Foreword

This British Standard has been prepared under the authority of the Iron and Steel Industry Standards Committee.

This edition presents a revision of the previous BS 3920 to take account of current international draft standards.

It also supersedes the derivation procedure previously covered by BS 3228 "*Procedures for obtaining properties of steel at elevated temperatures*" Part 1 "*Proof stress*" which is now withdrawn.

The minimum lower yield or proof stress is one of the design criteria used if a steel is to be employed at elevated temperatures, for example in the construction of boilers and pressure vessels. Accordingly British Standards for such steels give specified elevated temperature yield or proof stress values which are derived statistically from a body of data.

NOTE 1 Where this standard subsequently makes reference to proof stress it should be understood that lower yield stress is applicable if appropriate.
NOTE 2 Where this standard subsequently makes reference to the relationship between the elevated temperature proof stress and room temperature tensile strength, this includes the relationship between the elevated temperature proof stress and room temperature proof stress for austenitic steels.
NOTE 3 All proof stress tests used to implement this standard either at room temperature or at elevated temperature should be carried out in accordance with BS 3688 "*Methods for mechanical testing of metals at elevated temperatures*" Part 1 "*Tensile testing*".

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 General

1.1 Scope

This British Standard specifies the method for deriving lower yield or proof stress properties and defines the related verification procedure to be used, as an alternative to elevated temperature acceptance testing, whereby a manufacturer may satisfy the customer that the product supplied consistently meets the requirements of the specification.

The procedures given herein, whilst minimizing the amount of elevated temperature testing required to be done by the manufacturer, at the same time provide no less assurance to the purchaser than is provided by batch testing methods.

Section **2** defines the method for deriving minimum elevated temperature proof stress values (E_t) for inclusion in national standards or other specifications for steel products. For carbon and alloy steels this method is also applicable to the derivation of room temperature proof stress values where E_t is specified for design purposes.

Section **3** defines a related verification procedure which may be used by the manufacturer as an alternative to hot testing to satisfy the purchaser that his product consistently meets the minimum elevated temperature proof stress values specified in such standards.

Sections **2** and **3** of this standard relate to the derivation and verification of properties for steels not included in the series of International Organization for Standardization (ISO) pressure vessel steel standards and also to ISO type steels modified such that properties higher than those specified in the ISO standards are being claimed.

Section **2** (derivation procedure) does not apply in the cases of ISO steels adopted as British Standard steels where the properties have been derived from an international body of data according to ISO 2608 "*Carbon and low alloy steel products for pressure purposes: Procedure for deriving and verifying the elevated temperature yield or proof stress properties for inclusion in International Standards*" (in course of preparation) and the family of 95% lower confidence limit lines have been agreed by ISO and incorporated into this British Standard. For such British Standard steels the verification section only (Section **3**) applies.

1.2 Symbols and designations

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

Symbol	Designation
E_t	Elevated temperature proof stress
R_m	Room temperature tensile strength
R_p	Room temperature proof stress (non-proportional elongation) or yield stress

2 Procedure for deriving minimum properties

2.1 Basis of method

2.1.1. The elevated temperature proof stress properties are derived from a well defined body of data on the basis on a linear regression analysis at each of a number of temperatures. For carbon and alloy steels this regression analysis relates the elevated temperature proof stress values with the room temperature tensile strength. In the case of austenitic steels, the elevated temperature proof stress is related to the room temperature proof stress at the same offset.

2.1.2 For the purposes of this British Standard the specified minimum proof stress value at a given temperature is defined as follows.

1) *For carbon and alloy steels.* The proof stress derived from the lower 95 % confidence limit at a tensile strength 30 N/mm^2 above the specified minimum room temperature tensile strength.

2) *For austenitic steels.* The proof stress derived from the lower 95 % confidence limit at a proof stress 20 N/mm^2 above the specified minimum room temperature proof stress.

2.2 Basic requirements

2.2.1 The method shall be applied for each product form, thickness range, section size range or heat treatment condition for which elevated temperature proof stress properties are to be separately specified in the relevant national standard or other specification, unless it can be shown that the data being considered belong to the same population.

2.2.2 The data utilized shall be obtained using test samples which:

1) are representative of the product form, thickness or section size range and heat treatment to which the specified properties apply;

2) *for ferritic steels:* provide room temperature tensile strength values fairly uniformly distributed over not less than 80 % of the specified tensile strength ranges;