

Australian Standard®

**Wrought alloy steels—Hardened and
tempered to designated mechanical
properties**

This Australian Standard was prepared by Committee MT/1, Iron and Steel. It was approved on behalf of the Council of Standards Australia on 24 November 1989 and published on 11 June 1990.

The following interests are represented on Committee MT/1:

Australian Foundry Institute
Australian Institute of Steel Construction
Bureau of Steel Manufacturers of Australia
Confederation of Australian Industry
Department of Defence
Metal Trades Industry Association of Australia
Railways of Australia Committee
Society of Automotive Engineers, Australasia

Review of Australian Standards. To keep abreast of progress in industry, Australian Standards are subject to periodic review and are kept up-to-date by the issue of amendments or new editions as necessary. It is important therefore that Standards users ensure that they are in possession of the latest edition, and any amendments thereto.

Full details of all Australian Standards and related publications will be found in the Standards Australia Catalogue of Publications; this information is supplemented each month by the magazine 'The Australian Standard', which subscribing members receive, and which gives details of new publications, new editions and amendments, and of withdrawn Standards.

Suggestions for improvements to Australian Standards, addressed to the head office of Standards Australia, are welcomed. Notification of any inaccuracy or ambiguity found in an Australian Standard should be made without delay in order that the matter may be investigated and appropriate action taken.

This Standard was issued in draft form for comment as DR 89022.

Australian Standard®

**Wrought alloy steels—Hardened and
tempered to designated mechanical
properties**

First published as AS G18—1966.
Revised and redesignated AS 2506—1981.
Second edition 1990.

PREFACE

This draft was prepared by the Standards Australia Committee on Iron and Steel, to supersede AS 2506—1981, Wrought alloy steels—En series. It is proposed to discontinue the use of the En designation system in Australia, and replace it with the system developed by the American Iron and Steel Institute (AISI) and the Society of Automotive Engineers (SAE), which is used in other Australian Standards dealing with wrought alloy steels.

During 1941 the En series of steels were introduced by the United Kingdom in BS 970, *Wrought steels for general engineering purposes*, to provide a comprehensive schedule of steels for general use in the engineering industries, and which would meet the stringent material requirements of the armed services and the motor industry. The alloy steel grades were subsequently adopted in Australia to supplement the alloy steel grades supplied to AISI-SAE standards.

When the 1955 edition of BS 970 was revised by the British Standards Institution, the En designation system was abandoned since it did not possess sufficient flexibility to permit the inclusion of new steels. A new six-digit designation system was introduced to replace the En series grades. The Australian industry did not favour the introduction of another steel designation system into Australia and opted for the AISI-SAE system to designate the former En series grades. Additional grades have been added, and details on these are given in the Foreword.

© Copyright — STANDARDS AUSTRALIA

Users of Standards are reminded that copyright subsists in all Standards Australia publications and software. Except where the Copyright Act allows and except where provided for below no publications or software produced by Standards Australia may be reproduced, stored in a retrieval system in any form or transmitted by any means without prior permission in writing from Standards Australia. Permission may be conditional on an appropriate royalty payment. Requests for permission and information on commercial software royalties should be directed to the Head Office of Standards Australia.

Standards Australia will permit up to 10 percent of the technical content pages of a Standard to be copied for use exclusively in-house by purchasers of the Standard without payment of a royalty or advice to Standards Australia.

Standards Australia will also permit the inclusion of its copyright material in computer software programs for no royalty payment provided such programs are used exclusively in-house by the creators of the programs.

Care should be taken to ensure that material used is from the current edition of the Standard and that it is updated whenever the Standard is amended or revised. The number and date of the Standard should therefore be clearly identified.

The use of material in print form or in computer software programs to be used commercially, with or without payment, or in commercial contracts is subject to the payment of a royalty. This policy may be varied by Standards Australia at any time.

CONTENTS

	<i>Page</i>
FOREWORD	4
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE	5
1.2 REFERENCED DOCUMENTS	5
1.3 DEFINITIONS	5
1.4 DESIGNATION OF GRADE	6
1.5 ROUNDING OF TEST RESULT NUMBERS	7
1.6 MARKING	7
SECTION 2 PROCESSING REQUIREMENTS	
2.1 SCOPE OF SECTION	8
2.2 SURFACE DRESSING	8
2.3 HEAT TREATMENT	8
SECTION 3 PRODUCT REQUIREMENTS	
3.1 SCOPE OF SECTION	9
3.2 CONDITION OF STEEL ON DELIVERY	9
3.3 CHEMICAL COMPOSITION	9
3.4 MECHANICAL PROPERTIES	9
3.5 DIMENSIONAL TOLERANCES	9
SECTION 4 METHODS FOR MECHANICAL TESTING	
4.1 SCOPE OF SECTION	19
4.2 FORM OF TEST SAMPLE	19
4.3 PREPARATION OF TEST SPECIMENS	19
4.4 PREPARATION OF TEST PIECES	19
4.5 TENSILE TEST	20
4.6 HARDNESS TEST	20
4.7 IMPACT TEST	20
APPENDICES	
A PURCHASING GUIDELINES	21
B DETERMINATION OF COMPLIANCE OF A BATCH	22
C RELATED COMPOSITION SPECIFICATIONS	24
D GUIDE TO THE SELECTION OF STEELS BASED ON HEAT TREATMENT, MECHANICAL PROPERTIES AND RULING SECTION	25
E RECOMMENDED MACHINING ALLOWANCES FOR HOT-ROLLED BARS FOR MACHINING	27
F RECOMMENDED MACHINING ALLOWANCES FOR COLD-SIZED BARS FOR MACHINING	27
G RECOMMENDED MACHINING ALLOWANCES FOR PEELED BARS FOR MACHINING	28

FOREWORD

The alloy steels included in this Standard represent some of the former BS 970 En series steels, which are now obsolete. Other steels have been added to meet requirements for Australian quenched and tempered grades.

In this Standard, the various grades of steel are identified basically in the manner used by the American Iron and Steel Institute (AISI) and the Society of Automotive Engineers (SAE). Although the individual chemical compositions may not be identical in all respects, they are so closely related in all essential features that they may be considered interchangeable. Where a major deviation in chemical composition occurs, the prefix letter 'X' is added to the grade designation.

Apart from grades X4036, X4150, X7039, X7232, X9931 and X9940, requirements for the steels specified herein are technically identical with those for the AISI-SAE steels with the same basic identification number, except for the following changes:

- (a) Maximum phosphorus limits lower than 0.040 percent have been increased to this value in all cases.
- (b) Where a silicon content range of 0.15 percent to 0.30 percent is specified, this range has been increased to 0.10 percent to 0.35 percent.
- (c) The specified range for one or more of the principal alloying elements has been widened for steels 4130, 4140, 4340, 5132 and 8740.
- (d) Limits for residual elements given in Clause 3.3.3 of this Standard differ from American practice.

In some cases it was necessary to deviate from this system and to interpolate numbers for some carbon ranges and for variations in manganese, sulfur, chromium and other elements. Examples of these deviations are as follows:

- (i) Grade X4036 has been included to cover the former En 16 grade.
- (ii) The 70XX series is not listed in the current AISI-SAE series, but has been introduced into this Standard to cover the former En 41B grade.
- (iii) The 72XX series is not listed in the current AISI-SAE series, but has been introduced into this Standard to cover former grades En 29B and En 40B.
- (iv) The 99XX series is not listed in the current AISI-SAE series, but has been introduced into this Standard to cover former grades En 25 and En 26.

STANDARDS AUSTRALIA

Australian Standard

Wrought alloy steels—Hardened and tempered to designated mechanical properties

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE. This Standard specifies requirements for wrought alloy steels heat treated to designated mechanical property ranges for general engineering purposes. The steels may be either in the hardened and tempered condition or be capable of being hardened and tempered or nitrided. It applies to hot-rolled and cold-finished (cold-sized or bright) bars for machining, to bars, blooms, billets and slabs for forging, and to forgings.

NOTES:

1. Advice and recommendations on information to be supplied by the purchaser at the time of enquiry and order are contained in Appendix A.
2. Information on the determination of the compliance of a batch is given in Appendix B.
3. Information on alloy steel designations which are specified by other related Standards is given in Appendix C.

1.2 REFERENCED DOCUMENTS. The following documents are referred to in this Standard:

AS

- 1050 Methods for the analysis of iron and steel
 - 1199 Sampling procedures and tables for inspection by attributes
 - 1213 Iron and steel—Methods of sampling
 - 1391 Methods for tensile testing of metals
 - 1399 Guide to AS 1199, Sampling procedures and tables for inspection by attributes
 - 1444 Wrought alloy steels—Standard and hardenability (H) series
 - 1544 Methods for impact tests on metals
 - 1544.1 Part 1: Izod
 - 1816 Method for Brinell hardness test
 - 1817 Method for Vickers hardness test
 - 1821 Suppliers quality systems for design, development, production and installation
 - 1822 Suppliers quality systems for production and installation
 - 1823 Suppliers quality inspection systems
 - 2000 Guide to AS 1821-23—Suppliers quality systems
 - 2338 Preferred dimensions of wrought metal products
 - 2490 Sampling procedures and charts for inspection by variables for percent defective
 - 2706 Numerical values—Rounding and interpretation of limiting values
 - 3900 Quality systems—Guide to selection and use
 - 3901 Quality systems for design/development, production, installation and servicing
 - 3902 Quality systems for production and installation
 - 3903 Quality systems for final inspection and test
 - 3904 Quality systems—Guide to quality management and quality system elements
 - K1 Methods for the sampling and analysis of iron and steel
- ISO**
- 2566/1 Steel—Conversion of elongation values
Part 1: Carbon and low alloy steels
 - 4964 Steel—Hardness conversions
- BS**
- 970 Specification for wrought steels for mechanical and allied engineering purposes
Part 1: General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels
 - 5046 Methods for the estimation of equivalent diameters in the heat treatment of steel

1.3 DEFINITIONS. For the purpose of this Standard, the definitions below apply.

1.3.1 Bars—finished products of solid section which may have rectangular, square, round or hexagonal cross-section, defined as follows:

- (a) *Flat bars (flats)*—bars of rectangular cross-section, with edges of controlled contour and of thickness greater than or equal to 3 mm, width less than 600 mm, and supplied in straight lengths.
- (b) *Round bars (rounds)*—bars of circular cross-section supplied in straight lengths or coils.
- (c) *Square bars (squares)*—bars of square cross-section supplied in straight lengths or coils.