

Australian Standard™

Design of rotating steel shafts

This Australian Standard was prepared by Committee ME-005, Cranes. It was approved on behalf of the Council of Standards Australia on 9 March 2004 and published on 21 May 2004.

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Australian Elevator Association
Australian Industry Group
Australian Institute for Non-Destructive Testing
Bureau of Steel Manufacturers of Australia
Construction and Mining Equipment Association of Australia
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STANDARDS AUSTRALIA

RECONFIRMATION

OF

AS 1403—2004

Design of rotating steel shafts

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Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 1 November 2016.

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NOTES

Australian Standard™

Design of rotating steel shafts

Originated as AS B249—1969.
Previous edition AS 1403—1985.
Fourth edition 2004.

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Published by Standards Australia International Ltd
GPO Box 5420, Sydney, NSW 2001, Australia

ISBN 0 7337 5893 2

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME-005, Cranes, to supersede AS 1403—1985.

The 1985 edition was reviewed by the Committee, and it was found to be technically valid. Hence, this edition does not include technical alterations to the 1985 edition; however, the referenced documents have been updated, and editorial changes have been made to align with current Standards Australia policy.

The term ‘informative’ has been used in this Standard to define the application of the appendix to which it applies. An informative appendix is only for information and guidance.

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FOREWORD

The method of design in this Standard is the same as that contained in the 1984 issue and is based on calculations for infinite life of the shaft.

It is noted that, as the result of extensive laboratory and/or field tests, shafts of diameters smaller than those resulting from calculations in this Standard may be used.

Although the method is not theoretically precise, it gives results that are of sufficient accuracy for practical purposes. The method makes no allowance for corrosive or other abnormal conditions, such as the presence of buckling, ‘whipping’, cyclic vibrations and similar effects (see Clause 7.2).

In some cases, deflection may be the factor that determines the minimum value of the shaft diameter (see Clause 7.6).

Typical worked examples employing this method of shaft design are given in Appendices D, E and F.

A ‘trial’ diameter may be necessary in the application of the design method. The value may be assumed on the basis of the designer’s previous experience, or a simplified version of the method may be used to determine the order of magnitude of the shaft diameter, and the full method then applied to check the assumed trial diameter. A convenient quick method of estimating the ‘trial’ diameter is given in Appendix A, and an iterative method using programmable calculators is provided in Appendix B.

The process of carrying out an accurate and complete analysis of loadings applied to a shaft (see Clause 5) may involve much time and effort, and is warranted where it is desired to keep shaft diameters as small as possible. Where larger diameter shafts can be tolerated, it may be more appropriate to use approximations or to ignore inertia or other effects, but it is important to ensure that, where such inaccuracies are introduced, they result in increased rather than decreased margin of safety and stress-raising characteristics are avoided.

The effect of electric motors with high breakdown torque (also known as pull-out torque) or high locked-rotor torque (also known as starting torque) and the characteristics of motor controllers and torque-limiting devices are outlined in Appendix C.

STANDARDS AUSTRALIA

Australian Standard Design of rotating steel shafts

1 SCOPE

This Standard provides formulae for the design of rotating steel shafts that are subjected to torsional, bending and axial-tensile loads either singly or in combination, on the basis of infinite life.

The Standard does not cover specially developed shafts, for example, those involving extensive laboratory and field testing, heat treatment and like developments, or to shafts for specific applications such as automotive and construction equipment transmissions.

NOTES:

- 1 Particular consideration has to be given to deflections of long shafts where the effects of out-of-balance forces tend to induce 'whipping', and to long shafts that are subject to buckling due to compressive loading (see Foreword).
- 2 The use of this method of shaft design enables justification of the use of shafts of minimal diameter. Where the designer conservatively sizes a shaft, then only those calculations necessary to ensure that the shaft complies with this Standard (see Clause 5) are required.
- 3 A 'trial' shaft diameter is given in Appendix A.
- 4 An interactive method for calculating minimum diameter of shaft is given in Appendix B.
- 5 Characteristics of motor controllers and torque-limiting devices are provided in Appendix C.
- 6 A typical worked example for crane driving mechanism is provided in Appendix D.
- 7 A typical worked example for crane hoist drive is provided in Appendix E.
- 8 A typical worked example for conveyor drive is provided in Appendix F.

2 REFERENCED DOCUMENTS

The following documents are referred to in this standard:

AS

- | | |
|--------|---|
| 1391 | Methods for tensile testing of metals |
| 1654 | ISO system for limits and fits |
| 1654.1 | Part 1: Bases of tolerances, deviations and fits |
| 1654.2 | Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts |

ISO

- | | |
|------|--|
| 14 | Straight-sided splines for cylindrical shafts with internal centering; Dimensions, tolerances and verification |
| 4156 | Straight cylindrical involute splines; Metric module, side fit; Generalities, dimensions and inspection |

BS

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|------|---|
| 2059 | Specification for straight-sided splines and serrations |
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