

Australian Standard®

**NON-DESTRUCTIVE TESTING—
ULTRASONIC TESTING OF
CARBON AND LOW ALLOY
STEEL FORGINGS**

This Australian Standard was prepared by Committee MT/7, Non-destructive Testing of Metals and Materials. It was approved on behalf of the Council of the Standards Association of Australia on 4 December 1987 and published on 17 June 1988.

The following interests are represented on Committee MT/7:

Australian Nuclear Science & Technology Commission
Australian Institute for Non-destructive Testing
Australian Pipeline Industry Association
Australian Welding Institute
Bureau of Steel Manufacturers of Australia
Confederation of Australian Industry
Department of Defence
Department of Industrial Relations and Employment, N.S.W.
Department of Labour and Industry, Victoria
Electricity Supply Association of Australia
Hawker de Havilland Victoria, Aerospace Manufacturing Sector
Institute of Australian Foundrymen
Metal Trades Industry Association of Australia
National Association of Australian State Road Authorities
National Association of Testing Authorities
Pipeline Authority
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which subscribing members receive, and which gives details of new publications, new editions and amendments, and of withdrawn Standards.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.

STANDARDS AUSTRALIA

RECONFIRMATION

OF

AS 1065—1988

Non-destructive testing — Ultrasonic testing of carbon and low alloy steel forgings

RECONFIRMATION NOTICE

Technical Committee MT-007 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

Certain documents referenced in the publication may have been amended since the original date of publication. Users are advised to ensure that they are using the latest versions of such documents as appropriate, unless advised otherwise in this Reconfirmation Notice.

Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 12 July 2022.

The following are represented on Technical Committee MT-007:

Australasian Thermographers Association
Australian Industry Group
Australian Institute for Non-Destructive Testing
Australian Nuclear Science & Technology Organisation
Austroads Limited
Engineers Australia
Institute of Electrical Inspectors
Materials Australia
National Aerospace Non-Destructive Testing Board of Australia
National Association of Testing Authorities Australia
New Zealand Defence Force
New Zealand Non-Destructive Testing Association
Weld Australia

NOTES

AS 1065—1988

Australian Standard[®]

**NON-DESTRUCTIVE TESTING—
ULTRASONIC TESTING OF
CARBON AND LOW ALLOY
STEEL FORGINGS**

First published as AS 1065—1971.
Revised and redesignated AS 1065—1978.
Second edition 1988.

PUBLISHED BY STANDARDS AUSTRALIA
(STANDARDS ASSOCIATION OF AUSTRALIA)
1 THE CRESCENT, HOMEBUSH, NSW 2140

ISBN 0 7262 5053 8

PREFACE

This Standard was prepared by the Association's Committee on Non-destructive Testing of Metals and Materials by its subcommittee on ultrasonic testing, to supersede AS 1065—1978, *Methods for ultrasonic testing of ferritic steel forgings*. It sets out methods for manual ultrasonic testing of carbon and low alloy steel forgings at three recording levels by the use of equivalent reflector sizes.

The Standard covers the use of pulse-echo ultrasonic testing equipment under direct contact conditions. It describes various test methods (using ultrasonic sound waves) which may be specified by manufacturers of forgings, inspecting authorities, or purchasers of forgings for the testing of steel forgings. In this edition, levels of evaluation sensitivity based on equivalent flat bottom hole reflectivity criteria have been introduced.

© 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
SECTION 2. EQUIPMENT AND CALIBRATION	
2.1 GENERAL	5
2.2 PRESENTATION	5
2.3 ASSESSMENT OF HORIZONTAL AND VERTICAL LINEARITY	5
2.4 GAIN CONTROL	5
2.5 FREQUENCY RANGE	5
2.6 PROBES	5
2.7 OVERALL SYSTEM GAIN	5
2.8 RESOLUTION	5
2.9 COUPLANTS	5
2.10 CALIBRATION BLOCKS	5
2.11 REFERENCE BLOCKS	5
SECTION 3. METHODS OF TEST	
3.1 GENERAL	6
3.2 PREPARATION OF TEST SURFACES	6
3.3 PREPARATION FOR TESTING	6
3.4 ATTENUATION	6
3.5 PROBES	6
3.6 METHOD	6
3.7 SENSITIVITY	7
3.8 SCANNING REQUIREMENTS	7
SECTION 4. EVALUATION OF TEST DATA	
4.1 ACCEPTANCE CRITERIA	10
4.2 INTERPRETATION AND RECORDING OF INDICATIONS ...	10
SECTION 5. PRESENTATION OF TEST DATA	
5.1 GENERAL	10
5.2 RECORD OF TEST	10
5.3 TEST REPORT	10
APPENDICES	
A INFORMATION TO BE SUPPLIED WITH THE ENQUIRY OR ORDER	11
B FACTORS INFLUENCING PROBE SELECTION	13
C USES OF REFLECTIVITY (DGS) DIAGRAMS	14
D COMPENSATION FOR CONVEX CURVATURE	18
E SELECTION OF BEAM ANGLE FOR HOLLOW FORGINGS	20
F CLASSIFICATION OF DISCONTINUITIES	21
G METHODS FOR SIZING OF DISCONTINUITIES BY THE INTENSITY DROP METHOD	26
H METHODS FOR THE DETERMINATION OF ATTENUATION AND TRANSFER LOSSES	31

FOREWORD

Procedures described in this Standard make it possible to locate the discontinuities in forgings which have been machined, and which have received a grain-refining heat treatment. In addition, hot-rolled bar substituting for a forged bar can be tested by this method.

Ultrasonic testing of forgings to this Standard is carried out using normal probes. Angle or shear wave probes are used where the geometry of the forging prevents a comprehensive test, or to further evaluate indications detected by normal probes.

Examination of forgings which have not been machined or which have not received a grain-refining heat treatment may be severely restricted and comparison with a calibration block cannot be applied rigidly under these conditions. Ultrasonic testing of forgings for quality assurance in either of these conditions is not recommended.

Where adequate grain refining heat treatment has not been carried out and direct comparison with standard fine-grained calibration blocks is not appropriate, alternative blocks or sections of the forging itself should be used to evaluate sensitivities.

STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard

NON-DESTRUCTIVE TESTING—ULTRASONIC TESTING OF CARBON AND LOW ALLOY STEEL FORGINGS

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This Standard sets out methods for manual ultrasonic testing of carbon and low alloy steel forgings, at three recording levels, by the use of equivalent reflector sizes.

NOTE: Appendix A sets out information that should be supplied to the testing personnel before the commencement of the test.

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

AS 1929 Non-destructive testing—Glossary of terms

AS 1965 The measurement of surface roughness with direct-reading stylus electronic instruments

2083 Calibration blocks and their methods of use in ultrasonic testing

1.3 DEFINITIONS. For the purpose of this Standard, the definitions given in AS 1929 apply.

SECTION 2. EQUIPMENT AND CALIBRATION

2.1 GENERAL. The ultrasonic testing system shall be capable of displaying discontinuities likely to be present in forgings and of delineating their boundaries and contours.

2.2 PRESENTATION. A-scan presentation shall be used. The equipment shall be calibrated in accordance with AS 2083.

NOTE: C-scan presentation may be used by agreement between contracting parties.

2.3 ASSESSMENT OF HORIZONTAL AND VERTICAL LINEARITY. Horizontal and vertical linearity shall be assessed for the test ranges to be used. Any deviation of horizontal linearity exceeding 2 percent over the full screen width or vertical linearity exceeding ± 2 dB between 30 percent and 100 percent graticule height shall be known and recorded. Suppression should not be used. If used, its effect on vertical and horizontal linearity shall be known and recorded.

2.4 GAIN CONTROL. A gain control calibrated in steps not exceeding 2 dB shall be used for measuring the ratios of ultrasonic amplitudes.

2.5 FREQUENCY RANGE. The equipment shall be capable of testing at a frequency within the range 1 MHz to 10 MHz.

2.6 PROBES. Either single or twin probes may be used. They should have a nominal frequency suitable for use in the range 1 MHz to 10 MHz. Dominant frequency may be measured in accordance with AS 2083.

Probes having a specified frequency may be used by agreement, as provided for in Appendix B.

2.7 OVERALL SYSTEM GAIN. The overall system gain shall be assessed in accordance with AS 2083 and shall be not less than 20 dB.

2.8 RESOLUTION. The equipment should be capable of readily resolving adjacent reflectors with a separation along the beam axis of 2.5 wavelengths. For carbon and low alloy steels the nominal velocity of compression waves is 5920 m/s and 3230 m/s for shear waves. The resolution requirement is therefore as given in Table 2.1

TABLE 2.1
RESOLUTION REQUIREMENT

Nominal frequency MHz	Compression wave probes mm	Shear wave probes mm
1	14.8	8.1
2	7.4	4.1
2.5	5.9	3.3
4	3.7	2.0
5	3.0	1.6
10	1.5	0.8

2.9 COUPLANTS. A couplant with good wetting characteristics and compatible with the steel under test shall be used.

NOTE: The same couplants should be used for calibration and testing.

2.10 CALIBRATION BLOCKS. Calibration blocks as specified in AS 2083 shall be used to calibrate the testing equipment.

2.11 REFERENCE BLOCKS. Reference blocks shall be used to establish sensitivity and the same couplant should be used as that for the test. Blocks containing reference reflectors at various beam path lengths may be used to establish sensitivity or sections of a forging may also be used to establish sensitivity (see Example 1, Paragraph C1.5, Appendix C).