AS 1065—1988

Australian Standard®

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

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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

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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.

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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.

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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).