

Australian Standard™

Non-destructive testing—Ultrasonic testing of ferritic steel castings



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 Standards Australia on 16 June 2000 and published on 6 November 2000.

The following interests are represented on Committee MT/7:

- Australasian Railway Association
- Australian Aerospace Non-Destructive Testing Committee
- Australian Industry Group
- Australian Institute for Non-Destructive Testing
- Australian Nuclear Science & Technology Organization
- Australian Pipeline Industry Association
- Bureau of Steel Manufacturers of Australia
- Industrial Research Limited, New Zealand
- Institution of Engineers, Australia
- National Association of Testing Authorities, Australia
- New Zealand Non-Destructive Testing Association
- Society of Automotive Engineers — Australasia
- Test Safe Australia
- Victorian WorkCover Authority

Additional interests participating in the preparation of this Standard:

- Division of Telecommunications and Industrial Physics, CSIRO
- Foundries
- Testing Companies

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Australian Standard™

Non-destructive testing— Ultrasonic testing of ferritic steel castings

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee MT/7, Non-destructive Testing of Metals and Materials, to supersede AS 2574—1982, *Non-destructive testing—Ultrasonic testing of steel castings and classification of quality*.

The objective of this revision is to upgrade the requirements for the A-scan ultrasonic testing of ferritic steel castings that are 15 mm or greater in thickness.

During this revision, cognizance was taken of the following Standards:

ASTM A 609-91 Practice for castings, carbon, low-alloy, and martensitic stainless steel, ultrasonic examination thereof.

BS 6208:1990 Ultrasonic testing of ferritic steel castings including quality levels.

Currently there are no International Standards (ISO) published on the subject.

Statements expressed in mandatory terms in notes to tables and figures are deemed to be requirements of this Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

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FOREWORD

The detection and the location of discontinuities in steel castings are facilitated if a grain-refining heat treatment and appropriate test surface preparation have been carried out.

Where an adequate grain refining heat treatment has not been carried out, it is difficult to make a direct comparison of the ultrasonic response from a casting with that of a distance-amplitude curve (DAC) produced from standard fine-grained reference blocks, or to use recognized distance-gain-size (DGS) principles. In this case, alternative blocks, or sections of the casting itself, should be used to establish the test sensitivity.

Ultrasonic testing of castings is carried out using compression wave (normal) probes, and shear wave (angle) probes where the geometry of the casting limits the effectiveness of normal probes.

Indicated discontinuity sizes should not be taken as absolute in any assessment of serviceability of the casting. Ultrasonic testing can only produce an indication of the response of a discontinuity to ultrasound. The sizing techniques described in this Standard can, in some circumstances, underestimate the true size of small discontinuities.

STANDARDS AUSTRALIA

Australian Standard**Non-destructive testing—Ultrasonic testing of ferritic steel castings**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE AND APPLICATION

This Standard sets out methods for the ultrasonic testing of specified areas of heat-treated ferritic steel castings that are 15 mm or greater in thickness, using A-scan presentation. It employs three evaluation sensitivity levels and divides the casting wall thickness into zones.

NOTES:

- 1 Advice and recommendations on information to be supplied by the purchaser at the time of enquiry and order are contained in the purchasing guidelines set out in Appendix A.
- 2 This Standard does not apply to the testing of austenitic steel castings, unless by agreement, because such castings have a columnar structure which is not amenable to grain refining by heat treatment.
- 3 The level of evaluation of discontinuities is normally specified in relevant product Standards or is determined by agreement between the contracting parties after due consideration of the size, configuration and the service requirements of the casting.
- 4 Steel deposited during repair welding is deemed to be part of the casting.
- 5 This Standard does not include methods for the ultrasonic immersion testing of castings.

Procedures described in this Standard enable the test operator to determine the location, size, shape and often, the identification of discontinuities in all specified zones of heat-treated steel castings. To enable the accurate sizing of discontinuities, castings should be machined or ground to provide optimum probe contact. For unmachined castings it is necessary that some form of surface preparation be carried out.

The recording requirements and the acceptance criteria, as specified in Sections 3 and 5 respectively, may not apply to complicated castings where heavy indentations or shapes are to be produced by machining, e.g. gear teeth or splines, because the zone parameters (see Section 5) cannot be rigidly applied.

NOTE: In such cases the recording/acceptance criteria is subject to negotiation between the purchaser and the supplier.

Although the methods outlined in this Standard are intended to be applied to heat-treated castings, they may be used on non heat-treated castings, by agreement, provided that it is recognized that some types of discontinuity may be difficult to detect in structures that have not been grain refined. In this case, an acceptance standard cannot be applied. For non heat-treated castings, where direct comparison with standard fine grained calibration blocks, or the use of recognized distance-gain-size (DGS) principles, is not appropriate, alternative blocks, or sections of the casting itself, should be used to evaluate discontinuities.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1929 Non-destructive testing—Glossary of terms

2083 Calibration blocks and their methods of use in ultrasonic testing

AS

2207 Non-destructive testing—Ultrasonic testing of fusion welded joints in carbon and low alloy steel.

2382 Surface roughness comparison specimens

3669 Non-destructive testing—Qualification and registration of personnel—Aerospace

3998 Non-destructive testing—Qualification and certification of personnel—General engineering

1.3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 1929 and those below apply.

1.3.1 Air lock

A cavity formed by the entrapment of air during pouring and solidification.

1.3.2 Cold shut

A discontinuity at the surface of a casting formed when liquid metal has flowed over previously solidified or oxidized metal.

1.3.3 Crack

A stress-induced fracture of metal occurring during or after solidification.

1.3.4 Discontinuity outline

The projected image of an internal discontinuity, as outlined by the ultrasonic sizing methods used, marked on the surface of the casting.

NOTE: The outlined area may not be exactly equivalent to the size of the discontinuity.

1.3.5 Discrete discontinuity

A discontinuity such as a gas pore, a refractory inclusion or another type of non-metallic inclusion which produces a clearly defined, sharp, point-like ultrasonic response.

1.3.6 Filamentary shrinkage

A form of shrinkage characterized by extensive branching and interconnected cavities.

1.3.7 Gas porosity

Discrete cavities (pores) formed by the entrapment of gas resulting from the reaction of metal with the mould or a core during solidification, or from the release of gas from solution in the molten metal during solidification.

1.3.8 Hot tear

A fracture, frequently discontinuous and ragged, formed by restraint of metal during solidification or cooling.

1.3.9 Inclusion

Exogenous material entrapped in the casting during solidification.

1.3.10 Macroshrinkage

A large shrinkage cavity or cavities caused by contraction of the steel during solidification.

1.3.11 Microshrinkage

A very fine form of filamentary shrinkage.

1.3.12 Non-planar discontinuity

A volumetric type discontinuity having three dimensions.

1.3.13 Planar discontinuity

A discontinuity having length and width but not thickness.

1.3.14 Sand inclusion

Sand entrapped during solidification.

1.3.15 Segregation

A condition resulting from the local concentration of any of the constituents of an alloy.

1.3.16 Shrinkage

A cavity or cavities formed during solidification as a result of inadequate feeding.

1.3.17 Slag inclusion

A piece of slag entrapped during solidification.

1.3.18 Wormhole

A tubular cavity caused by the release of gas, usually oriented near and normal to the surface of the casting.

1.4 QUALIFICATION OF PERSONNEL

Personnel who perform ultrasonic testing to this Standard shall have recognized qualifications in the specific area of test and shall meet the visual acuity requirements of a relevant national Standard.

NOTE: The Australian Standards for qualification of personnel are AS 3669 and AS 3998. In New Zealand, personnel certification is available from the Certification Board for Inspection Personnel (CBIP).

SECTION 2 EQUIPMENT AND CALIBRATION

2.1 GENERAL

The ultrasonic testing system shall be capable of indicating discontinuities that may be present in castings, and of delineating their boundaries and contours.

2.2 PRESENTATION

A-scan presentation shall be used.

2.3 ASSESSMENT OF HORIZONTAL AND VERTICAL LINEARITY

Horizontal and vertical linearity shall be assessed in accordance with AS 2083 for the test ranges to be used. Any deviation of horizontal linearity exceeding 2% over the full screen width, or vertical linearity exceeding ± 2 dB between 30% and 100% graticule height, shall be recorded. Suppression should not be used unless its effect on vertical linearity is 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

Test equipment shall be capable of testing at a frequency within the range 0.5 MHz to 5 MHz.

2.6 PROBES

2.6.1 Compression wave (normal) probes

Compression wave probes having a 10 mm to 25 mm major dimension and a frequency range of 2 MHz to 5 MHz shall be used for scanning. They may be either single element or dual element.

2.6.2 Shear wave (angle) probes

Shear wave probes having an 8 mm to 25 mm major dimension and a frequency range of 2 MHz to 5 MHz shall be used for scanning. They may be either single element or dual element.

NOTES:

- 1 Probes of other frequencies and sizes may be used for accurately locating and evaluating indications.
- 2 Factors influencing probe selection are given in Appendix B.
- 3 The dominant frequency of all probes should be measured in accordance with AS 2083.

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 shall be capable of resolving adjacent reflectors that have a separation along the beam axis of 2.5 wavelengths. The resolution of the equipment shall be in accordance with the requirements of Table 2.1.

NOTE: In ferritic steels the nominal velocity of compression waves is 5920 m/s and of shear waves is 3280 m/s.

TABLE 2.1
REQUIREMENTS FOR RESOLUTION
OF ADJACENT REFLECTORS

Nominal frequency MHz	Maximum separation of reflectors, mm	
	Compression (longitudinal) wave probes	Shear (transverse) wave probes
0.5	29.6	16.2
1.0	14.8	8.1
2.0	7.4	4.1
2.5	5.9	3.3
4.0	3.7	2.0
5.0	3.0	1.6

2.9 COUPLANTS

Couplants shall have good wetting characteristics and be compatible with the casting under test. The same couplant shall be used for calibrations and examinations.

2.10 CALIBRATION BLOCKS

Calibration blocks manufactured in accordance with AS 2083 shall be used to calibrate the equipment.

2.11 REFERENCE BLOCKS

Blocks containing reference reflectors at various beam path lengths may be used to establish a distance-amplitude curve (DAC).

NOTE: Sections of a casting may also be used to establish sensitivity (see Clause 3.3.2).

SECTION 3 METHOD OF TEST

3.1 GENERAL

Because it is difficult to completely specify scanning patterns or procedures, it is important for the purchase order to include sufficient information, together with suitably marked-up drawings that show critical and highly stressed regions, to enable appropriate scanning procedures to be determined.

3.2 PREPARATION OF TEST SURFACES

3.2.1 General requirements

All surfaces over which probes are to be traversed shall have the following characteristics:

- (a) A profile to permit uniform probe contact throughout the test.
- (b) A roughness that does not exceed $6.3 \mu\text{m } R_a$ (see AS 2382).

NOTES:

- 1 A machined surface is preferred for testing.
- 2 Where grinding is used to prepare the test surface, care is required to prevent excessive roughness and burring and to preserve the natural profile of the casting.
- 3 Abrasive blasting, needle gun or flame descaling, followed by wire brushing, usually produces a satisfactory testing surface; however, local grinding may be necessary to ensure adequate probe contact.
- 4 Dimpled, rippled, excessively shot blasted, heavily grooved, ground or machined finishes can cause high transmission losses and spurious echoes.

Methods used to prepare test surfaces shall not be detrimental to the casting.

3.2.2 Additional surface requirements

Where a product Standard requires a surface finish for testing to be better than that specified in Clause 3.2.1, such requirements shall apply.

3.3 PREPARATION FOR TESTING

3.3.1 Time base calibration

The time base shall be calibrated in accordance with AS 2083, and be verified against a known thickness of the casting under test to determine if the sound velocity within the material varies from that of the calibration block by more than $\pm 2\%$.

3.3.2 Preparation of reference blocks

Reference blocks shall be prepared from one of the following:

- (a) Material of similar composition and heat treatment to the casting.
- (b) Material having known attenuation characteristics.
- (c) A non-critical section of the casting.

NOTES:

- 1 Reference holes should be drilled in castings only with the approval of the purchaser. Whether such holes are repaired after testing or are allowed to remain in the casting is subject to the discretion of the purchaser.
- 2 Where side-drilled holes are used instead of flat-bottomed holes, it is necessary to assess and record the relationship between the two.

Where steel similar to that being tested is not available, corrections for attenuation and transfer loss shall be made in accordance with Appendix C.

3.3.3 Distance amplitude curves

Distance amplitude curves used for the assessment of discontinuities shall be prepared in accordance with AS 2083 using reference blocks prepared in accordance with Clause 3.3.2.

As an alternative, recognized distance-gain-size (DGS) principles may be used to establish a distance amplitude curve provided any attenuation characteristics are accounted for.

3.4 DETERMINATION OF ATTENUATION AND SUITABILITY FOR ULTRASONIC TESTING

3.4.1 General

A casting can show different attenuation characteristics in different zones. Therefore, it is necessary to assess the attenuation throughout the zone under test, or in zones as near as practicable to those under test.

3.4.2 Determination of suitability for ultrasonic testing

The procedure to be used to determine whether a casting can be effectively tested by the ultrasonic method using the specified probe(s) and to determine how to compensate for attenuation, shall be as follows:

- (a) Determine the attenuation coefficient in terms of dB loss/mm transit path (see Appendix C). Should the attenuation coefficient exceed 0.01 dB/mm, completion of the test should be subject to—
 - (i) the assurance of the operator that the required sensitivity can be obtained throughout the full thickness of the casting; and
 - (ii) agreement between the purchaser and supplier.
- (b) Determine the attenuation and transfer loss correction factor as detailed in Appendix C and apply it to the scanning and evaluation sensitivity settings.

3.5 PROBES

Probes shall comply with the requirements of Clause 2.6.

The selection of probes for scanning is dependent on the section thickness and shall be in accordance with the following:

- (a) Compression wave probes (single element and dual element) for volumetric flaws, in accordance with Table 3.1.
- (b) Shear wave probes (single element and dual element) for planar flaws, in accordance with Table 3.2.

NOTE: For shear wave probes, the recommended angles of refraction are 45°, 60° and 70°; however, other angles may be applied depending on particular circumstances. Information on the selection of beam angle for the testing of hollow castings is given in Appendix D.

3.6 METHOD

3.6.1 General

Castings shall be tested using compression wave probes to ensure that, as far as possible, the whole volume of the casting is scanned in those zones specifically identified as critical or highly stressed. The testing shall be carried out using particular probes to ensure that the beam axis is, as far as possible, aligned normal to the maximum reflecting surface(s) of any expected discontinuity and to ensure that discontinuities at all likely locations and orientations are detected.

All testing shall be carried out at the scanning sensitivity specified in Clause 3.6.2.

NOTE: Information on compensation required when using flat probes on convex surfaces, or for convex curvature of the back wall, is given in Appendix E.

TABLE 3.1
SIZE AND FREQUENCY OF COMPRESSION WAVE PROBES

Section thickness	Maximum probe size (major dimension)	Frequency
mm	mm	MHz
≥15 ≤30	25	4 to 5
>30 ≤100	25	2 to 4
>100	25	2

NOTE: For subsurface investigations, it may be advantageous to use dual element (twin crystal) probes or short pulse length single probes.

TABLE 3.2
SIZE AND FREQUENCY OF SHEAR WAVE PROBES

Examined thickness	Maximum probe size (major dimension)	Frequency
mm	mm	MHz
≤30	25	4 to 5
>30 ≤100	25	2 to 4
>100	25	2

3.6.2 Scanning

3.6.2.1 General

Scanning shall be carried out using probes selected in accordance with Clause 3.5, from the surfaces nominated and to the extent of coverage required. The scanning rate shall not exceed 150 mm/s.

Twin crystal probes should be used for the detection of flaws located close to the entry surface.

3.6.2.2 Scanning sensitivity

Scanning shall be carried out using a gain of at least 6 dB greater than that required to bring the signal from a 6 mm diameter flat bottom hole reference reflector at the maximum beam path length to 40% graticule height. For long items, the beam path may be divided into sections to improve clarity of presentation.

3.6.3 Evaluation and recording sensitivity

Unless otherwise agreed by contracting parties, the sensitivity used for the evaluation of discontinuities shall be that necessary to enable comparison with either a 6 mm diameter flat-bottom hole or a reflector with equivalent reflectivity, at the same beam path distance.

Discontinuities shall be evaluated and recorded for reflectivity, dimension, including length, width and where possible, section depth (see Section 4) and location, using one of the following levels:

- (a) *Level 1*—For the DAC method, a discontinuity is evaluated and recorded if its amplitude is equal to or greater than one half of the amplitude resulting from a 6 mm diameter flat-bottom hole. For the DGS method, a discontinuity is evaluated and recorded if its amplitude is equal to or greater than the amplitude resulting from a 4 mm diameter flat-bottom hole.

- (b) *Level 2*—For both the DAC and the DGS methods, a discontinuity is evaluated and recorded if its amplitude is equal to or greater than the amplitude resulting from a 6 mm diameter flat-bottom hole.
- (c) *Level 3*—For the DAC method, a discontinuity is evaluated and recorded if its amplitude is equal to or greater than double the amplitude resulting from a 6 mm diameter flat-bottom hole. For the DGS method a discontinuity is evaluated and recorded if its amplitude is equal to or greater than the amplitude resulting from a 8 mm diameter flat-bottom hole.
- (d) When the presence of a discontinuity reduces the back echo by 50% or greater.

When the evaluation and recording sensitivity level is not specified at the time of enquiry or order, Level 2 shall apply.

3.6.4 Alternative scanning and evaluation sensitivities

Where reference reflectors, evaluation and recording levels other than those specified in Clause 3.6.3 are required by the purchaser, these details should be specified at the time of enquiry or order.

3.6.5 Acceptability

The acceptance criteria are specified in Section 5 of this Standard.

NOTE: A summary of scanning sensitivity and evaluation sensitivity levels, details of the recording method, the sizing method and the acceptance criteria are given in Table 5.1 (see Section 5). The application of Table 5.1 is subject to compliance with the requirements of Clause 3.4.

SECTION 4 IDENTIFICATION AND SIZING OF DISCONTINUITIES

4.1 GENERAL

The type, size and orientation of discontinuities in a casting are influenced by the design, the method of manufacture and the metallurgical factors involved in the solidification of metal; hence, discontinuities tend to be associated with particular features of the casting and have a characteristic location, orientation and ultrasonic response.

NOTE: Guidance on the nature, the location and the identification of discontinuities common to steel castings is given in Appendix F.

4.2 ULTRASONIC RESPONSE TO DISCONTINUITIES—CHARACTERISTIC RESPONSE

4.2.1 Discrete discontinuities

Ultrasonic responses from discrete discontinuities are characterized by a strong signal followed by a sharp drop in signal strength when the probe is moved through one probe diameter in any direction.

4.2.2 Planar discontinuities

Ultrasonic responses from planar discontinuities are characterized by a strong signal which can be traced over an area, provided one dimension is greater than the probe diameter.

NOTE: Planar discontinuities may be branched, and may cause a reduction in the back echo.

4.2.3 Non-planar discontinuities

Non-planar discontinuities usually produce a multipeak ultrasonic response and a loss of the back echo.

4.3 SIZING OF DISCONTINUITIES

4.3.1 General

The sizing of discrete and planar types of discontinuities in castings usually does not present any difficulty; however, the filamentary and branching nature of non-planar discontinuities prevents accurate sizing. It is preferable to describe this type of discontinuity as having a reflectance equivalent to a certain size reference reflector extending over a distance and/or over an area.

The sizing of discontinuities shall be carried out in accordance with one of the methods described in Clauses 4.3.2, 4.3.3 and 4.3.4 or, where an alternative assessment is required, e.g. for the sizing of planar discontinuities, in accordance with the 20 dB drop method or the 6 dB drop method described in Appendix G.

4.3.2 Method for the sizing of discontinuities by reflectivity

The reflectivity, as related to the response from a flat-bottomed hole of equivalent diameter, shall be obtained using the distance amplitude curve (DAC) method, as follows:

- (a) Using a series of distance-amplitude, or other appropriate blocks prepared in accordance with AS 2083, construct a reflectivity diagram comprising an amplitude-reference line corresponding to the evaluation sensitivity specified in Clause 3.6.3.

NOTE: This amplitude-reference line usually corresponds to the response from a series of calibration blocks each containing a 6 mm diameter flat-bottomed hole but having different metal path distances.

- (b) Assess the size of discontinuities by comparing their indications against the amplitude reference line for the flat-bottomed hole size.
- (c) Where the ultrasonic response of the reference blocks and that of a casting are different, determine the difference in attenuation between the reference blocks and the casting in accordance with Appendix C and apply any difference to the DAC reference line obtained in accordance with Step (a) of this Clause.

4.3.3 Last significant echo method for sizing planar and non-planar discontinuities

Planar and non-planar discontinuities shall be sized at the sensitivity appropriate to their position in the casting zone (see Section 5) using the last significant echo method described in Appendix G.

NOTE: When using angle probes, it will be necessary to make appropriate projections of the casting on drawings to correctly locate the discontinuity.

4.3.4 Distance-gain-size method (DGS) for the sizing of discontinuities by reflectivity

The DGS method was developed to determine flaw sizes by comparison to a back wall echo produced on the part being ultrasonically tested. The derivation of DGS curves is extensively covered in standard texts on ultrasonic testing. The distance or the thickness of the casting being tested shall be accurately defined on the screen, as noted on the overlay. The back reflection of the part shall then be established and a suitable amount of gain added. Flaw echo indications that appear are sized using the flaw size curves on the overlay. An example of a DGS overlay is shown in Figure 4.1.

NOTE: The reflectivity diagram method illustrated in Appendix H is an alternative method to the use of the clip-on DGS overlay for the sizing of discontinuities.

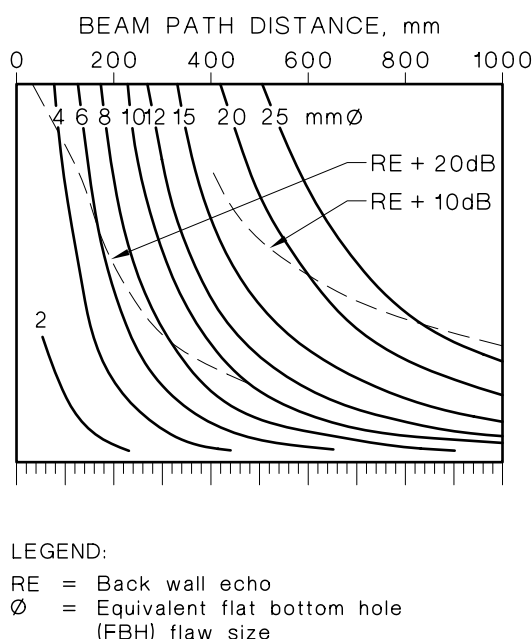


FIGURE 4.1 EXAMPLE OF A DGS OVERLAY

SECTION 5 APPLICATION ZONES AND ACCEPTANCE CRITERIA

5.1 GENERAL

As this Standard is intended for application to castings that have a wide variety of sizes, shapes, compositions, melting processes, foundry practices and applications, it is impractical to specify ultrasonic acceptance limits that would be universally applicable to such a diversity of products. Ultrasonic acceptance or rejection criteria for individual castings should be based on a realistic appraisal of service requirements derived from practical experience and the quality that can normally be obtained in production of the particular type of casting.

5.2 ZONES OF CASTING

5.2.1 General

Unless otherwise agreed between the purchaser and the founder, for the purposes of assessment, the casting wall thickness shall be regarded as being divided into zones comprising a mid zone and two outer zones (see Figure 5.1).

The division of the section thickness into zones shall relate to the dimensions of the section thickness.

If it is required that the zones relate to either the rough-machined or finished-machined dimensions, a drawing detailing these dimensions shall be supplied with the enquiry or order. Under these conditions, unless otherwise agreed, the casting shall be rough machined before testing.

5.2.2 Outer zones

Unless otherwise agreed, the depth of each outer zone in terms of the casting section thickness, T , at time of test, shall be as follows:

- (a) For sections $>15 \text{ mm} \leq 100 \text{ mm}$ thick: $T/3$ or 25 mm, whichever is the lesser.
- (b) For sections $>100 \text{ mm} \leq 300 \text{ mm}$ thick: $T/4$ or 50 mm, whichever is the lesser.
- (c) For sections $>300 \text{ mm}$ thick: $T/8$ or 75 mm, whichever is the lesser.

5.2.3 Mid zone

The mid zone of the casting is the central section located between the two outer zones.

5.2.4 Critical zone(s)

For some castings, it may be necessary to make reference to a critical zone or zones within a specified depth of any surface nominated on the drawing, within which more stringent criteria of acceptance than those applicable to the outer zone may be specified.

5.2.5 Demarcation between zones

The demarcation between mid and outer zones cannot always be interpreted exactly if castings are of complex configuration. If discontinuities are located on the boundaries of the zones, the founder should report and discuss them with the purchaser. A joint decision shall then be made regarding the appropriate quality level to be chosen for the purposes of the inspection.

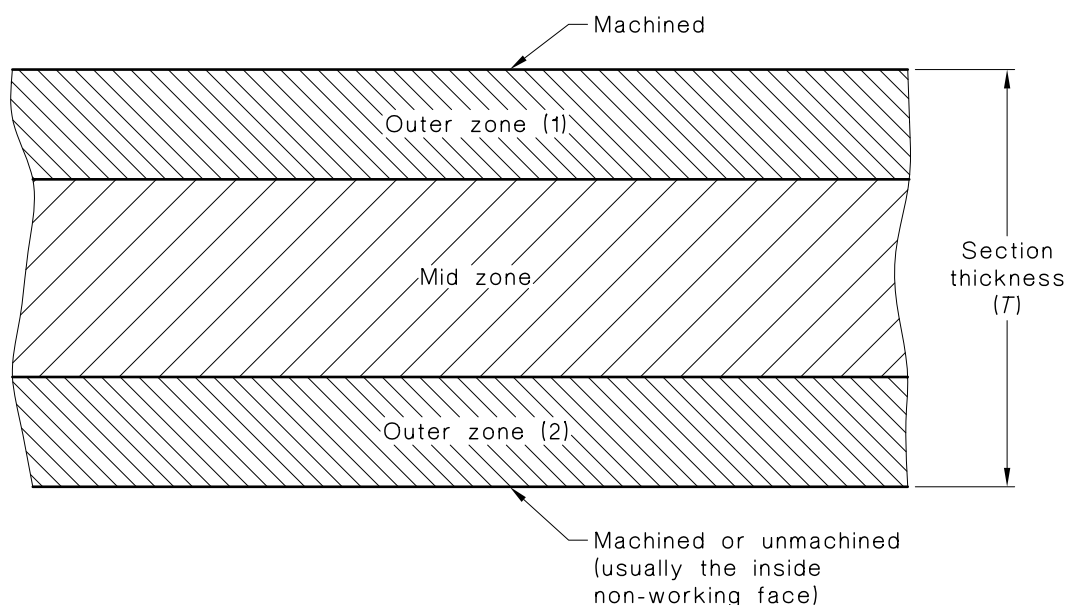


FIGURE 5.1 DIVISION OF CASTING WALL INTO ZONES

5.3 ACCEPTANCE CRITERIA

Unless otherwise agreed by the purchaser and the supplier, when using both the scanning and evaluation sensitivities specified in Clause 3.6, the requirements for acceptance shall be in accordance with Table 5.1.

NOTE: Examples of the application of evaluation sensitivity levels to casting zones are given in Appendix I.

5.4 ACCEPTANCE CRITERIA FOR WELD REPAIRS

Unless otherwise agreed between purchaser and manufacturer, weld repairs shall be inspected and assessed for acceptability in accordance with the requirements stated on the enquiry or order, taking into account the area and zone of the casting in which the weld repair is located.

NOTE: A related Standard for the ultrasonic testing of fusion welds in steel is AS 2207.