

Australian Standard[®]

Metal castings

Part 1: Ferrous sand moulded



This Australian Standard® was prepared by Committee MT-001, Iron and Steel. It was approved on behalf of the Council of Standards Australia on 27 June 2007. This Standard was published on 12 September 2007.

The following are represented on Committee MT-001:

- Australasian Railway Association
 - Australian Building Codes Board
 - Australian Foundry Institute
 - Australian Industry Group
 - Bureau of Steel Manufacturers of Australia
 - Materials Australia
-

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Metal castings

Part 1: Ferrous sand moulded

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PREFACE

This Standard was prepared by the Australian members of the Joint Standard Australia/Standards New Zealand Committee MT-001, Iron and Steel, to supersede AS 4738.1—2004, *Metal castings—Part 1: Ferrous sand moulded*.

This Standard incorporates Amendment No. 1 (June 2008). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian, rather than an Australian/New Zealand Standard.

The objective of the Standard is to specify the general technical delivery requirements for iron and steel castings, including the requirements for the preparation of the samples and test pieces.

The objective of this edition is to revise the Standard by introducing a designation system for cast iron as specified in ISO/TR 15931.

When material or product Standards differ from this general delivery specification, the materials or product Standards apply. In special cases, variations from these conditions may be agreed upon at the time of order.

This Standard also specifies a group of supplementary requirements, which may be applied to iron and steel castings. These requirements are provided for use when additional testing or inspection is desired, and applied only when individually specified by the purchaser.

During the preparation of this Standard, cognisance was taken of the following International Standards:

ISO/TR

15931 Designation system for cast irons and pig irons

This Standard is one of a series of Standards covering the range of cast irons and steels. The series comprises the following:

AS

1830 Grey cast iron

1831 Ductile cast iron

1832 Malleable cast iron

1833 Austenitic cast iron

1982 Methods for the measurements of case depth in steels

2027 Abrasive-resistant cast irons

2074 Cast steels

4314 Founding—Patterns, pattern equipment and coreboxes for the production of sand moulds and sand cores

4738 Metal casting

4738.1 Part 1: Ferrous sand moulded (this Standard)

5049 Cast iron—Designation of microstructure of graphite

5052 Compacted (vermicular) graphite cast irons—Classification

5053 Ausferritic spheroidal graphite cast irons—Classification

5080 Ferrous materials—Heat treatment—Glossary of terms

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.

Statements expressed in mandatory terms in footnotes to tables are deemed to the requirements of this Standard.

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STANDARDS AUSTRALIA

Australian Standard Metal castings

Part 1: Ferrous sand moulded

1 SCOPE

This Standard specifies the general technical delivery requirements for iron and steel castings, including the requirements for the preparation of samples and test pieces.

When material or product Standards differ from this general delivery specification, the material or product Standard applies. In special cases, variations from these conditions may be agreed upon at the time of order.

NOTES:

- 1 Appendix A lists the supplementary requirements that may be applied to ferrous castings.
- 2 Appendix E lists the application for iron and steel castings.
- 3 For guidance and a list of equivalent Standards on the designation for cast irons and pig irons refer to Appendix H.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1100	Technical drawing
1100.201	Part 201: Mechanical engineering drawing
1171	Non-destructive testing—Magnetic particle testing of ferro-magnetic products, components and structures
1199	Sampling procedures for inspection by attributes
1199.0	Part 0: Introduction to the ISO 2859 attribute sampling system
1199.1	Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
1210	Pressure vessels
1654	ISO system of limits and fits
1830	Grey cast iron
1831	Ductile cast iron
1832	Malleable cast iron
1833	Austenitic cast iron
1988	Welding of ferrous castings
2027	Abrasive-resistant cast irons
2062	Non-destructive testing—Penetrant testing of products and components
2074	Cast steels
3507	Non-destructive testing
3507.1	Part 1: Guide for radiography for ferrous castings
3507.2	Part 2: Radiographic determination of quality of ferrous castings

AS

3978 Non-destructive testing—Visual inspection of metal products and components

4314 Founding—Patterns, pattern equipment and coreboxes for the production of sand moulds and sand cores

5052 Compacted (vermicular) graphite cast irons—Classification

5054 Ausferritic spheroidal graphite cast irons—Classification

AS/NZS

1050 Methods for the analysis of iron and steel

1050.1 Part 1: Sampling iron and steel for chemical analysis

2574 Non-destructive testing—Ultrasonic testing of ferritic steel castings

AS/NZS ISO

9001 Quality management systems—Requirements

9004 Quality management systems—Guidelines for performance improvements

HB 18.28 Conformity assessment—Guidance on a third-party certification system for products

ISO

185 Grey cast irons—Classification

1083 Spheroidal graphite cast irons—Classification

2892 Austenitic cast iron—Classification

5922 Malleable cast iron

9147 Pig irons—Definition and classification

16112 Compacted (vermicular) graphite cast irons—Classification

17804 Founding—Ausferritic spheroidal graphite cast irons—Classification

21988 Abrasion-resistant cast irons—Classification

BS

3100:1991 Specification for steel castings for general engineering purposes

3 DEFINITIONS

For the purposes of this Standard, the definitions below apply.

3.1 Certificate of compliance

Certificate stating that the castings comply with the requirements of the purchaser's order.

3.2 Non-specific inspection and testing

Inspection and testing carried out by the manufacturer in accordance with his own procedures, on test blocks or castings made by the same manufacturing process, but not necessarily on the test blocks or castings actually supplied.

3.3 Specific inspection and testing

Inspection and testing carried out on the test lot to be supplied, in order to verify whether these products comply with the requirements of the order.

3.4 Test certificate

A certificate showing the results of tests carried out to establish compliance with this Standard, including any additional tests agreed at the time of ordering.

4 INFORMATION TO BE SUPPLIED BY THE PURCHASER

4.1 Ordering requirements

The order shall include all of the particulars necessary to allow manufacturing and testing to proceed.

4.2 Order information

The purchaser shall, as a minimum, provide the following information at the time of enquiry and order:

NOTE: For supplementary requirements, see Appendix A and Appendix G.

- (a) A description of the casting by pattern number and/or drawing number.

- (b) The number of castings to be made from each pattern or drawing.

NOTE: Variations in the ordered quantities should be agreed to at the time of enquiry and/or order.

- (c) The material Standards and grade designation.

NOTES:

1 The Australian Standard and grades of iron or steel can be found in AS 1830, AS 1831, AS 1832, AS 1833, AS 2027 and AS 2074 (See Appendix D).

2 When specifying the grade for wear resistant iron, the minimum wear life should be specified at the time and/or enquiry.

- (d) Delivery information (required date or schedules, delivery location and terms of delivery).

- (e) Patterns, drawings or samples of the casting with finished casting (see Appendix C) dimensions, tolerances and machining locations clearly indicated. When no drawing is supplied, the casting is purchased to pattern supplied and the manufacturers shall not be responsible for the shape and dimensions of the castings.

When both a pattern and drawing are supplied by the purchaser, the pattern shall be capable of producing a casting in the specified material complying with the drawing.

NOTE: A pattern is designed to be used with one material. When used with different materials a variation in the design weight and dimensions may result which could prevent the meeting of the requirements specified in Paragraph A2.2, Appendix C and AS 4314.

- (f) Available information regarding significant difficulties previously encountered in connection with castings of the same or similar pattern.

- (g) Any supplementary requirement including surface defects.

NOTES:

1 The purchaser's visits and/or inspections to exercise these options should not cause interference to the normal operations of the manufacturer, and all visitors need to comply with the manufacturer's plant rules for visitors.

2 It is recommended that before the patterns are made, and preferably while the design is still on the drawing board, that the purchaser confer with the manufacturer regarding casting requirements. The exact service conditions under which the ferrous castings will have to operate are rarely known to the manufacturer and the quality of the ferrous castings required to match the service conditions may only be determined by the purchaser, who should give an indication of the quality Standards required at the time of enquiry. In this regard, the manufacturer's experience can often assist the purchaser in obtaining castings best suited for his overall needs.

3 For guidance on supplementary requirements for surface texture and discontinuities, refer to Appendix F.

5 CONDITIONS OF MANUFACTURE

5.1 Foundry practice

Unless otherwise agreed at the time of enquiry and/or order, or otherwise specified in the material Standard, the techniques used for moulding, metal melting, casting and heat treatment shall be at the discretion of the manufacturer.

5.2 Fettling and dressing

All castings shall be properly fettled and dressed, and all surfaces shall be satisfactorily cleaned for inspection purposes.

Unless specified to the contrary at the time of enquiry and order, the castings shall be delivered in the unmachined condition, trimmed, with heads and gates removed. Feeders, pads and other modifications to the shape shall be removed unless otherwise agreed between purchaser and manufacturer. Accessible surfaces shall be free from adhering sand and loose scale.

NOTE: In view of the costs involved in excessive fettling operations, it is recommended that the purchaser and the manufacturer negotiate the degree of fettling required.

5.3 Freedom from defects

Notwithstanding the fact that castings may have been accepted previously, if subsequent processing reveals non-compliance with the purchaser's order and referenced documents, the castings shall be deemed not to comply with this Standard, provided that they have not been improperly treated after delivery.

5.4 Welding

Welding rectification of defects in steel castings shall be permitted unless agreed otherwise at the time of enquiry and/or order. Any limitations on the method, extent or location of repairs shall be agreed at the time of enquiry and/or order.

Weld repairs shall be carried out in accordance with AS 1988 or another welding Standard approved by the purchaser.

Qualification of the weld procedure shall include any preheat and post-weld heat treatment that is appropriate to the parent metal and weld metal.

Rectification of defects in iron castings, that will not impair the subsequent processing and usefulness of the castings, shall be permitted unless otherwise agreed. If restrictions are to be placed on the method, extent and location of repairs and proof of fitness for purpose then these shall be negotiated by the purchaser and the manufacturer at the time of enquiry and/or order.

NOTE: Aspects such as the intent to perform surface hardening after machining may make restrictions on welding appropriate.

6 INSPECTION AND TEST REQUIREMENTS

NOTE: See Appendix B for guidelines on compliance with this Standard.

6.1 Mechanical testing

6.1.1 General

When the material Standard requires specific mechanical properties for the order grade, the mechanical properties of specimens taken from test bars obtained in accordance with Clause 6.1.2 shall comply with the requirements for the relevant grade.

6.1.2 *Provision of test bars for mechanical properties*

Whether test bars for mechanical properties are required to be attached to the casting (integral) or separately cast should be negotiated at the enquiry stage. If the purchaser does not specify a requirement, the method of providing the test bars shall be at the manufacturer's discretion.

If integral test bars are required, the location and number are subject to agreement between the purchaser and the manufacturer at the time of enquiry and/or order.

If a casting is made from more than one cast (except where the casts are mixed in one ladle before pouring and may be considered as a single cast), the number and the position (if applicable) of the test bars are subject to agreement between the purchaser and the manufacturer at the time of enquiry and/or order.

The test bars shall be prepared in accordance with the relevant mechanical testing Standard.

NOTES:

- 1 It is recommended that separately cast test bars be used wherever possible, since the attachment and removal of integral test bars may have adverse effects on the quality of the casting.
- 2 It is emphasized that neither integral nor separately cast test bars exhibit mechanical properties which are fully representative of the properties of the casting under all manufacturing conditions.

6.2 Chemical composition

6.2.1 *General*

When the material Standard requires a specific chemical composition for the order material grade, the chemical composition of samples obtained in accordance with Clause 6.2.2 shall comply with the requirements for the relevant grade in the material Standard.

6.2.2 *Sampling*

A chemical analysis sample for each cast shall be analyzed to determine the proportions of the specified elements and residuals. The method of sampling for chemical analysis shall be in accordance with AS/NZS 1050.1. The chemical composition shall be determined by any procedures which are at least as accurate as those in the AS/NZS 1050 series of Standards.

Where one ladle is used for a casting, the reported composition shall be that of a sample removed from that ladle. Where more than one ladle is used for a casting, the reported composition shall be that of the weighted mean of the compositions of all the ladles used.

6.2.3 *Residual elements*

Elements which are designated as residual elements in the individual specifications in materials Standards shall not be intentionally added. Where these elements are present, their proportions shall be kept as low as is practicable.

The reporting of unspecified residual elements shall be at the manufacturer's discretion unless otherwise agreed.

6.3 Visual examination

Examination of the accessible surfaces of the casting shall be carried out visually in accordance with AS 3978.

NOTE: Supplementary requirements may be used when additional inspection is desired (see Appendix A). Unacceptable surface discontinuities may be rectified by removal and/or repair, followed by visual re-examination to the original requirements.

6.4 Dimensions and tolerances

The shape and dimensions of the casting shall comply with the casting dimensional tolerances and machining allowances shown in Appendix C unless otherwise negotiated at the time of enquiry and order.

In case of dispute, verification of the dimensions shall be carried out on castings in the as-delivered state, at the reference temperature of $20 \pm 5^\circ\text{C}$.

6.5 Non-destructive testing

NOTE: Non-destructive testing may be specified by the purchaser, see Appendix A.

6.6 Certification

When requested by the purchaser at the time of enquiry and order, the supplier shall provide certificates of compliance or test certificates.

6.7 Records

Unless otherwise specified on the order, the manufacturer shall maintain records of results of all of the tests performed to ensure compliance with this Standard for a minimum period of 5 years.

7 MARKING

The location of identification marks (recessed or raised) required by the purchaser or manufacturer and their size and shape shall be indicated on the drawing or incorporated in the pattern, shall be at the purchaser's discretion.

NOTES:

- 1 When castings are to be machined on all surfaces, special arrangements should be made to ensure that the identification of the castings is maintained.
- 2 By agreement, small castings may be batched and the identification marks stamped on the label attached to each batch.
- 3 After delivery, the purchaser has the responsibility of preserving any identification marks necessary for traceability purposes.
- 4 It is considered normal foundry practice to provide identification marks on castings.

8 COMPLAINTS

Complaints shall be lodged in writing. The manufacturer shall be given reasonable access and time to examine the castings in a condition as close as possible to as-delivered.

The purchaser shall preserve and make available to manufacturer evidence of the reason for the complaint.

APPENDIX A

SUPPLEMENTARY REQUIREMENTS

(Informative)

A1 GENERAL

In addition to the requirements of this Standard, one or more of the following supplementary requirements may be requested by the purchaser. These will apply only when specified in the order. Details of these supplementary requirements and their appropriate testing methods and acceptance criteria should be agreed between the manufacturer and purchaser at the time of enquiry and/or order.

A2 PRE-PRODUCTION REQUIREMENTS

A2.1 Subjects for supplementary requirements

Purchasers may wish to add the following requirements:

- (a) *Witnessing*
To specify whether it is the intention of the purchaser to witness the pour and/or inspect the castings at the manufacturer's foundry.
- (b) *Submission sample*
To specify whether a submission sample (or first article) is required. It should be supplied for approval before the production quantities are produced.
- (c) *Hardness testing*
To specify whether the use of raised pads for hardness determination are required, and if so their location should also be specified.
- (d) *Magnetic properties*
To specify whether particular magnetic/non-magnetic properties are required.
- (e) *Annealing lugs*
To specify whether integral annealing lugs on the castings are required.
- (f) *Regulatory authority requirements*
To specify whether any regulatory authority requirements need to be satisfied (e.g. compliance with AS 1210).
- (g) *Marking*
To specify whether cast-in symbols, pattern number or trademarks need to be used and whether the cast-in identification should be raised or recessed including its location and form.

A2.2 Mass

Any mass limitations should be specified. The mass of a casting should correspond either to the mass calculated in accordance with the drawing using the densities in Table A1, or to the mass of a sample with complying dimensions.

NOTES:

- 1 In the first case, possible modifications adopted for casting or moulding, as well as machining allowance, should be taken into account.
- 2 The designation Table A1 should be used as a guide only.

Castings with a mass exceeding 115% of the mass calculated when using actual dimensions, may be rejected. Castings made in accordance with the same drawing and with the same pattern should not vary by more than—

- (a) 5% for machine-moulded castings;
- (b) 7% for castings manufactured individually in accordance with a pattern; and
- (c) 10% for castings manufactured individually in accordance with a template or frame.

For machine-moulded castings, the mass of a casting with complying dimensions may be considered to be the mean mass of the first castings manufactured.

The same pattern should not be used for different mould and/or ferrous casting materials, as this could change the mass of the casting or the casting dimensions, see Appendix C and AS 4314.

TABLE A1
DENSITY OF CASTINGS

Material standard	Density kg/dm ³
AS 1830 (Note 1)	6.90
AS 1830 (Note 2)	7.30
AS 1831	7.15
AS 1832	7.15
AS 1833	7.50
AS 2027 (Note 3)	7.80
AS 2027 (Note 4)	7.40
AS 2074	7.90

NOTES:

- 1 Grades up to and including 250.
- 2 Grades above 250.
- 3 U or NiCr specified grades.
- 4 Cr specifying grades.

A3 PROCESSING REQUIREMENTS

Purchasers may wish to add the following requirements:

- (a) *Defect rectification*

To specify whether there is any restriction or prohibition on defect rectification, e.g. welding.

- (b) *Special heat treatment*

To specify whether any special heat treatment is required.

NOTE: Special heat treatment may produce mechanical properties different from those specified in the materials Standard, and consequently make the material non-complying with that particular material Standard.

- (c) *Gauges and checking fixtures*

To specify whether gauges and checking fixtures are to be used, and if so, the applicable procedures for their use.

(d) *Mechanical property requirements*

To specify whether the mechanical property requirements are different from, or additional to the material Standard, e.g. increased ductility, or the addition of hardness tests.

NOTE: Variations in the physical properties in some circumstances could make the material non-compliant with the particular material Standard.

(e) *Reporting of residual elements*

To specify whether analysis for and reporting of residual elements not listed in the material Standard needs to be conducted.

(f) *Quality management systems*

To specify whether quality management systems are required.

A4 TESTING AND CERTIFICATION

Purchasers may wish to add the following requirements:

(a) *Test bars*

To specify whether integral test bars are required on the casting.

(b) *Test pieces*

To specify whether the purchaser requires to select and identify the test pieces.

(c) *Witnessing*

To specify whether the purchaser or their agent wish to witness the tests being performed.

(d) *Inspection*

To specify whether inspection at the manufacturer's works is required before delivery.

(e) *Statistical control*

To specify whether statistical control techniques will be used, and if so, the method and sampling regime to be employed.

(f) *Certificate*

To specify whether a test certificate or certificate of compliance is required.

(g) *Test records*

To specify whether a period of test record retention more than 5 years is required.

A5 NON-DESTRUCTIVE TESTING

Where non-destructive testing (NDT) is required to be performed, additional requirements for surface finish may be necessary. In this regard, reference should be made to the relevant non-destructive testing Standards.

Purchasers may wish to add the following requirements:

(a) *Surface texture*

To specify whether castings are to be subjected to surface conditions based on visual or tactile samples, e.g. SCRATA or BNIF details. The extent of the examination and the levels of acceptance should be agreed between the purchaser and supplier.

(b) *Pressure tightness tests*

To specify whether pressure-tightness tests are to be performed and conditions (test pressure, fluid, temperature and time), and the interpretation of the results.

(c) *Liquid penetrant inspection*

To specify whether the examination is to be carried out in compliance with AS 2062 or other agreed methods. The extent of the examination and the levels of acceptance should be agreed between the purchaser and supplier.

(d) *Magnetic particle inspection*

To specify whether the examination is to be carried out in compliance with AS 1171 or other agreed methods. The extent of the examination and the levels of acceptance should be agreed between the purchaser and supplier.

(d) *Radiographic inspection*

To specify whether the examination is to be carried out in compliance with AS 3507.1 or other agreed methods. The extent of the examination and the levels of acceptance (see AS 3507.2) should be agreed between the purchaser and supplier.

(e) *Ultrasonic inspection*

To specify whether the examination is to be carried out in compliance with AS/NZS 2574 or other agreed methods. The extent of the examination and the levels of acceptance should be agreed between the purchaser and supplier.

A6 FINISHING

Purchasers may wish to add the following requirements:

(a) *Dressing and fettling*

To specify whether additional or particular dressing and fettling is required.

(b) *Tolerances*

To specify whether special tolerances apply.

(c) *Texture*

To specify whether special surface texture requirements apply.

(d) *Machining*

To specify whether machining, proof, partial or final, is required.

(e) *Datum points*

To specify whether machining datum points are critical.

NOTE: It is recommended that the manufacturer be supplied with a copy of the machining drawing.

(f) *Special finishing*

To specify whether special finishing, including blasting, pickling, metal spraying, painting or enamelling, are required.

(g) *Packaging*

To specify whether procedures for any surface protection, special crating, handling, packing or transportation are required.