

ROADS AND MARITIME SERVICES (RMS)

QC SPECIFICATION 2386

DUCTILE CAST IRON COMPONENTS FOR TIMBER TRUSSES

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ADDITIONAL NOTICE TO SPECIFIERS

*When using this QC Bridgeworks Specification, the specifier must ensure that the wording is appropriate for the particular project. The Specification must not be changed. Any changes required are to be made by inserting clauses into the **Job Specific Requirements** within the General section of the Specification*

RMS QC SPECIFICATION 2386

DUCTILE CAST IRON COMPONENTS FOR TIMBER TRUSSES

REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0		First issued.		

GUIDE NOTES

(Not Part of Contract Document)

Using RMS 2386

RMS 2386 is a RMS QC Bridgeworks Specification.

This specification is intended for use for the supply of new ductile cast iron structural components (made of spheroidal graphite cast iron) to replace existing grey cast iron or welded steel castings in heritage timber truss bridges.

Edition 1

Comments and suggestions on Edition 1 should be forwarded to the Senior Bridge Engineer, Policy and Specifications, RMS Bridge & Structural Engineering, tel. 02 8837 0850 or fax. 02 8837 0054.

Ordering of Structural Castings and Selection of Foundry

Structural castings are critical to the structural performance of the timber truss. Accordingly, RMS 2386 specifies a high level of inspection and testing and mechanical properties which are more stringent than the castings normally produced by foundries.

The production of ductile cast iron castings should be regarded as specialist work. Tenders should only be invited from foundries which have the quality control and competence to meet the RMS 2386 requirements. A sole tender from a proven supplier, who have a track record of successfully producing similar casting types and possesses the particular patterns, may be justified. Conversely, use of foundries where there is a significant risk that the quality will not be met is not justified.

Where possible, castings should be ordered at a minimum of 6 months in advance of the timber truss fabrication work.

Upon placement of the order, provide a copy of the order and the closing date of tender to the Supervising Bridge Engineer (Structural Surveillance and Welding), RMS Bridge & Structural Engineering, tel. 02 8837 0576 or fax. 02 8837 0020 to assist coordination of steel inspector services.

Testing Regime

As mentioned above, the level of inspection and testing specified in RMS 2386 is quite onerous. Therefore, inspection by the Principal's steel inspectors is necessary for such critical structural components.

The Project Manager is given discretion in Annexure 2386/A.3 to require certain additional tests (e.g. separate trial castings) or a more intensive level of testing, in exceptional circumstances where there is a high level of perceived risk; for example, a foundry which have not previously supplied to the RMS or have no previous experience in producing structural castings of the required grade or casting type.

Before specifying any additional testing, the Project Manager should consult with the Supervising Bridge Engineer (Structural Surveillance and Welding), RMS Bridge & Structural Engineering and the bridge designer.

Impact Test

The concessionary test temperature of $-10 \pm 2^{\circ}\text{C}$ (with no adjustment of the required impact resistance value) for the Charpy V-notch impact test as specified in Clause 3.2.2 of this Specification should make the required impact resistance in AS 1831 easier to achieve. This temperature is based on the shade air temperature specified in Table 17.2 (1) of AS 5100.2 for NSW "inland" bridges at

elevations of more than 1000 m height above sea level. The service temperature of timber truss structural castings should be close to the shade air temperature, owing to their small size.

It is not practical to apply a further test temperature concession for inland bridges less than 1000 m height above sea level (e.g. to -5°C) because of the sensitivity of the mechanical properties to variation in temperature just around freezing point, which is aggravated by the $\pm 2^{\circ}\text{C}$ tolerance. No RMS timber trusses exist in “coastal” locations as defined in AS 5100.2 (i.e. less than 20 km from the coast).

Microstructure Analysis

Clause 3.3 require that the microstructure analysis be carried out only on the first ladle of each order, provided that mechanical testing and microstructure analysis results are both satisfactory. Where the test results are nonconforming on the first ladle, the Supplier must carry out further microstructure analyses on each ladle until the test results are conforming for three consecutive ladles (with the additional microstructure analyses at no additional cost to the Principal).

Whenever a new supplier is used, the Project Manager should specify more microstructure analyses to be carried out by the Supplier (preferably for the first five ladles of the order).

Completing Annexure 2386/A

The Project Manager is responsible for preparing Annexure 2386/A after consulting the Regional Bridge Maintenance Planner (RBMP), RMS Bridge & Structural Engineering and the bridge designer.

Protective Treatment

The protective treatment of timber truss structural castings is not covered by RMS 2386 and must be separately arranged by the Project Manager. RMS M743 is the applicable specification and Coating System SC4B with the finish coat colour Black is the applicable coating within RMS M743. The treatment should be consistent for all structural castings supplied under the order.

Handling and Storage of Structural Castings After Delivery

Castings are expensive structural components. They should be carefully handled and stored after delivery in order to minimise deterioration or damage to the protective treatment. All castings delivered to site must be stacked at least 150 mm clear of the ground.

Management of Patterns Produced Under Previous RMS Projects

New patterns produced for the ordered castings remain the property of the Principal and are to be stored at the foundry for a period of 3 years, during which time they can be re-used for future orders from the foundry (refer Clause 2.8).



DUCTILE CAST IRON COMPONENTS FOR TIMBER TRUSSES

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VERSION FOR: DATE:

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FOREWORD

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REVISIONS TO EDITION 1

This document is based on RMS QC Specification 2386 Edition 1 Revision 0 – October 2010.

All revisions to RMS 2386 Ed 1 /Rev 0 (other than minor editorial and project specific changes) have been indicated by a vertical line in the margin as shown here.

PROJECT SPECIFIC CHANGES

Any project specific changes have been indicated in the following manner:

- (a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.
- (b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

RMS QC SPECIFICATION 2386

DUCTILE CAST IRON COMPONENTS FOR TIMBER TRUSSES

1 GENERAL

1.1 SCOPE

This specification sets out the requirements for the supply of ductile cast iron (also known as spheroidal graphite cast iron, SG iron or nodular cast iron) structural components in timber truss bridges, such as shoes, washer plates and anchor blocks that transmit loads between different elements of the truss.

The specification details the inspection, testing and investigation to be undertaken by the Supplier to assure the quality of the castings. Protective treatment of castings is not addressed in this Specification.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.2.1 Details of Work

Project specific details of work are shown in Annexure 2386/A.

1.2.2 Resolution of Nonconformities, Measurement and Payment

The method of measurement and payment must comply with Annexure 2386/B.

Acceptance of materials and work must be in accordance with Annexure 2386/B.

1.2.3 Reference Documents and Abbreviations

Unless otherwise specified the applicable issue of a reference document, other than an RMS Specification, must be the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure 2386/M.

1.3 DEFINITIONS AND ABBREVIATIONS

1.3.1 Definitions

For definitions of casting surface texture and discontinuity related terms used in this Specification, refer to AS 3978.

For definitions of discontinuities assessed by radiography related terms used in this Specification, refer to AS 3507.2.

For definitions of microstructure and graphite related terms used in this Specification, refer to AS 5049.

The following definitions apply to this Specification:

Batch	An amount of molten iron prepared for casting and inoculated at one time to produce ductile iron on solidification. In the context of the Specification, a batch is deemed to be a ladle.
Carbide	A phase in ferrous materials consisting of essentially the compound iron carbide distinguished from the carbide present in the pearlite phase by being present as a separate phase.
Critical bearing surfaces	Surfaces of castings where closer dimensional tolerances are required for even bearing on loaded surfaces or for accurate truss geometry.
Critical stress areas	Areas of castings subject to high stress concentrations. Typical critical stress areas for timber truss shoes are shear keys and bolt connection locations. Critical stress areas must be identified by the Principal.
Design drawings	Detailed drawings provided by the Principal that show geometry, dimensional tolerances and other design requirements for the finished castings.
Dross	Material resulting from the reaction between the molten iron and the inoculant(s) and/or air.
Elongation after fracture	The permanent elongation of a gauge length after fracture, expressed as a percentage of the original length, in accordance with Clause 11.1 of AS 1391. If the original gauge length is not equal to 5 times the specimen diameter, modification of the test must be carried out in accordance with Appendix B of AS 1831.
Ferrite	A phase in ferrous materials consisting of essentially pure iron.
Heat	A stated tonnage of metal obtained from a period of continuous melting in a furnace.
Initial sample casting	The first casting produced from each pattern.
Joint line	Line on a casting resulting from the interface between the top and bottom moulds.
Principal's inspector	Person or persons nominated by the Principal to inspect castings for conformity to specification requirements. Normally, this will be a Surveillance Officer.
Template casting	An existing structural casting provided by the Principal, in the absence of design drawings as the design benchmark for the new finished castings. The template casting could be an original grey cast iron casting.

1.3.2 Abbreviations

The following abbreviations apply to this Specification:

AINDT	Australian Institute of Non-Destructive Testing
CBIP-NZ	Certification Board of Inspection Personnel, New Zealand
NATA	National Association of Testing Authorities
NDE	Non-Destructive Examination

2 MATERIALS AND MANUFACTURING

2.1 MATERIALS

The material from which the structural castings are to be manufactured must be ductile cast iron grade 400-18-LT, material designation ISO 1083/JS/400-18-LT in accordance with Clause 7.1 and Table G.1 of AS 1831, with a concession for impact testing temperature in accordance with Clause 3.2.2 of this Specification.

The material microstructure consists of graphite nodules distributed in a ferritic matrix.

Note: High nodule quantity and reduced nodule size promote improved tensile strength, proof strength, elongation and fatigue strength.

The Supplier must use accepted foundry practices to ensure near eutectic composition { Carbon + $\frac{1}{3}$ (Silicon + Phosphorous) \approx 4.3% } and sufficient inoculant to give nodularity and nodule count to achieve the material requirements of this Specification and to maximise the fatigue strength of the castings.

2.2 PRE-FABRICATION PREPARATION

The Principal must provide one of the following as the design benchmark for manufacture:

- (a) design drawings,
- or
- (b) template castings together with a list of design requirements (e.g. dimensional tolerances).

The Supplier must prepare shop drawings in accordance with AS 4738.1, based on the design drawings or the template castings (as applicable). The shop drawings must allow for casting shrinkage, machining (required by design and for finishing) and casting draft angle (for removal from mould) so as to achieve finished casting dimensions within the tolerances specified in the design drawings (or for template castings, the design requirements) and this Specification (refer Clause 3.5).

Patterns must be dimensionally checked by the Supplier prior to moulding. Notify the Principal of the inspection date and results. The Supplier must reinspect the patterns prior to their use when remoulding is needed.

Unless agreed otherwise, the Supplier must make patterns of durable materials to enable their re-use for up to 3 years after the completion of original production (refer Clause 2.8).

Moulds will be prepared by the foundry with provisions made to produce identification numbers at least 20 mm high, raised at least 2 mm above the surface or equivalent using the foundry's in-house system. Casting identification must be at a discrete location away from surfaces to be machined. Locations of casting identifications must be approved by the Principal prior to pattern production to ensure traceability after installation.

The foundry must obtain the Principal's approval for the location of casting joint line to minimise aesthetic impacts.

2.3 MANUFACTURING

Unless noted otherwise in this Specification or agreed with the Principal's inspector, prepare castings in accordance with AS 4738.1.

Manufacturing must be consistent with established foundry industry best practice, including minimising residual levels of magnesium, deslagging of ladles, good gating and pouring practices, the use of filters in the gating system and the reduction of tramp elements in the melt that promote deterioration of the graphite form, in order to ensure optimum fatigue properties in the ductile cast iron.

The Principal's inspector will witness the pouring of all castings and confirm the identification of the moulds and the test bars poured at the end of each ladle (refer to Annexure 2386/L for the Inspection and Test Plan).

Clean castings after stripping of moulds by abrasive blast cleaning, and then fettle and dress and remove the gating systems and riser pads.

The maximum roughness of unmachined castings surfaces must be 220 µm.

Grind joint lines flush on the visible exterior surfaces of the casting. Unless noted otherwise, round all corners on exposed edges to a radius of 1.5 mm ± 0.5 mm. Carry out surface machining to achieve the required dimensional tolerances as described in Clause 3.5.

Castings after grinding must be made available for inspection by the Principal's inspector.

Finished castings must be inspected by the Principal's inspector prior to application of protective coatings.

2.4 INITIAL SAMPLE CASTINGS

Unless agreed otherwise by the Principal, produce an initial sample casting from each new pattern.

Initial sample castings must be visually inspected by both the fabricator and the Principal's inspector immediately after shakeout of the casting to ensure that major visible imperfections are detected and corrective actions are taken as early as possible.

The Supplier must obtain the Principal's acceptance of the initial sample castings prior to commencing production of the remaining castings. Where the initial sample castings do not conform, produce additional initial sample castings at no cost to the Principal.

2.5 HEAT TREATMENT

This clause applies whenever heat treatment of castings is required to achieve the specified material properties. Do not carry out more than 2 heat treatments for a casting. Inform the Principal the times when heat treatments will be carried out.

Test bars representing castings from a batch must be heat treated with the castings they represent, in accordance with Clause 10.4 of AS 1831.

2.6 TRACEABILITY

Identify each casting produced to this Specification using “cast on” identification marks. This identification must include the relevant heat and ladle number.

Casting for test bars (test blocks) must identify heat and ladle number. Retain this identification throughout for traceability of all castings produced from that ladle.

2.7 RECTIFICATION

Rectify surface defects by machining or grinding, providing a surface roughness similar to, and blending with, the finish on surrounding areas. Do not reduce the cross-sectional thickness of any part of the casting by more than 10% or 3 mm less than the design thickness, whichever is the lesser. The resulting depression must be tapered out smoothly for a distance of at least 75 mm from the defect.

Do not make any cosmetic repairs by any other method to castings.

Do not carry out welding on castings.

2.8 STORAGE AND RE-USE OF NEW PATTERNS

The Principal will retain ownership of all new patterns produced for the castings under the order, for a period of 3 years from the date of the order, for future re-use on any similar castings ordered by the Principal. During this period, the Supplier must store the patterns in dry, sheltered and secure conditions within the foundry at no cost to the Principal.

3 INSPECTION AND TESTING

3.1 GENERAL

This clause specifies the required tests and inspections of castings.

Acceptance by the Principal of a casting will only be made if the test and inspection results conform to this Specification.

A typical Inspection and Test Plan (ITP) is given in Annexure 2386/L and must be completed by the Supplier for each ladle. Where additional or more intensive testing is required for some castings, the additional testing requirements are specified in Annexure 2386/A.3.

The ITP must be completed, signed and dated by both the Principal and the Supplier following each inspection or test. Changes to the ITP must be agreed in writing by the Principal. Figure 2386/L.1 in Annexure 2386/L shows a flowchart of the typical inspections and tests required.

Test reports must contain, where applicable:

- Casting identification;
- Heat and ladle numbers;
- Job number and title;
- Test time, date and procedure;
- Venue; and
- Name of the person who carried out the test.

Test results must be submitted to the Principal.

For radiographic and magnetic particle inspections, carry out testing by a suitably qualified NDE technician. NDE technicians must be currently accredited by AINDT, CBIP-NZ or equivalent overseas institutions. The radiographic test report must be prepared by a qualified and accredited NDE technician, and must contain the NDE technician's signature, NDE qualification and accreditation registration number.

3.2 MECHANICAL TESTS

Machine the specimens for mechanical testing from separately cast samples (test blocks) in accordance with Clause 7.1 of AS 1831. Cast the test blocks following casting of the batch which they represent, and expose them to the same heat treatment (where required) as the represented batch.

Note: Based on the ruling section of typical castings with wall thickness of approximately 25 mm, test blocks Type IIa or IIb would be appropriate.

Cast sufficient test blocks to allow for retesting and heat treatment of the represented batch (where required).

Mechanical tests must be performed by laboratories with the relevant NATA accreditation. Give the Principal's inspector at least 72 hours notice to witness the tests.

3.2.1 Tensile Test

Specimens for tensile testing must be dimensionally proportional in accordance with Clause 9.1 of AS 1831. Use a 14 mm diameter specimen with a gauge length equal to 5 times the diameter. The test method used, loading rate and measurements must be in accordance with AS 1391.

A minimum of one tensile test must be carried out for each ladle.

The following mechanical properties must be reported for each specimen:

- Tensile strength;
- 0.2% proof strength; and
- Percentage elongation after fracture.

Acceptable test results must be in accordance with Table 1 of AS 1831 for material designation ISO 1083/JS/400-18-LT/S.

3.2.2 Impact Test

Carry out Charpy V-notch impact tests on a minimum of three specimens per ladle. Test methods and testing equipment must be in accordance with AS 1544.2. Test specimens must conform to Clause 9.1 of AS 1831.

Acceptable individual and average test results must be in accordance with Table 2 of AS 1831 for material designation ISO 1083/JS/400-18-LT/S, except that the test will be carried out at a temperature of $-10 \pm 2^{\circ}\text{C}$ instead of $-20 \pm 2^{\circ}\text{C}$. Test results will be assessed individually against the acceptance criteria.

3.3 MICROSTRUCTURE ANALYSIS

Determine the microstructure of the graphite in the casting in accordance with AS 5049.

Samples for microstructural analysis may be taken from the tensile test piece after fracture. The test bar cross-section may be used after polishing to a one micron diamond finish and etching. The area of the polished surface must be sufficient to truly represent the graphite distribution. Ensure that after polishing of the specimens, the graphite particles appear in their true form and size.

Present to the Principal a microstructure report including a photomicrograph at a magnification of x100 in the Nital etched condition. The report must describe the microstructure features including form, distribution and size of graphite spheroids and the structure of the matrix.

An acceptable microstructure will comprise well-distributed small size graphite nodules in an essentially fully ferritic matrix. Referring to AS 5049 for graphite microstructure definitions, the nodule size must have a Reference Number of 6 or smaller, the nodule form must be 95% approximately Form VI with the remainder being Form V, and there must be no evidence of Form III (vermicular) graphite, free carbides or dross in the structure.

The microstructure analysis need only be carried out on the first ladle of each order, provided that the test results achieved for mechanical testing and microstructure analysis are both satisfactory.

Where conforming test results are not achieved on the first ladle, carry out further microstructure analyses on each ladle until the results conform for three consecutive ladles. All such further microstructure analyses will be at no additional cost to the Principal.

The microstructure analysis may be carried out by the Supplier in-house (where available) and must be witnessed by the Principal.

3.4 VISUAL INSPECTION FOR CASTINGS

After cleaning, fettling, dressing and heat treatment (where required), visually inspect all castings in accordance with AS 3978.

The visual inspection must be carried out by the Supplier and witnessed by the Principal. Complete and submit to the Principal's inspector an inspection report. The report will include stage of manufacturing at inspection, casting surface conditions and preparation, any access restrictions, details of any observed flaws or defects where applicable, and conformity to this Specification, where applicable.

Acceptable castings must not have visual evidence of linear discontinuities, shrinkage, non-metallic inclusions, gas porosity, expansion discontinuities, fusion discontinuities, inserts, chills or fins, all as defined in Appendix F of AS 3978.

3.5 DIMENSIONAL CHECK AND DIMENSIONAL TOLERANCES

The design drawings show the finished casting dimensions.

It is the Supplier's responsibility to achieve the final casting dimensions within the tolerances specified in the design drawings (or, for template castings, the design requirements) and this Specification.

All finished castings must be dimensionally checked against the Principal's design drawings or template castings. Dimensional checks must be carried out by the Supplier and witnessed by the Principal's inspector.

Unless noted otherwise on design drawings, dimensional tolerances for castings must be in accordance with that shown in Table 2386.1. Special dimensional tolerances apply for critical bearing surfaces, as specified on the design drawings or by the Principal, where the timber truss geometry or alignment is sensitive to the casting dimensions.

Casting surfaces in the unmachined condition are acceptable provided that they meet the specified tolerances. When it is impractical to produce unmachined castings within the specified dimensions and tolerances, carry out machining to achieve these dimensions. The design drawings may specify critical bearing surfaces to be machined.

All tolerances, unless noted otherwise, must be symmetrically disposed with respect to a basic dimension (i.e. one half on the positive side and one half on the negative side).

Apply closer surface flatness tolerances for all surfaces of castings which bear directly against a truss member or connection. Unless noted otherwise on the design drawings, the flatness tolerance Δf , as illustrated in Figure 2386.1, for casting surfaces bearing against metal or timber elements must not exceed ± 0.2 mm or ± 0.7 mm, respectively.

Carry out verification of all dimensions on finished castings in the "ready to deliver" state, at a reference temperature of $20 \pm 5^\circ\text{C}$.

Table 2386.1 - Dimensional Tolerances (mm)

Maximum dimension of the finished casting	Up to and including 400	400 to 1000	More than 1000
General dimensional tolerance	± 3	± 4	± 5
General wall thickness tolerance	± 4	± 6	± 7
Special dimensional tolerance (applicable to dimensions that may affect truss geometry and alignment)	± 0.5	± 1.0	± 1.5

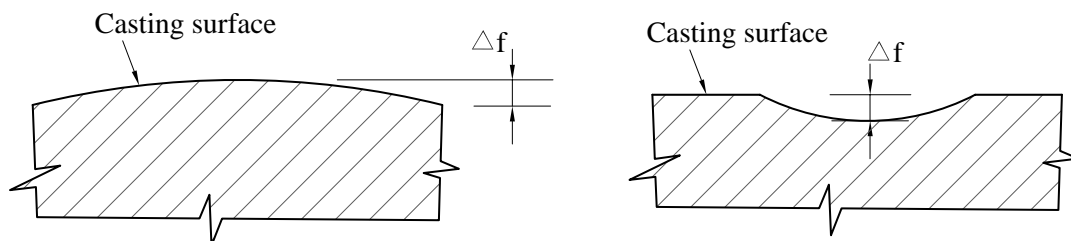


Figure 2386.1: Tolerance on out of flatness of casting surfaces

3.6 BRINELL HARDNESS TEST

Unless agreed on otherwise by the Principal, carry out Brinell hardness tests in accordance with AS 1816.1 on all castings as a production control, to prove that no material inhomogeneity has occurred and that all castings have been heat treated (where required). Use a portable Brinell hardness tester for this purpose.

Unless specified otherwise by the Principal, carry out the test at 3 locations on each casting at different casting wall thicknesses. The locations will be nominated by the Principal to minimise the aesthetic effects of the indentation.

Prepare for the test using polishing to remove all decarburisation and surface anomalies likely to affect the accuracy of the test. The test must be carried out by the Supplier and witnessed by the Principal. The machines used for the test must be recently calibrated.

Testing must be in accordance with Clause 9.3 and Appendix E of AS 1831 for material designation ISO 1083/JS/HBW155. Acceptable test results will range from 135 HBW/3000 to 180 HBW/3000, using a 10 mm diameter ball and test force of 29.42 kN, which is equivalent to a force-diameter ratio of 30 MPa for a test duration time of 5 to 10 seconds.

Test results for castings must be compatible with the measured elongation and tensile strength of test bars from the same ladle. Any discrepancies must be referred to the Principal for further investigation and recommended action.

3.7 RADIOGRAPHIC INSPECTION

Unless agreed otherwise by the Principal, radiographic inspection must be completed on the initial sample casting of each type targeted at the critical stress areas nominated by the Principal. The need for further testing will be decided by the Principal depending on other test and inspection results.

Carry out radiographic inspection on castings after fettling, dressing, machining and heat treatment (where required). Remove all loose scale and excessive roughness to produce a relatively smooth surface so that the interpretation of the radiographs is not impaired and discontinuities are not masked.

Prior to radiographic inspection, provide the testing personnel the material specification, casting configuration and dimensions, details of critical stress areas and other production details such as grinding.

The laboratory carrying out the inspections must have the relevant NATA accreditation and the NDE technician must be suitably qualified in accordance with Clause 3.1.

The inspection report must be in accordance with AS 3507.1 and AS 3507.2, and must contain the NDE technician's signature and NDE qualification and accreditation registration number. The report must also include casting surface condition and preparation, positions of radiography source and corresponding film positions of all exposures, details of any observed discontinuities where applicable, and conformity with this Specification, where applicable.

The following represent the acceptable levels of discontinuities (refer to Table 4 of AS 3507.2 for definitions):

- Gas porosity, blow holes, sand and inclusions – Class 1
- Macroshrinkage – Nil
- Filamentary shrinkage – Class 1
- Hot tears, cracks and unfused chaplets – Nil

3.8 MAGNETIC PARTICLE INSPECTION (MPI)

Carry out magnetic particle inspection in accordance with AS 1171 on all castings on critical stress areas as directed by the Principal. Apply the magnetic field in several directions to enable the detections of cracks with different orientations.

Magnetic particle inspection must be carried out by the Supplier and witnessed by the Principal's inspector. In-house foundry inspections by suitably qualified technicians, in accordance with Clause 3.1, are acceptable.

Acceptable castings must have no linear discontinuities.

3.9 CHEMICAL ANALYSIS INVESTIGATION

The Supplier must provide a report on the chemical composition of the casting to the Principal for information only. Any recognised method for analysis, such as Atomic Emission Spectrometry in accordance with AS 3641.1 for iron, may be used.

3.10 NONCONFORMITY

When a batch fails to achieve the specified mechanical properties during tensile and impact testing, carry out re-tests at the frequency specified in Clause 10 of AS 1831.

Refer to the Principal any failure to achieve the specified requirements during re-testing. The Principal may direct that the castings be rejected or heat treatment be required.

Do not exceed two heat treatment cycles on each casting.

Where test results of castings which have undergone heat treatment are nonconforming, all castings from that batch will be rejected.

Failure to achieve the specified requirements for radiographic inspection will require all castings from that batch and casting type to be re-inspected targeting critical stress areas. Any castings containing flaws outside the specified limits must be referred to the Principal, or rejected.

Failure to achieve the specified requirements for MPI will require the entire surfaces of all castings to be inspected by MPI. Any castings identified as containing flaws outside the limits specified must be referred to the Principal, or rejected.

Nonconformity for the Brinell hardness testing of a casting must require rejection of that casting.

Nonconformity of a casting from visual inspection must require rejection of that casting.

Nonconforming microstructure analysis results must require rejection of all castings from the ladle.

Nonconformity for dimensional tolerances must require additional machining, where applicable, or rejection of the casting.

Additional tests and inspections due to nonconformity must be carried out by the Supplier at its expense as specified in Annexure 2386/B.

3.11 DOCUMENTATION

Bound test and inspection reports, including the signed “Test and Inspection Plan” and a copy of all test certificates, NATA endorsed as applicable, and check sheets, must be supplied to the Principal.

4 TRANSPORT AND HANDLING

Pack and handle all castings so that they are protected from damage during transport. Delivery must be carried out by the foundry at no additional cost to the Principal. Delivery locations and times must be agreed with the Principal.

ANNEXURE 2386/A – PROJECT SPECIFIC REQUIREMENTS

(Refer to Clause 1.2.1)

A1 DETAILS OF WORK

Contract Reference:	
Bridge Name and Location:	
Principal's Bridge No:	
Delivery Location:	
Design Benchmark for Manufacture (Clause 2.2)	Design Drawings / Template Castings (<i>delete as applicable</i>)
Design Drawings Drawing No: Drawing Type:	

A2 CASTING COMPONENT LIST

General Form of Casting (e.g. shoe, block)	Casting Type (code shown in Design Drawings)	Casting Orientation (Left or Right Hand, where applicable)	Number in Each Type

A3 ADDITIONAL TESTING REQUIREMENTS

(Refer to Clause 3.1)

Description or Name of Additional Test	Applicable Castings (e.g. Shoe Type X only)	Required Test Regime (e.g. 1 per Ladle)

ANNEXURE 2386/B – MEASUREMENT AND PAYMENT

B1 PAYMENT

In the Schedule of Prices accompanying the Lump Sum Tender, the cost of castings include the following:-

- shop drawing preparation and the design and manufacture of new patterns and moulds;
- manufacture and supply of the castings listed at Annexure 2386/A, including any additional initial sample castings;
- tests and inspections as described in Clause 3 of this Specification, including any additional tests and inspections due to non-conforming requirements and any additional tests required at Annexure 2386/A.3;
- delivery of castings to the location specified in Annexure 2386/A; and
- the storage of new patterns at the foundry for a period of 3 years in accordance with Clause 2.8.

Note that additional radiographic inspections may be required by the Principal on other than the initial sample castings, in accordance with Clause 3.7 of this Specification. These costs must not be included in the contract price and will be ordered as a variation to the lump sum as required.

ANNEXURE 2386/C TO K – (NOT USED)

ANNEXURE 2386/L – INSPECTION AND TEST PLAN


The Inspection and Test Plan must be completed for each **ladle**.

Notes:


- An **Inspection Point** represents a test or an inspection that will be carried out by the Supplier in-house or at an external laboratory, depending on the type of test/inspection. The inspection report/certificate must be submitted to the Principal.
- A **Notification Point** represents a stage at which the Principal must be given 72 hours notice that a process will occur should it wish to send a representative to observe.
- A **Review Point** represents a stage at which test results will be reviewed for conformity to acceptance criteria. If the criteria have been achieved, the process can proceed. If not, the results must be referred to the Principal for clearance of a nonconformity before the process proceeds.
- A **Witness Point** provides the Principal with the opportunity to verify the inspection or test, at its discretion. 72 hours notification of an approaching witness point must be given to the Principal's inspector.

Ductile Cast Iron Components for Timber Trusses

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 Inspection / Test Plan Ductile Cast Iron Components for Timber Trusses			Ladle No:		Inspection Test Plan No:		
			Heat No:		Drawing No & Date:		
			Job Description:				
Supplier's Name:							
Task No	Task Description	Verifying Documents	Inspection Requirements				Comments
			Principal	Sign / Date	Supplier	Sign / Date	
1	Pattern inspection	Supplier's shop drawing	Notified		Inspect		<ul style="list-style-type: none"> Verify all pattern dimensions.
2	Prepare moulds for castings and for test blocks				Inspect		<ul style="list-style-type: none"> Provisions for identification for traceability purpose. Obtain Principal's approval for locations of joint lines and casting identifications.
3	Pour initial sample castings		Witness		Inspect		<ul style="list-style-type: none"> To be carried out for each pattern. Obtain Principal's approval prior to producing further castings.
4	Pouring castings and test blocks		Witness				<ul style="list-style-type: none"> Test blocks type IIa or IIb to be separately cast and poured after last casting from each ladle.
5	Chemical analysis	For information only	Notified		Inspect		<ul style="list-style-type: none"> To be carried out for each ladle for information only.
6	Blast cleaning, fettling and dressing.		Inspect grinding		Review		<ul style="list-style-type: none"> Grinding must be inspected by the Principal's inspector. Refer to Clauses 2.3 and 2.7 of this Specification.
7	Heat treatment (where applicable), followed by abrasive blast cleaning.	Check temperature control	Witness		Review		<ul style="list-style-type: none"> Supplier procedures, with heat treatment batch correlated to casting identification. Heat treatment must be witnessed by the Principal's inspector. Monitoring thermocouple in contact with casting/s.
8	Mechanical properties (Tensile Test and Impact Test)	NATA endorsed reports/certificates	Witness		Inspect		<ul style="list-style-type: none"> One tensile test and 3 impact tests per ladle. Refer to Clause 3.2 of this Specification.
9	Microstructure analysis	Microstructure report	Witness		Inspect		<ul style="list-style-type: none"> To be carried out on the first ladle of each order. Further testing may be required (Refer to Clause 3.3). Photomicrograph at a magnification of X100 to be produced in the Nital etched condition. Report should include the nodule size, distribution and form and the matrix structure.

Ductile Cast Iron Components for Timber Trusses**2386**

 Transport Roads & Maritime Services			Ladle No:		Inspection Test Plan No:		
			Heat No:		Drawing No & Date:		
			Job Description:				
Inspection / Test Plan							
Ductile Cast Iron Components for Timber Trusses							
Supplier's Name:							
Task No	Task Description	Verifying Documents	Inspection Requirements				Comments
			Principal	Sign / Date	Supplier	Sign / Date	
10	Visual inspection	Inspection report	Witness		Inspect		<ul style="list-style-type: none"> To be carried out on all castings. Refer to Clause 3.4 for acceptance criteria.
11	Dimensional check	Design drawings / Template castings	Witness		Inspect		<ul style="list-style-type: none"> The initial sample castings must be checked firstly, followed by the rest of the castings. Refer to Clause 3.5 for accepted tolerances.
12	Brinell hardness test	Test report	Witness		Inspect		<ul style="list-style-type: none"> To be carried out by the Supplier on all castings. Unless noted otherwise, 3 tests per casting ideally at locations nominated by the Principal's inspector. Accepted results are range from 135 to 180 HBW/3000.
13	Radiographic inspection	NATA endorsed test report or a report from a qualified and accredited NDE technician	Notified		Inspect		<ul style="list-style-type: none"> To be carried out on the initial sample casting of each type, targeted at critical stress areas. The need for further testing will be decided by the Principal depending on other tests and inspection results. Refer to Clause 3.7 for acceptance criteria.
14	Magnetic particle inspection		Witness		Inspect		<ul style="list-style-type: none"> To be carried out on all castings targeted at critical stress areas. Refer to Clause 3.8 for acceptance criteria.
15	Final acceptance	Final acceptance	Review		Review		<ul style="list-style-type: none"> ITP signed and dated and all reports submitted to the Principal.

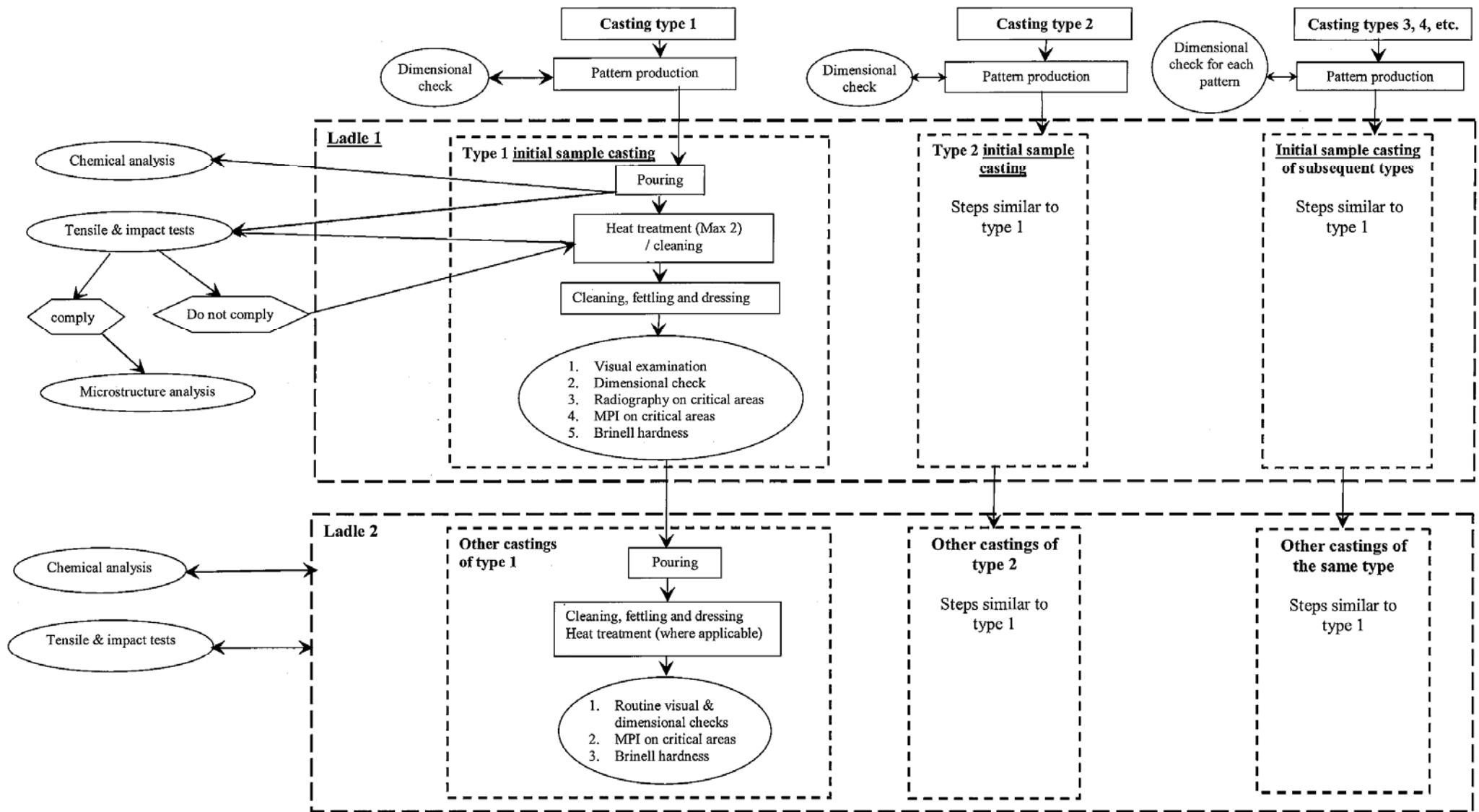


Figure 2386/L.1 Flowchat for typical inspections and tests required for castings

ANNEXURE 2386/M – REFERENCE DOCUMENTS

(Refer to Clause 1.2.3)

Australian Standards

AS 1171	Non - destructive testing – Magnetic particle testing of ferromagnetic products, components and structures
AS 1391	Metallic materials – Tensile tests at ambient temperature
AS 1544.2	Method for impact tests on metals – Charpy V-notch
AS 1627.4	Metal finishing – Preparation and pre-treatment of surfaces – Abrasive blast cleaning
AS 1816.1	Metallic materials – Brinell hardness test – Test methods
AS 1831	Ductile cast iron
AS 3507.1	Non- destructive testing – Guide to radiography for ferrous castings
AS 3507.2	Non-destructive testing – Radiographic determination of quality of ferrous castings
AS 3641.1	Recommended practice for atomic emission spectrometric analysis
AS 3978	Non - destructive testing – Visual inspection of metal products and components
AS 4738.1	Metal castings - Ferrous sand moulded
AS 5049	Cast iron – Designation of microstructures of graphite