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RAILINFRASTRUCTURE CORPORATION

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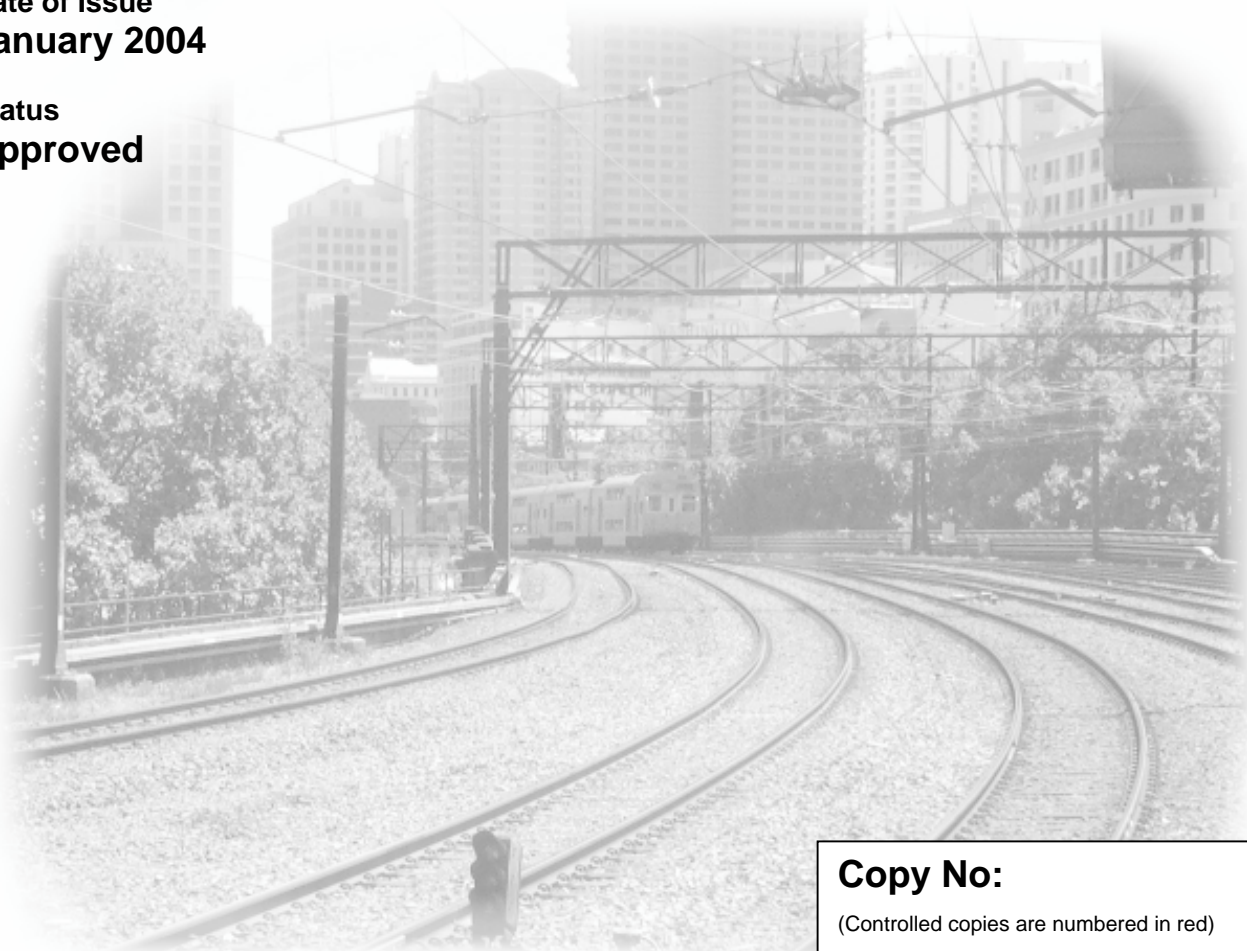
Title
**SPECIFICATION FOR HIGH STRENGTH AXLES FOR
LOCOMOTIVES**

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About This Standard

This specification is based on the TRS 0156 which was formerly CME F145.

Version History

Version 1.0

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1 Scope

This Specification provides for the manufacture and supply of high strength forged axles for locomotives

Drawings are referred to without amendment suffixes. This Specification, therefore, shall be read in conjunction with all applicable drawing issues current at the time of the inquiry. Variations will not be permitted from any of the conditions contained in this Specification or the order without authority in writing from the Principal Engineer Rolling Stock & Mechanical Assurance.

It should be noted that where the term "The Engineer" is used within this Specification, it is deemed to mean the Principal Engineer Rolling Stock & Mechanical Assurance appointed representative.

2 Manufacture

Ingots shall be manufactured from steel produced by the basic oxygen or electric furnace process.

Ingots shall be kept in a vertical position until ready to be rolled or until the metal in the interior has had time to solidify. No bled ingots shall be used. Sufficient discard shall be made from each ingot to secure freedom from piping and undue segregation.

The axles shall be produced by forging.

In processing from ingot to axle bloom, the minimum cross section reduction shall be 3 times.

The blooms shall be free from injurious defects and finished in an acceptable manner, with the ends cut square. They may be chipped to remove surface defects provided that the depth of chipping does not exceed 1.5mm per 25mm of dimensions concerned up to a maximum depth of 20mm and provided also that the width of the chipping is at least four times its greatest depth. Where two chipping grooves run approximately parallel and near together, the narrow tongue between them may be removed at the discretion of the Engineer.

The blooms shall be true to the prescribed dimensions within the limits of tolerance as specified by the Engineer.

The cast number shall be legibly stamped on the end of each bloom.

3 Margins Of Manufacture

Axles shall be manufactured to the dimensions, tolerances and type of machining specified on the appropriate detail drawings.

All journal, gear and wheel seats shall be machined true, cylindrical and concentric and when spun between centres the total dial gauge variation shall not exceed 0.075mm.

Ovality shall not exceed 0.025mm at any point on the journal, gear and wheel seats.

Gear and wheel seat taper shall not exceed 0.025% and only taper which provides increasing interference in the direction of assembly, is acceptable.

4 Chemical Composition

The steel shall conform to the requirements of AS 1444/4340.

The manufacturer shall supply the analysis of each heat.

5 Heat Treatment

Axles shall be heat treated by being quenched and tempered.

Reheat Treatment:-

If the results of the mechanical tests (Section 7) for any batch of axles do not conform to the requirements specified, the axles may be reheat treated, but not more than two additional times, and retested in accordance with this Specification.

5.1 Results of Retests:

The re-heat treated test batch shall be deemed to comply with this Specification only if the test pieces taken from the re-heated axles comply with Clause 6.

5.2 Notification of Reheat Treatment:

The Engineer shall be notified should any batch of axles be reheat treated for any reason(s). The notification shall be in writing and include the reason(s) for reheat treatment.

6 Mechanical Testing

6.1 Test Pieces:

For test purposes, prolongations shall be attached to at least 5% of the axles of each heat, in each heat treating batch.

If axles with prolongations have been expended then axles may be used for test procurement.

6.2 Rate of Testing:

The rate of testing shall be one tensile test and one izod test per heat treatment batch per heat of axles, provided always that each test represents no more than 70 axles.

7 Tests:

7.1 Tensile Test:

The tensile test shall be carried out in accordance with AS 1391.

Elongation results shall be reported on a gauge length of $L_0 = 5.65[S_0]^{1/2}$, where S_0 is the cross-sectional area of the test piece before testing.

The mechanical properties of the test piece shall comply with the following requirements:

Tensile strength	980 Mpa minimum
Yield strength	770 Mpa minimum
Elongation	14% minimum
Reduction of area	40% minimum

7.2 Izod Test:

One test with three notches shall be prepared from each sample and tested, at 20°C, in accordance with AS 1544, Part 1.

Each individual impact test shall give a minimum value of 30J.

8 Retests

8.1 Defective Test Piece:

A test piece which shows defective machining or develops flaws shall be discarded and another test specimen prepared and tested.

8.2 Tensile Test:

If the results of the tensile test do not conform to the requirements specified then the whole batch can be reheat treated in accordance with Section 5.

8.3 Izod Test:

If an individual test value is below 30J then one additional test piece from the original sample shall be tested in accordance with Clause 7.2. The test batch shall be deemed to comply with this Specification if not more than one result of the six tests is below the specified individual test value of 30J.

If two or more individual test values are below 30J, then the entire test batch which failed shall be reheat treated in accordance with Clauses 5.1. and 5.2.

9 Magnetic Particle Inspection

All axles shall be tested for transverse and longitudinal defects using the magnetic particle method.

The test shall be carried out in accordance with the requirements of RSS 0033.

Defects revealed by this test shall be interpreted using the criteria specified in Section 11 of this Specification.

10 Ultrasonic Inspection

All axles shall be tested using the ultrasonic method in accordance with the requirements of RSS 0033.

Defects revealed by this test shall be interpreted using the criteria specified in Section 11 of this Specification.

11 Rejection

Axles containing cracks will be rejected.

Fine longitudinal discontinuities on the finished machined surfaces, variously termed hairlines, stringers or fine seams are not considered injurious if they meet the following conditions:-

- (i) Must not extend into fillets and must not have sharp edges.
- (ii) Must not be over 12mm long individually.
- (iii) Total sum length of such imperfections 6mm to 12mm long must not exceed 38mm in any 300mm of axle length.
- (iv) Within any 75mm length there may not be more than two such imperfections 6mm to 12mm long in line with each other.

In ultrasonic testing, axles which do not produce a one third full screen height indication from the end face opposite the probe, shall be rejected or made acceptable by heat treatment.

The axle shall be rejected if the amplitude at any discontinuity indication found during ultrasonic testing exceeds the indicated levels obtained for the flat bottomed holes listed in RSS 0033, considering the distance amplitude correction.

Notwithstanding the above mentioned definite limits of non-injurious defects the right of the Purchaser is reserved to reject temporarily any axles showing other unforeseen or objectionable conditions not specifically listed and make final settlement on the basis of further negotiations between representatives of the manufacturer and the purchaser who are specifically qualified to decide such questions.

12 Branding

After the machining of ends, the axles shall be distinctly branded cold on each end with the markings as required the Principal Engineer Rolling Stock & Mechanical Assurance.

13 Protection Of Axles

Prior to delivery protective measures approved by the purchaser shall be taken to prevent damage to wheel/gear seats and journals while the axles are in transit or storage. All holes are to be kept clean and free from swarf and dirt. Any anti-corrosion treatment shall be readily removed by washing with suitable non-toxic solvents, and wiping clean with cloth.

14 Inspection

The Engineer shall have free access to the Works of the Manufacturer at all reasonable times; he shall be at liberty to inspect the manufacture at any stage, and to reject any material that does not conform to the terms of Specification.

15 Testing Facilities

The Manufacturer shall supply the material required for testing free of charge and shall, at his own cost, furnish and prepare the necessary test pieces, and supply labour and appliances for such testing as may be carried out on his premises in accordance with this Specification. Failing facilities at his own works for making the prescribed tests, the Manufacturer shall bear the cost of carrying out the tests elsewhere within the State in which his works are situated, provided always that suitable NATA approved testing facilities exist in that State.

16 Referenced Documents

16.1 RIC Standards

RSS 0033 Non Destructive Testing of Axles

16.2 Australian Standards

AS 1391 Method for Tensile Testing of Metals

AS 1444 Wrought Alloy Steels

AS 1544.1 Method for Impact Test on Metals - Izod