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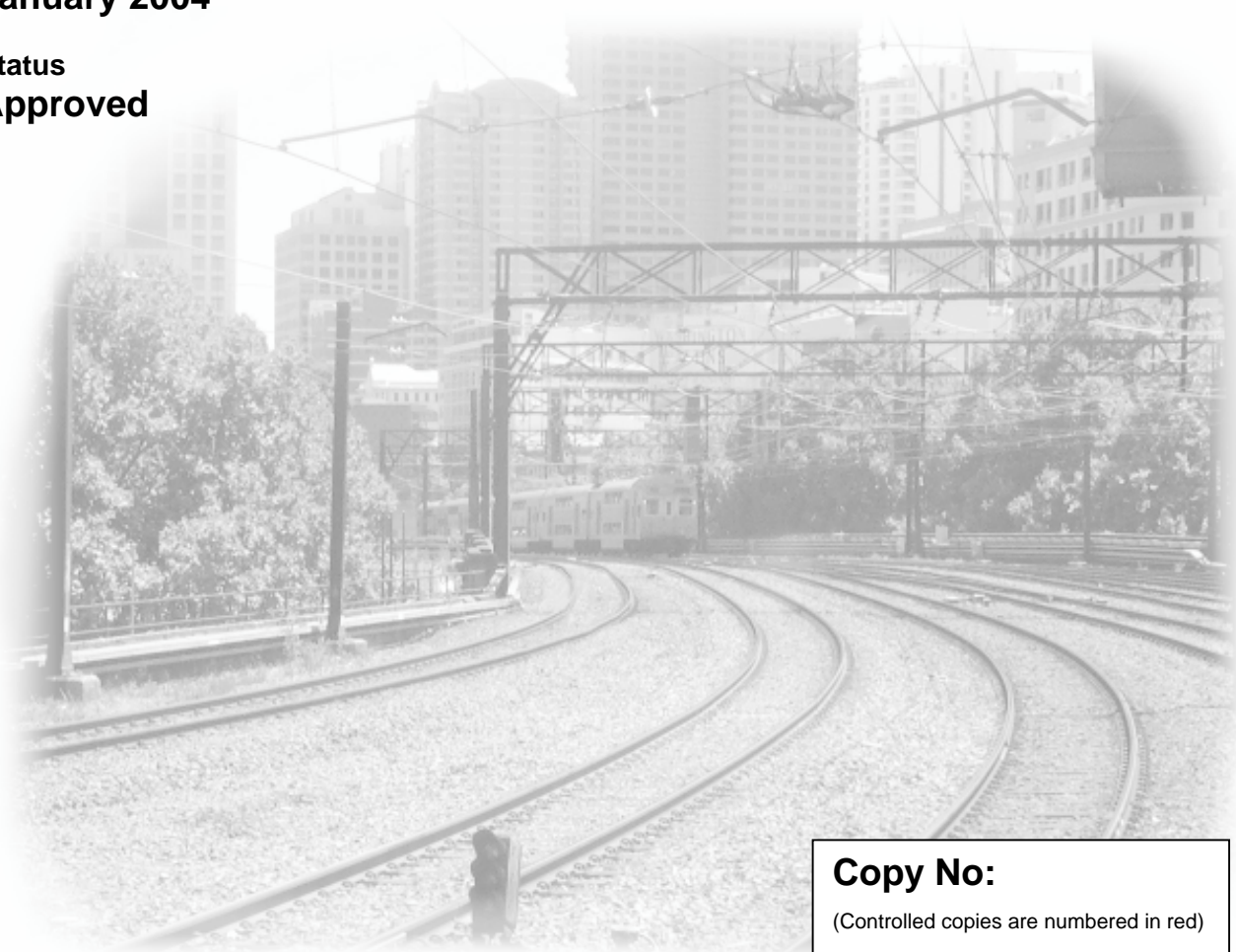
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NON DESTRUCTIVE TESTING OF AXLES

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About This Standard

This standard is based on TRS Standard 0165 Non Destructive Testing of Axles.

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1 Scope

Age of Axles: Axles have an indefinite service life and need not be scrapped due to age alone.

1.1 For New Axles

The entire axle shall have a visual inspection, a magnetic particle inspection (MPI) to the requirements of Section 3 and an Ultrasonic Inspection to the requirements of Section 4.

1.2 For Used and Reworked Axles Without Wheels, Gear or Bearings

The entire axle shall have a visual inspection followed by magnetic particle inspection (MPI) of the axle barrel (including suspension-bearing journals where applicable), gear seat, road wheelseats and the bearing journal/abutments. There is no need for ultrasonic testing of the wheelseat.

1.3 For Axles With Gear Mounted

The exposed portions of the axle shall have a visual inspection followed by magnetic particle inspection (MPI) of the axle barrel (including suspension-bearing journals where applicable), road wheelseats and the bearing journal/abutments. There is no need for ultrasonic testing of the wheelseat.

1.4 For Axles With Road Wheels Fitted

The exposed portions of the axle shall have a visual inspection. No MPI or ultrasonic testing is required unless the operator considers there is a need for the additional testing.

As there is no history of cracking at gear wheelseats, this area does not require ultrasonic inspection.

If for any reason the road or gear wheel is to be removed then testing of the axle shall be performed after removal.

All the exposed surfaces of an axle shall be inspected to the requirements of RSS 0031.

Ultrasonic testing of the wheel seat area shall be performed on assembled wheel sets that have been removed from service because of derailment, prior to be returned to service. If the wheels are removed from the axle then magnetic particle inspection of the barrel, wheelseat bearing journal area will be sufficient.

2 General

2.1 Rejection

Axles containing cracks are to be rejected.

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

Must not extend into fillets and must not have sharp edges.

Must not be over 12mm long individually.

Total sum length of such imperfections 6mm to 12mm long must not exceed 38mm in any 300mm of axle length.

Within any 75mm length there may not be more than two such imperfections 6mm to 12mm long in line with each other.

Axles shall be rejected if the amplitude at any discontinuity indication found during Ultrasonic Testing exceeds the indication levels specified in Section 4 of this Standard/Instruction.

Rejection of axles on other grounds (e.g. surface finish, straightness etc.) is covered in RSS 0031.

2.2 Marking

After inspection the last two digits of the year of inspection shall be stamped on each end of the axle (e.g. '94 for 1994).

This stamping shall be legible and indelible in characters of approximately 10mm in height.

2.3 Personnel

Qualified and/or fully trained operators must be used for both Magnetic Particle and Ultrasonic Testing.

Testing shall be in accordance with AS 1171 and AS 2062.

2.4 Records And Reporting

A record is to be kept of axle inspection & testing including axle number, date of inspection, type of tests carried out and the results for each axle. Axle records shall table previous test results.

Where an axle is to be rejected, for any reason, a notification of condemned axle form as shown in section 6 must be forwarded to the Principal.

3 Magnetic Particle Inspection

If the axle has been stripped of road and gear wheels then a magnetic particle inspection shall be carried out on the entire axle with particular attention given to the gearseat, wheel seats and journals.

The magnetic particle inspection shall be carried out in accordance with the following requirements of Section 3.

Defects revealed by this inspection shall be interpreted using the criteria specified in Section 2.1 of this specification.

Under no circumstances shall a Magnetic Particle Inspection be carried out with the bearings fitted.

3.1 Fluorescent Magnetic Particle Inspection

A fluorescent magnetic particle inspection system shall be used comprising: -

A fluorescent magnetic particle/liquid suspension

A high amperage, low voltage AC power source

A high amperage magnetising coil

A black light inspection lamp(s)

3.2 Requirements

The magnetic particle testing system shall conform to the following requirements:
-

The fluorescent magnetic particle media shall comply with the requirements of AS 2085. The reservoir containing the media shall have means of keeping the particles in suspension by agitation. Media from a pressurised spray may be used, provided the spray can is vigorously shaken during use.

The power supply shall provide AC low voltage current.

The black light inspection lamp(s) shall produce ultraviolet radiation of wave length from 400 to 320 nanometres. The radiation intensity shall not be less than 8 watt/m² on the test surface.

The inspection area shall be darkened but may be illuminated with a dull amber light not exceeding 10 lux.

For the detection of longitudinal defects the current flow method shall be used. The current applied shall be a minimum of 7.5 amperes/millimetre of axle diameter (peak current).

For the detection of transverse defects, the encircling coil method shall be used. The magnetising coil shall be of circular shape, not more than 45cm diameter and capable of producing a minimum of 4000 ampere turns magnetising force. The applied current shall be a minimum of 800 amperes (peak current).

3.3 Procedure

For the current flow method, the current is turned on and the magnetic particle media hosed or sprayed onto the axle. During the process the axle is rotated so the entire surface is well covered with media. The application of media is stopped while current remains on for a short time (approximately 3 seconds) to avoid washing off small indications. The axle is inspected under the black light(s) while being slowly rotated.

3.4 Demagnetisation

Axles shall be demagnetised after testing. Proof of demagnetisation shall be established by using a Gauss Meter. Each axle shall be checked and if residual magnetism is detected, then the axle shall be demagnetised again and re-checked.

4 Ultrasonic Inspection

4.1 General

In the case of assembled or partially assembled wheelsets an Ultrasonic Inspection shall be carried out to check for cracks in the wheelseats. The Ultrasonic Inspection shall be carried out in accordance with the following information.

Where possible both the Far End and Angle methods should be carried out. Each type of axle will require a separate procedure as their differing geometrics result in different ultrasonic responses. The same basic principles apply however, and these are contained in this Section.

The Contractor must submit a procedure for the Ultrasonic Inspection of each axle type being tested. The Principal prior to any testing being carried out must approve this procedure. This procedure must include the complete set-up and scanning specifications and the method of interpreting all signals received from each axle type (i.e. signals from fillets, stress relieving grooves etc and defects).

4.2 Far End Test

4.2.1 Probe:

Normal

Single Crystal

Approximately 24mm diameter

4.2.2 Frequency:

1 - 2 MHz

4.2.3 Scanning:

Patter - overlapping spiral

Position - both ends of the axle

4.2.4 Sensitivity:

Journal fillet indication at far end to 80% full screen height.

4.2.5 Evaluation:

During scanning the amplitude of the indication from the end face opposite the probe shall be monitored and the amplitudes of all discontinuity indications shall be evaluated with respect to the distance from the test surface.

Wheelseat defects at the far end greater than 20% full screen height or twice the grass height shall be grounds for rejection of the axle.

Cracks most commonly occur under the wheelseat at or near the inner face of the wheel boss. To a lesser extent cracks may occur under the inner end of the journal at the fillet. Occasionally cracks have been found in the barrel of the axle between the wheels.

Signals may be received from fillets, stress relieving grooves, shrink fit areas at gear and wheelseats and, if the geometry is appropriate, from mode conversions along the barrel. It is because of these signals that a general procedure covering all axles cannot be provided.

4.3 Angle Test

4.3.1 Probe:

35 or 45 degree angle probe

4.3.2 Frequency:

2 MHz

4.3.3 Scanning:

As much of the gear and wheelseats as the geometry allows. Paying particular attention to the inner side of the wheelseat immediately under the inside face of the wheel.

4.3.4 Sensitivity:

Reference axle with groove cut to 2mm deep set to 80% full screen height at the scanning distance.

4.3.5 Evaluation:

Any indication greater than 20% full screen height at the scanning distance.

5 Economical Repair

The economical repair of an axle can be determined by using the following formula as a guide.

$$\text{If Repair Cost} < \text{New Axle Cost} * \left(1 - \frac{\text{New Dia} - \text{Current Dia}}{\text{New Dia} - \text{Condemn Dia}} \right)$$

then axle is economical for repair.

6 Notification of Condemned Axle

Workshop	
Date	
Axle number	
Loco/Vehicle number (if applicable)	
Date of last inspection	
Wheelseat diameter	
Cost to repair	
Replacement cost	

6.1 Type Of Inspection:

Visual	
Magnetic Particle Test	
Ultrasonic Test	
Measured	
Other	

6.2 Reasons For Scrapping Of Axle

Hot Box	<input type="checkbox"/>	ECMD Journal	
Circumferential Crack – Journal, Wheelseat or Barrel	<input type="checkbox"/>	Metal Sprayed Journal	
Longitudinal Crack - Journal Wheelseat or Barrel	<input type="checkbox"/>	Surface finish of journal/bearing seat	
Bent Axle	<input type="checkbox"/>	Surface finish of barrel	
Picked up when wheel/gear pushed off	<input type="checkbox"/>	Undersize wheel seat	
Chromed	<input type="checkbox"/>	Undersize journal	

Seal wear ring groove	<input type="checkbox"/>		
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Other (please specify)	
If condemned because of cracking, describe location and extent of cracking	

7 References

7.1 RIC Standards

RSS 0031 Wheel & axle reference manual

7.2 Australian Standards

AS 1171 Non destructive testing – magnetic particle testing of ferromagnetic products, components and structures

AS 2062 Non destructive testing – Penetrant testing of products and components