



Transport safety alert

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12 April 2012 | TSA no. 40

Catastrophic failure of freight axles in the barrel area

Background

There have been three catastrophic freight axle failures in NSW over the past six years with the most recent incident occurring at Coalcliff on 23 November 2011. In each of these incidents, the axles failed through fatigue as a result of a stress raiser (or initiator) such as a heavy impact mark or sharp transverse incision.

In response to these incidents, the Independent Transport Safety Regulator (ITSr) undertook compliance inspections of a number of wagons in service, including a visual examination of the barrels to determine feedback on the extent — and hopefully origin — of those surface defects that have the potential to eventually lead to a similar axle failure.

Approximately 80 axles were inspected during scheduled Unit Train Maintenance (UTM) for any evidence of defects along the barrel that could be significant enough to lead to either premature failure through fatigue or be non-compliant with workshop inspection procedures. Three axles were found with significant defects (axles A, B and C), in contrast to a fourth (axle D) that had been detected earlier — and removed from service — following ultrasonic testing.

In addition to these inspections, ITSr also:

- reviewed existing intervention periods and inspection criteria for the exposed surfaces of freight axles
- discussed sampling and monitoring requirements of post workshop attention of bogies and wheelsets with stakeholders
- reviewed current transportation techniques of bogies and wheelsets
- observed ultrasonic testing of wagons in service.

Axle A

A significant defect found on this axle was easily detected on the day of the inspection by feeling the abrupt surface surrounding the defect. These heavy transverse gouge marks, which were evident near the axle centre (refer to Figure 1), were likely to have been present for some time. The axle was last inspected in February 2010. It should have been rejected (unfit for service) if examined as per the requirements of the transport operator's axle re-qualification standard.

Axle B

A small sharp transverse cut was found on this axle on the day of the UTM (refer to Figure 2). This particular defect would — as a minimum — warrant attention in compliance with the transport operator's axle re-qualification standard. The axle was last inspected in July 2011.

Axle C

A small number of freestanding, recently overhauled freight bogies — awaiting to be fitted to wagons — were inspected in the yard. This particular axle had two separate defects: a heavy impact mark; and a long transverse incision (refer to Figures 3 and 4 respectively). These defects would warrant remedial action (and most likely rejection) in compliance with TRS 1447. The wheelset received attention as recently as March this year as part of the bogie overhaul process.

Axle D

Two axles that had previously been ultrasonically tested were withdrawn from service due to the presence of defects found in the axle barrel (refer to Figure 5). Both axles were in the freestanding state awaiting further examination in the near future. One was a Chinese-manufactured axle with sub-surface defects and the other (axle D) displayed heavy abrasion marks just inboard of one of the wheels (refer to Figure 6). Although not evident at the time, this axle also had two heavy indentations in the centre of the barrel. These indentations were obscured by the identification tape (refer to Figures 6 and 7) which was applied at the maintenance facility. The tape did not show any damage that would indicate it had been applied post or after the impact marks. The damage sustained by this axle is most probably post derailment related. The axle was last inspected in August 2011 and should have been rejected (unfit for service) if examined as per the requirements of the transport operator's axle re-qualification standard.

A summary of these axles with corresponding figures is provided in the table below:

Tab washer date	Axle	Wagon bogie details	Axle barrel defect details	Refer to Figures
02/10	A	Examined during UTM	Heavy transverse gouge marks. Wheelset last overhauled in February 2010.	1
07/11	B	Examined during UTM	Small sharp transverse cut. Wheelset last inspected in July 2011.	2
03/12	C	Freestanding bogie	Wheelset last overhauled in July 2011.	3 - 4
08/11	D	Freestanding wheelset	Separate impact mark and long transverse cut mid way between axle centre and back of wheel. Identification tape applied over some of the defects. Bogie recently overhauled in March 2012.	5 - 7



Figure 1: Axle A, heavy transverse gouge marks



Figure 2: Axle B, small sharp transverse incision



Figure 3: Axle C, long transverse cut



Figure 4: Axle C, transverse impact mark



Figure 5: Axle D (foreground); Chinese-manufactured axle found with sub-surface defects (background).



Figure 6: Axle D, significant abrasion marks. Note the identification band still wrapped around the centre of the axle.



Figure 7: Axle D, heavy impacts marks evident after the identification tape had been partially removed.

Findings

- In all of the above cases, the last scheduled maintenance and inspection intervention on the wheelsets was performed at the same major overhaul maintenance centre.
- All the above axles were subject to compliance with the requirements of the transport operator's axle re-qualification standard, *Inspection Criteria for the Exposed Surfaces of Axles* (see attached). This standard was initially developed to aid overhaulers of wheelsets in identifying and repairing (where appropriate) axle barrel damage.
- Three of the above axles, which had all been recently inspected at a major overhaul maintenance centre, were found with significant defects as a result of sampling carried out in the field. The damage exhibited by all three axles would have warranted actioning as per the requirements of the transport operator's axle re-qualification standard.
- Existing in-service maintenance and inspection regimes for rolling stock do not generally require an examination of the axle barrel surface.
- The time taken from the initiation of a crack as a result of a stress raiser to the ultimate failure of the axle may far exceed the current intervention periods for wheelset/axle attention at maintenance facilities (normally 2 to 3 years, depending on kilometreage travelled in that time).
- The separate issue of sub-surface defects in the barrel warrants a more thorough investigation.
- The extent of axle defects in service is unknown.
- The source of these defects is as yet undetermined.

Actions

Owners and lessees of rolling stock, maintainers, overhaulers and transporters of bogies and wheelsets shall therefore, reassess as soon as reasonably practicable:

- the coverage of this matter (includes both surface and sub-surface defects) in their standards, operating practices, risk registers, asset management systems and other relevant documentation,
- the maintenance and inspection procedures that manage the possibility of defective (includes manufacturing defects), abused or poorly maintained axles and/or other risk control measures, such as ultrasonic testing and dye penetrant inspection, to verify that axle barrels are fit for purpose. This should also include an appropriate final visual inspection process (of the axle barrel area) just prior to fitment to a wagon,
- the training, competency and assessment of personnel who inspect, handle, transport and assemble wheelsets or bogies, and
- the adequacy of processes for monitoring compliance with the relevant in-field and preventative maintenance instructions and procedures.

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