

# Safety Alert



## NOTICE TO RAIL TRANSPORT OPERATORS

RSA-2014-02

Date Issued: 3 April 2014

### SUBJECT

#### Thermal (or Metal) Spraying of Axles

### ISSUE

A major passenger operator recently suffered an axle failure on one of its electric multiple unit (EMU) fleet. Approximately fourteen (14) years prior, the axle in question had been subjected to thermal spraying on the gearbox bearing and oil thrower surfaces.

Indications that surface preparations used to promote proper bonding of the coating material resulted in minor circumferential grooving around the axle barrel which acted as origins for fatigue initiation. Although the rate of crack propagation was very low, the numerous fatigue initiators coupled with the fact that these were aligned (i.e. as in a continuous groove), eventually resulted in a fracture surface that was perpendicular to the longitudinal axis.

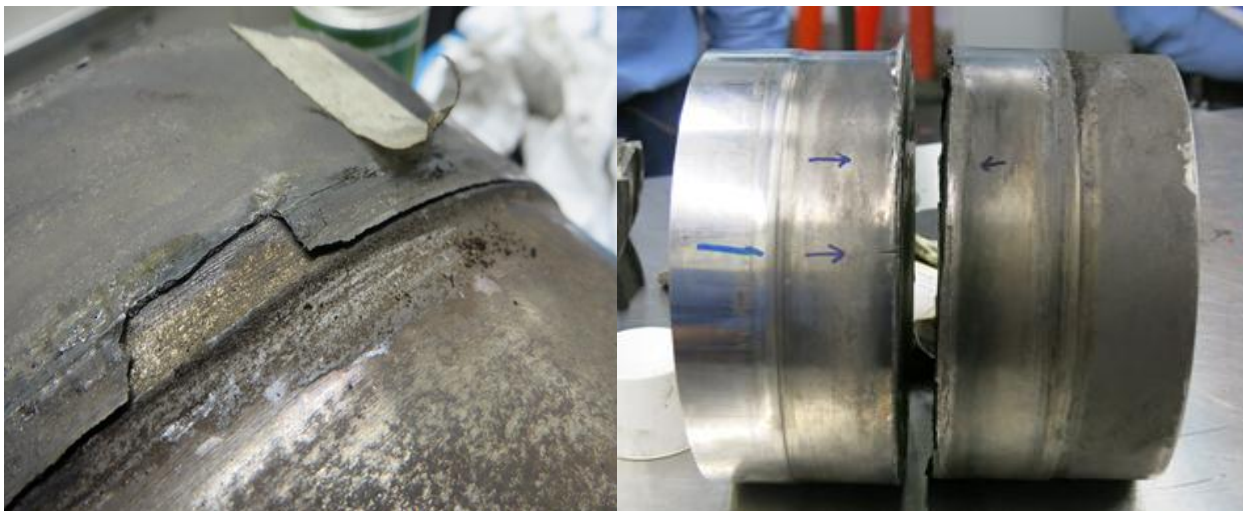
In regard to this incident, the coated surfaces could only be visually examined with the gearbox assembly removed from the axle. Subsequently, a further seven (7) axles have since been identified as having been subjected to the same process with at least one exhibiting cracking in the sprayed area.

#### What is Thermal Spraying?

Thermal spraying, also known as metal spraying, is a surface coating process where a melted (or heated) metal is sprayed onto the surface of another material, such as a rail axle. Combustion or electrical arc discharge is usually used as the source of energy for thermal spraying. Thermal spraying can provide a coating with a wide thickness range (20 micrometres to several mm). Quality is usually assessed by measuring its porosity, oxide content, macro and micro-hardness, bond strength and surface roughness.

The metal spray equipment falls into four main categories, namely, 1) plasma spraying, 2) wire arc spraying, 3) flame spraying, and 4) high velocity oxy-fuel coating spraying.

Although not shown in the above list, a more verifiable process known as electro-chemical metal deposition (ECMD), has been used for many years in the US railroad industry (as well as in NSW) to restore undersized and/or damaged axle journal bearing diameters or oversized gearwheel bores. ECMD is a process by which a film of solid metal is deposited from a solution of metal ions onto an electrically conducting surface and has been approved by the AAR (M967 Specification) subject to certain limiting conditions being satisfied (e.g. the requirement to conduct an Adhesion Test).



**The above images depict the circumferential grooving and partial delamination of the metal coating and matched fracture surfaces**

Rail Transport Operators may need to review and revise their current risk registers (and the associated standards and work procedures) in order to manage to a SFAIRP level, the hazards associated with an axle failure (other than at the journal bearing seat) due to thermal spraying.

In addition, due consideration needs to be given to the inherent limitations of non-destructive testing (NDT) and other inspection methods to detect the existence of any fatigue initiators on the metal sprayed axle surfaces during the scheduled inspection and maintenance interventions.

For further information please contact Grant Holliday via [grant.holliday@transportregulator.nsw.gov.au](mailto:grant.holliday@transportregulator.nsw.gov.au) or alternatively on (02) 8263 7182.

**THIS ADVICE IS EFFECTIVE IMMEDIATELY**

Peter Doggett  
**Executive Director National Operations**