

Safety Alert

Mines

Office of the Commissioner for Mine Safety & Health

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Earthmover tyre and rim safety

Over the past few months there have been several tyre-related incidents and accidents involving earthmovers, including a fatality last December at the Foxleigh mine that involved an on-highway tyre mounted to a coal haulage roadtrain.

Tyres, rims and wheel assemblies are safety-critical items that must be maintained and used correctly if people's lives are not to be placed at risk.

The purpose of this alert is to refresh your understanding of the causes of these accidents so as to help you guard against the risk.

***Note:** Many of the points made here apply also to light vehicles, personnel carriers and buses, and other non-earthmoving applications such as forklifts and cranes.*

Be sure to:

- **maintain** correct inflation pressure, payload and vehicle speed
- **maintain** an optimal working environment for tyres
- **employ** trained and competent mine service personnel, in line with established safe work procedures, who use fit-for-purpose equipment
- **test** rims and wheels for metal fatigue, as per relevant Standards and manufacturers' guidelines.
- **capture and analyse** tyre and rim operational data to ensure a sound understanding of the health of the mine's tyre and rim assets.
- **prepare and follow** emergency procedures for dealing with tyre-related accidents.

Your general obligations

Everyone involved with earthmover tyres — from design and manufacture to use and maintenance — must adhere to safety standards. This is required by mining legislation and supported by the recently revised Australian Standards on earthmover tyres:

- AS4457:1 2007 Earthmoving Machinery – Off the road wheels, rims and tyres – Maintenance and repair Part 1: Wheel assemblies and rim assemblies.
- AS4457:2 2008 Earthmoving Machinery – Off the road wheels, rims and tyres – Maintenance and repair Part 2: Tyres.

Critical aspects of tyre management

Selection — The key to safe tyre performance is the correct selection of tyres. In consultation with the tyre manufacturer, it is vital to choose tyres that suit the operating conditions at the mine.

The safe operation envelope of the tyre in terms of payload and vehicle speed must be established through weight and cycle time studies to allow calculation of the 'tonne kilometre per hour' (TKPH) of the

tyre, or equivalent. Vehicles must not be operated outside of the tyre payload and speed — exceeding these will create unsafe tyre conditions, such as heating and/or mechanical degradation of the tyre.

Pressure — To maintain any tyre in a safe and serviceable condition, there must be a system for checking and recording tyre pressures.

Where tyres are mounted as duals, there must be ready access to the inner valve stem so that pressure readings can be obtained for analysis.

Tyres must always be inflated to the manufacturer's recommended inflation pressure because both under-inflation and over-inflation are dangerous. Constant under-inflation, in particular, will result in the weakening of a radial tyre's steel belting structure, which can cause the tyre to burst suddenly and violently. These so called zipper failures (see picture) can have fatal consequences. Correct tyre pressures can only be achieved by using high-quality tyre pressure inflation gauges that are calibrated and systematically crosschecked against a calibrated master gauge before use.



Records — If tyre pressures are recorded systematically, leaking or damaged tyres can be readily identified and removed before they become a hazard.

Tyre and rim hazards

The points below will help you understand what can go wrong and why, and what you can do about it.

- **Bursting or exploding tyres and disintegration of pressurised tyre/rim assemblies during operation or maintenance:** Serious injury, even death, can result from tyre bubbles, 'hot' tyres, tyre damage affecting the integrity of the tyre, and incorrectly fitted or damaged lock rings or other rim components.

What you can do: Provide all staff with training on the hazards (with corresponding expected safe behaviours) at induction and at regular intervals afterwards.

- **Poor training in tyre and rim maintenance**

What you can do: Ensure required training and refresher training for **onsite** tyre service personnel and line supervisors is provided only by *registered* training organisations that are experienced in tyre and rim maintenance and use these approved training packages:

- RIISAM210A Remove and fit wheel assemblies, and/or
- RIISAM211A Remove, repair and refit tyres and tubes.

Providers of tyre and rim maintenance and service to the minerals industry **offsite** ought to be trained to the same standard.

Non-mine personnel, such as operators and maintenance personnel (e.g. fitters) who work on and around mobile equipment, should also receive awareness training in basic tyre hazards from an experienced provider, as their work is often in the direct vicinity of equipment-mounted tyres. Training and education for this group of people should focus on identifying tyre and rim hazards and taking precautions.

- **Sudden disintegration of pressurised tyre and rim assemblies:** This is the main cause of fatalities among tyre service personnel or bystanders. Typical root causes and prevention are as follows:
 - Earthmover rims undergo punishing dynamic loading cycles during their operation that can result in metal fatigue and general deterioration of the assembly. The combination of compromised rim integrity with failure to deflate the tyre before removing the assembly can be fatal.

What you can do: Incorporate into the site's safety and health management system (SHMS) a reliable, non-destructive testing regime to identify fatigue and other deterioration in rims and rim components, as well as a deflation protocol (as detailed in AS4457:1 2007).

You should also have a way of recording the history of the life of rims and rim components so that you can compare their actual life with the manufacturer's stipulated safe life. In this way, you will be able to detect unsafe rims/wheels and remove them from service. The maintenance management system also ought to be able to track, accurately report, and alert on rim-testing status.

- Mismatch and subsequent disintegration of assembled rim components

What you can do: Identify rim components. Clear and unique identification (stamping) across the entire rim stock will minimise incorrect assembly of components. It will also help you administer non-destructive testing regimes.

- Sprung, damaged, corroded, stretched or poorly fitted lock rings reduce rim and rim-component integrity

What you can do: Make sure all lock rings are inspected by competent persons before being fitted or replaced. Where practicable, use intrinsically safer rim/wheel designs provided by some earthmover rim manufacturers. Be aware that some rim designs deliver relatively longer fatigue life, reducing the need to take rims off vehicle hubs during routine tyre maintenance. Their use is encouraged because they reduce the exposure to several tyre maintenance and manual-handling hazards. Similarly, check the integrity of light vehicle rim systems, including sprung lock-ring systems and 'split rims' fitted to personnel carriers, site ambulances and other non-earthmoving equipment. Eliminate 'split rim' types from light vehicles.

- Damage to, and material fatigue of, tyres

What you can do: As part of your maintenance management system, ensure that competent personnel regularly check the condition of tyres in accordance with the safe use and removal criteria specified by tyre manufacturers.

- **Human fatigue** can cause slips and lapses of concentration.

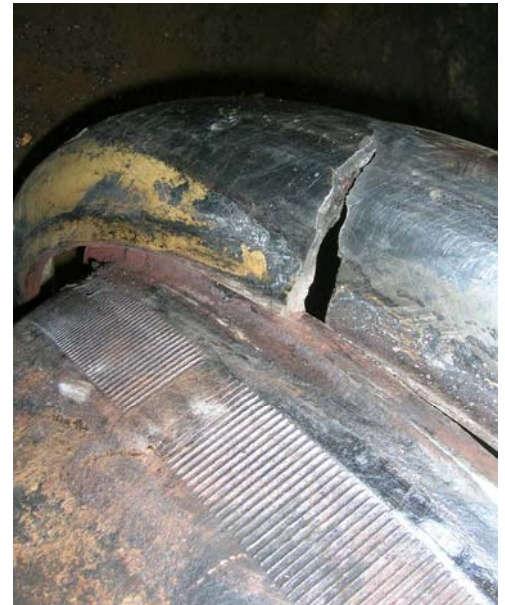
What you can do: Engage sufficient numbers of competent tyre service personnel.

- **Unsuitable tyre-handling equipment and tyre-maintenance equipment**

What you can do: Ensure that all such equipment is fit for purpose. Structural integrity and serviceability of tyre-handling equipment can be achieved through inspections, structural examinations and preventive maintenance by competent maintenance personnel. Better education and specialised training of tyre-service personnel in the use of tyre-handling equipment will also help reduce accidents such as dropped tyres, rims and assemblies. Consider the effort required to place tyre-maintenance equipment under a vehicle. For instance, a long-handled trolley jack is a safer choice than a short-handled jack (because it eliminates the need for someone to place themselves under a vehicle, possibly close to a tyre). A long-handled jack also reduces manual-handling hazards.

- **Incorrect tyre inflation**

What you can do: Tyre inflation should be detailed in the site's procedures and occur in an engineered and certified tyre-inflation cage; or, where that is not possible, the tyre-inflation equipment should enable the tyre-service personnel to stand well clear and to the side of the tyre, controlling the inflation through a remote shutoff valve and pressure-gauge attachment. To comply with the legislative requirement to keep risk at an acceptable level, the mine's SHMS must ensure that any maintenance involving tyre and rim assemblies is captured in risk-based site-specific work procedures, and carried out only by authorised, competent personnel that have completed approved



Cracked flange ring

training programs. Particular emphasis must be given to deflation and pressure reduction of tyre and rim assemblies, in accordance with AS4457:1 2007.

Other safety-critical tasks

- Ensure tasks such as vehicle isolation, chocking, jacking, supporting of the vehicle, deflation and inflation, torqueing and re-torqueing accord with manufacturer's recommendations, site conditions and published standards. Torque tools will require regular calibration as per manufacturer's requirements to ensure wheel nuts/studs are not over-tightened or under-tightened, do not become damaged, and/or that assemblies do not fall off the hub while the equipment is being operated.
- Incorporate safe tyre-handling practices and use of appropriate fit-for-purpose tools and equipment into work procedures. Manufacturer maintenance manuals, safety alerts and bulletins, and other available information on tyre and rim safety ought to be sourced in order to compile comprehensive and effective work procedures. These procedures should also take into account the hazards associated with heating of wheel fasteners (studs), which is known to cause pyrolysis (the decomposition of rubber through heat inside the tyre cavity and subsequent violent explosion of the accumulated gases). Furthermore, potential heating of wheel assemblies due to other conditions (e.g. hot bearings, hot brakes, over-heating wheel motors) needs to be managed through the mine's maintenance-management system.
- Carry out maintenance on tyres at fit-for-purpose tyre-bay facilities.
- Create 'tyre friendly' mine-operating conditions to reduce damage to tyres and improve tyre and rim safety, tyre performance and mine production — through road maintenance, supported by mine haulage designs and operational standards, and ongoing improvements to operator awareness.
- Challenge your mine's emergency preparedness through simulated emergency scenarios covering suspected or actual hot tyres, tyre fires, pyrolysis events through contact with power lines or lightning strike, and safe evacuation of vehicle operators. (A high-potential incident at a New South Wales mine — where a dump truck was hit by lightning causing three of the six vehicle tyres to explode violently within minutes of the strike, throwing rim components several hundreds of metres into the air — has again demonstrated the enormous potential for harm.)
- Manage the re-introduction and use of Bias Ply tyres (often from manufacturers newly entering the earthmover tyre market) and the use of second-hand and repaired tyres through your site's 'management of change' process. Resolve TKPH before introducing such tyres (in consultation with tyre specialists).

Conclusion

Substantial improvements in tyre life and tyre safety can be achieved through a combination of sound management principles — based on dedicated inspections, preventive actions, good operating conditions, improved operator awareness and practices, and management of tyre performance. Adopting such principles and implementing the recommendations contained in AS4457 Part 1 and 2 into a mine's SHMS — combined with effective communication with all stakeholders — will result in a safer workplace for all.

Please ensure that all relevant people in your organisation receive a copy of this alert, and place it on noticeboards at your mine.

Stewart Bell

Deputy Director-General and Commissioner for Mine Safety and Health
Department of Employment, Economic Development and Innovation

Contact: Tilman Rasche, Senior Inspector of Mines,
+61 7 3403 3148 or via email Tilman.Rasche@deedi.qld.gov.au

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