

Recognised standard 13

Tyre, wheel and rim management

Coal Mining Safety and Health Act 1999

November 2016

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Recognised standards

This document is issued in accordance with Part 5 — Recognised standards and Section 37 (3) of the *Coal Mining Safety and Health Act 1999*.

Part 5 – Recognised standards

71 Purpose of recognised standards

A standard may be made for safety and health (a “recognised standard”) stating ways to achieve an acceptable level of risk to persons arising out of coal mining operations.

72 Recognised standards

- (1) The Minister may make recognised standards.
- (2) The Minister must notify the making of a recognised standard by gazette notice.
- (3) The chief executive must keep a copy of each recognised standard and any document applied, adopted or incorporated by the recognised standard available for inspection, without charge, during normal business hours at each department office dealing with safety and health.
- (4) The chief executive, on payment by a person of a reasonable fee decided by the chief executive, must give a copy of a recognised standard to the person.

73 Use of recognised standards in proceedings

A recognised standard is admissible in evidence in a proceeding if—

- (a) the proceeding relates to a contravention of a safety and health obligation imposed on a person under part 3; and
- (b) it is claimed that the person contravened the obligation by failing to achieve an acceptable level of risk; and
- (c) the recognised standard is about achieving an acceptable level of risk.

Part 3 – Safety and health obligation

37. How obligation can be discharged if regulation or recognised standard made

37(3) if a recognised standard states a way or ways of achieving an acceptable level of risk, a person discharges the person’s safety and health obligation in relation to the risk only by—

- (a) adopting and following a stated way; or
- (b) adopting and following another way that achieves a level of risk that is equal to or better than the acceptable level.”

Where a part of a recognised standard or other normative document referred to therein conflicts with the *Coal Mining Safety and Health Act 1999* or the *Coal Mining Safety and Health Regulation 2001*, the Act or Regulation takes precedence.

This recognised standard is issued under the authority of the Minister for Natural Resources and Mines.

Recognised Standards may be updated from time-to-time. To ensure you have the latest versions, refer to the Department of Natural Resources and Mines website www.dnrm.qld.gov.au or contact your local Inspector of Mines:

North Region PO Box 1752 Townsville Qld 4810 Ph (07) 4447 9248 Fax (07) 4447 9280	North Region PO Box 334 Mount Isa Qld 4825 Ph (07) 4747 2158 Fax (07) 4743 7165	South Region PO Box 1475 Coorparoo Qld 4151 Ph (07) 3330 4272 Fax (07) 3405 5345	Central Region PO Box 3679 Red Hill Rockhampton Qld 4700 Ph (07) 4936 0185 Fax (07) 4936 4805	Central Region PO Box 1801 Mackay Qld 4740 Ph (07) 4999 8512 Fax (07) 4999 8519
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1. Purpose

The purpose of this standard is to give an outline of what elements must be considered in a mine's Safety and Health Management System (SHMS) and to assist in the development of a Standard Operating Procedure, and other procedures, for the management of tyres, wheels and rims at a coal mine. It provides a managed approach to achieve an acceptable level of risk to persons using the SOP required by Section 72 (a) of the Coal Mining Safety and Health Regulation 2001.

72 Miscellaneous

A coal mine must have standard operating procedures for the following—

(a) fitting, removing, testing, maintaining and repairing

tyres and rims on fixed and mobile plant;

2. Scope

This standard applies to all tyres, wheels and rims on mobile, transportable and fixed plant at a mine and includes all associated tools and equipment as mentioned in this standard.

Note: Recognised standards are not mandatory

Recognised standards are not mandatory, but when followed provide a way of meeting safety and health obligations. A person may adopt another way of managing that risk, however in the event of an incident the person may be required to show that the method adopted was equivalent to the method in the recognised standard.

3. Application framework

3.1 Wheels and rims

There are many designs of wheels and rims in use at mines - single piece wheels, industrial two piece and multi piece wheels and rims.

3.2 Tyres

There many types of tyres in use at a mine, pneumatic tyres (radial and bias construction), filled tyres (polyurethane, rubber insert and water ballasted) and solid tyres.

3.3 Associated tools and equipment

Equipment mentioned in this standard that is used for fitting, removing and handling of tyres, wheels and rims, for example tyre handler, forklift etc.

3.4 Exclusions

Tyres, wheels and rims that have a proven low risk (such as tyres and wheels or rims fitted to gas trolleys, wheelbarrows, parts trolleys, ride on lawnmowers, and earthmover equipment jacks) are excluded from this standard.

Also tyres, wheels and rims that the mine risk assessment identifies as low risk may be excluded from this standard. The controls for all excluded items are to be contained in the mine's SHMS; this standard may be used as guidance material in developing the controls.

Note: Risks associated with overpressure, split wheels and plastic wheels fitted to plant such as wheel barrows or trolleys must be considered.

4. Technical guidance

The controls mentioned in this standard will form part of the mine's SHMS and may be an integral part of the Standard Operating Procedure. The system is to have regard for the guidance given in this section that covers the life cycle of tyres, wheels and rims from procurement to disposal.

Major hazards associated with tyres and wheel or rim components include their physical size, weight, complexity of multi-piece wheels and rims, stored pressure energy, potential for explosion and the damage resulting from the arduous conditions to which they are subjected. Manual handling is possible for only a few types of tyre, wheel or rim as most are of a size and weight that necessitates machine assistance. Trained personnel are required for work on the wheel and rim assemblies due to the complexity and critical nature of the work. The consequences of rapid deflation, tyre fire and ejection of wheel or rim components have resulted in fatal accidents and serious injuries to mine workers.

Sound tyre and rim management = safe production	4.1 Tyre and rim - selection and procurement
	4.2 Receipt and storage of tyres and rims
	4.3 Mounting, demounting, assemble and disassemble
	4.4 Fit for purpose tyre maintenance facility
	4.5 Maintenance and upkeep
	4.6 Operation and hazardous conditions management
	4.7 Removal and disposal
	4.8 Information documentation and tracking
	4.9 Competency
	4.10 Systems

4.1 Tyre, wheel and rim — selection and procurement

The first element in development of a tyre, wheel and rim management system is selection and procurement of the tyre and wheel or rim. The systematic risk assessment approach requires that the correct people are involved, for instance the tyre, wheel and rim manufacturers, mine designers and operators, tyre, wheel and rim technicians and maintainers and the plant OEM. Data required for the risk assessment is to include:

- Application:
 - Earthmoving, large tyres, wheel or rims, light vehicle or fixed plant
 - Will the wheel or rim be a multi-piece, divided (two piece or split rim), single piece or drop centre?
 - Will the mounting be cleat mounted or disc mounted?
 - Will the tyre be for earthmoving, grader, truck, light vehicle or fixed plant? Will it have lugs, tread or smooth?
 - Is the tyre pneumatic or is there a requirement for solid fill or solid tyres? Solid or solid fill are generally used for slow moving or occasionally moved equipment (trailers, crib huts).

- What is the TKPH (earthmoving) or duty cycle required?
- What are the conditions of operation, type of plant, payload, speed, environment conditions, equipment utilisation, road gradients and road surfaces?

Other considerations at this early stage should include:

- management of change by the introduction of new tyres, wheels or rims into service (for instance training of on-site personnel, new style truck)
- tooling requirements, including tyre handlers, if different from those presently in use
- unique identifier, branding of tyres, stamping of wheels or rims for tracking and recordkeeping (in protected places on the wheel or rim to retain legibility, also see 4.2.2f) (AS 4457.1 for earthmover wheels and rims)
- consistency of types of tyres, wheels or rims to provide standardisation on site and reduce confusion
- establishment of a wheel, rim, components and tyre supply guidelines, detailing:
 - how the wheel, rim, components and tyres are packaged for transport (taking into consideration the site's transport, unload and load procedures)
 - rim identification nomenclature
 - wheel, rim and component colour coding
- choice of modern 'safer' designs, for instance:
 - bead seat band designs (for certainty of lock ring correct fitment and retainment)
 - double gutter rims (for reduction of hazard exposures such as vibration and manual handling when replacing tyres in duals)
 - two piece lock rings to eliminate sprung potential energy, minimise manual handling and line of fire risks (these many also have lock ring retainers, bolted connectors)
- if the tyres are re-groovable, re-treadable or repairable. Reconditioned tyres should have repair marks on the sidewall and be tracked in the mine site's management system (refer AS 4457.2, AS 1973)
- reconditioned tyres may have speed or load restriction and may only be fitted to certain positions on the plant
- repairs on tyres should face the inside of the machine
- repaired tyres should not be used as steering tyres
- introducing and managing a third party latent risk:
 - on-site acceptance of wheel and rim components and wheel and rim assemblies, assembled off site
 - visitors vehicles and goods delivery to the site
 - mobile or fixed plant introduced by contractors
- if a dispensation has been given for the application:
 - where the tyre loading exceeds the manufacturers branding on the sidewall of the tyre, the manufacturer or supplier may raise the load rating by increasing the tyre pressure, restricting the speed of the haul, provide specific training for the operators and written instructions for the mine records (applies specifically to earthmoving trucks and on-road haulage used at mine sites)
 - ensure wheel or rim rating matches or exceeds tyre load rating
 - consider equipment design parameters e.g. wheels or rims and fasteners (studs, nuts and cleats), suspension components, steering.

Note: Dispensation in this document refers to the term used in the recommendations made by the Coroner in the Wayne MacDonald inquiry (Appendix 2).



Image 1: Example of unique identifier



Image 2: Earthmover wheel with two-piece lock ring

Other items to be supplied to the site include:

- the OEM or suppliers recommended tyre pressure, wheel or rim fastener torque settings and any dispensation (assists the mine to develop and post a wall chart for relevant personnel information)
- the OEM or suppliers 'reasons for removal' of a tyre, wheel or rim (posted wall chart) (AS 4457.2 Appendix B has a list of conditions to determine serviceability of earthmover tyres)
- guidance on management of fasteners (reference manufacturer's guidance when considering the effects of broken or missing fasteners)
- maintenance requirements during the life of the wheel or rim. (AS 4457.1 has types of inspection and tests, for earthmover wheels and rims).

4.2 Receipt and storage of tyres and rims

4.2.1 Transportation, receipting, loading, handling and unloading

Risk assessments shall be conducted to identify the controls for transporting and handling:

- a) Specifically the prevention of injury to personnel or damage to tyres (bead area), wheels and rims (gutter section, grooves and mating surfaces) and assemblies. Appropriate controls include using competent personnel, manual handling techniques, transporting with lock ring fitted and appropriate lifting aids (tyre handler).
- b) Containerised delivery has its own inherent hazards.
- c) On highway transport contractors should ensure that consideration is given to other road users (transport earthmover tyres vertically reduces the need for wide loads).
- d) An appropriate inflation pressure for handling and transport of assemblies, mounted on or off the truck
- e) Solid and solid fill tyres (polyurethane and inserts) present handling hazards due to their weight.

On receipt of assemblies, where tyres have been fitted off site, conduct a fitment verification check. Check that tyres are at the sites nominated pressure, prior to storage, and verify the competencies of the person assembling the wheel or rim assembly.

Conduct a similar check of all equipment arriving on site including contractors equipment e.g. introduction to site process, change management, machinery inspection. Tyre, wheel and rim site register to be updated:

- contractors equipment introduced to site
- the wheels and rims that have stamped or branded serial numbers (see 4.2.2 f), prior history of tyres, wheels and rims where known.

A tyre management and tracking process for tyres, wheels and rims shall be implemented that is functional, effective and followed. It shall contain:

- tyre/wheel/rim details (e.g. TKPH)
- application (equipment and working environment)
- pressures, tread history, damage, position, rotation history, hours
- NDT history
- maintenance records including repair history.



Image 3: Vertical transport of tyres



Image 4: Unloading tyre using fit-for-purpose equipment

4.2.2 Storage of tyres, wheel and rim and assemblies

Tyres, wheels and rims should be stored in a safe and clean environment using the controls developed from a risk assessment. The following points should form part of the risk assessment:

- Stored:
 - so that they do not present a hazard and cannot be damaged. Typical hazards could include fire, toppling over, falling off a stack, rolling away and injuring a person
 - away from traffic to prevent interaction or damage
 - with adequate working space and adequate lighting for working during hours of darkness and easy access for fire-fighting equipment
 - sidewall information or relevant information chalked or painted on is clearly visible
 - in a segregated manner to avoid mismatch and reintroduction of quarantined or damaged items and to lower the risk of fire hazards
- A stock rotation strategy should exist to limit storage time of all components, 'first in first out', based on manufacturers recommendations (e.g. rubber products have a 'use by' date, corrosion induced cracking)
- Wheel and rim components should be stamped/branded for ease of identification and differentiation between manufacturers, to facilitate selection before fitment and service life tracking:
 - stamping should include unique serial number, manufacturing date, repair date, rim style, size etc.
 - stamping in a number of places will aid visibility and legibility
 - outward facing when fitted to plant
 - AS4457.1:2007 provides guidance for earthmover wheels and rims
- Tyres should also be classified by manufacturer, application, retread, reconditioned, quarantined, size, pattern, tread depth and status (for instance new, used, scrap, awaiting inspection)
- Storage areas shall be free of petroleum products, electrical equipment producing ozone and if possible out of direct sunlight
- Clear signage to identify stored items.

Storage methods

For earthmover and large tyres and assemblies AS4457.1 section A10 and AS4457.2 section 2.4 provides guidance. Tyres and wheel or rim assemblies should be stored in an appropriate tyre holding device or restrained such that they cannot roll away, topple or be dislodged.

When storing large tyres and assemblies horizontally the tyre at the base of the stack may suffer structural integrity damage to the tyre; they should preferably be stacked no more than three high to reduce the risk of a dislodged tyre toppling or rolling away in an uncontrolled manner. If the stack is required to be more than three high, then a risk assessment should take into account factors such as: type of terrain, skill of operators, size of tyres, and capability of tyre handler or forklift.



Image 5: Vertical tyre storage showing inspection corridors and segregation

To overcome tyre bead issues, assemblies must be inflated to site storage pressures, as determined by a risk assessment process, for the size and type of assembly (earthmover tyre typically between 20 psi and 30 psi, 140 kPa to 210 kPa) to maintain the bead in the correct seating location on the rim base. It is recommended that the inflation pressure and date of inflation is written on the tyre sidewall with permanent crayon.

Valve caps shall be fitted to all valve stems to prevent ingress of dirt into the valve stem and provide airtight seal against leakage. Consideration should be given to metal valve caps.



Image 5: Large tyre racking



Image 6: Wheels, rims and their components



Image 7: Wheel and rim storage

1. Signage shall be in place for all categories of wheel, rim and component storage.
2. Stored in designated and clearly identifiable areas in a stable configuration, sorted by manufacturer, size, lock ring, bead seat profile and common design (single or multi-piece etc.) to simplify selection of like components and avoid selection of incompatible rim/wheel components.
3. Stored off the ground on a compacted well drained area that allows all-weather access for forklifts and other load shifting equipment, such as tyre handlers.
4. Rim components such as bead seat, flange rings and lock rings must be stored in a manner that retains their serviceability and segregates compatible and incompatible components. Colour coding reduces the possibility of assembling incompatible components. (Components from different manufacturers are not necessarily compatible).
5. Components waiting for testing or repair shall be clearly marked and stored in a designated and clearly identified 'quarantine area' to prevent accidental return to service.
6. Damaged, worn-out or unserviceable components shall be rendered inoperable (e.g. by cutting up lock rings) and discarding to a designated area or metal recycling bin.

4.3 Mounting, demounting, assemble and disassemble

Fitting a wheel or rim assembly to a vehicle or plant, assembling wheel or rim components and mounting a tyre to a wheel or rim are tasks that require care and attention to detail. The steps vary depending on the type and size of the tyre, wheel and rim. This section outlines the controls and points to consider ensuring mounting, demounting, assembly and disassembly are done correctly and safely. It is not a step by step guide.

During development of the standard a risk assessment was conducted, the outline of the risk assessment is in Appendix 1, it shows the development of the standard and examination of hazards for each step. The risk assessment was developed by an industry group specifically for the preparation of this recognised standard.



Each vehicle, type of tyre, wheel and rim, application and size (earthmover, large, light truck and passenger vehicle) presents a different risk profile. For instance, fitting of tyre chains presents a unique set of risks. All activities and procedures must be based on risk assessment principles and developed by a representative group. The safety critical steps and their controls shall be identified and highlighted in any developed procedure. For multi piece earthmover applications the safety critical steps should consider:

- establishing all components to be reused meet the manufacturer's component reusability criteria
- establishing all of the components to be reassembled are compatible components, reference to manufacturers manual
- confirmation of correct seating of components prior to partial inflation
- confirmation of correct seating of components prior to increasing the pressure from partial inflation to full inflation
- establishing the use of no-go zones to exclude personnel from hazardous areas during inflation and deflation and the criteria on when access to these areas can be allowed by qualified personnel.

The International Council on Mining and Metals (ICMM) has published a critical control management good practice guide and a critical control implementation guide (referenced documents section 6).

For polyurethane filling of tyres the manufacturer's process must be followed. The process includes pre-stretching of the tyre carcass, pre drilling of the tyre tread area (to allow air to escape as the fill material is injected) and the method of ensuring a complete fill. An incomplete fill will allow the fill material to move during operation of the vehicle and subsequent frictional heating inside the tyre.

In a fit for purpose facility (tyre bay)

Planning

Some things will exist in the facility (Section 4.4) but should be checked before any maintenance work. They include:

- fit for purpose hand tooling
- fit for purpose jacks and stands, OEM nominated jacking and support points
- inflation tool, cage
- mobile remote inflation/deflation and pressure monitoring ability
- methods showing demarcated zones during inflation (reflective cones, marker tape, painted hazard areas)
- calibrated torque tool, pneumatic and manual
- current chart showing torque for the plant being maintained and re-torque schedule
- pressure gauges and calibrated master gauge
- current chart showing the recommended cold inflation pressure for the plant being maintained
- tyre handler for large or earthmover tyres, wheels and rims. Fitted with safety devices e.g. fall back arrest arms, relief valves in tyre handler arms (to avoid overloading arms, if inflating tyre while between arms). Truck mounted tyre handler or forklift for smaller wheel or rim assemblies if required.

Preparation

- Clean and inspect vehicle on entry to the tyre bay, prior to any maintenance (load in the tray, product hang up in tray and rocks between duals).

- Secure vehicle e.g. isolate and wheel chocks.
- Identify tyre type and specification (pneumatic, solid and application). New, used, retread and reconditioned tyres (restriction on fitting position).
- Identify wheel or rim type, multi-piece, two-piece, single (preference is for the use of drop centre single piece rather than two-piece).
- Fit for purpose valve stems (inner and outer), their accessibility and the possibility of fitting fusible links (pressure or thermal).
- Lock ring retainer, driver (bead seat band).



Image 8: Lock ring retainer and driver

Critical control points

- Earthmover and large rim assemblies including their duals shall (and wheel assemblies should) be deflated to zero, or a safe handling pressure before being removed from the plant (handling of assemblies at zero pressure may introduce unintended risks).
- For earthmoving equipment use staged jacking because of rearward movement of the jacking point as the rear wheel rotates to the rear, (maximum single lift 200mm i.e. lift 200mm, set and hold on stand, reset jack ground position, lift another 200mm etc.) See graphical representation below.
- Inspection of the wheel or rim assembly prior to fitment on plant.
- Post-fitment inspection and release to production – quality control check (possibly by supervisor or other competent person not involved in the task).
- If tyres were fitted away from the mine then a check/signoff by a designated & competent person at the site before use on the site. If a doubt exists, the tyre is to be removed, inspected and refitted.

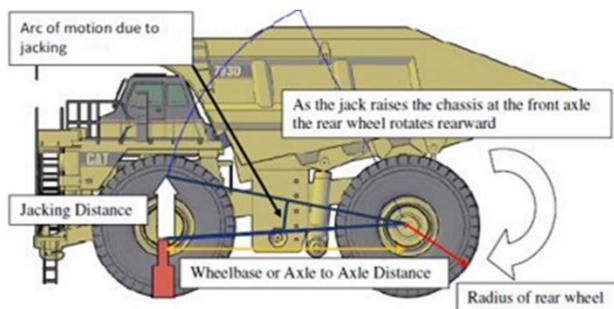
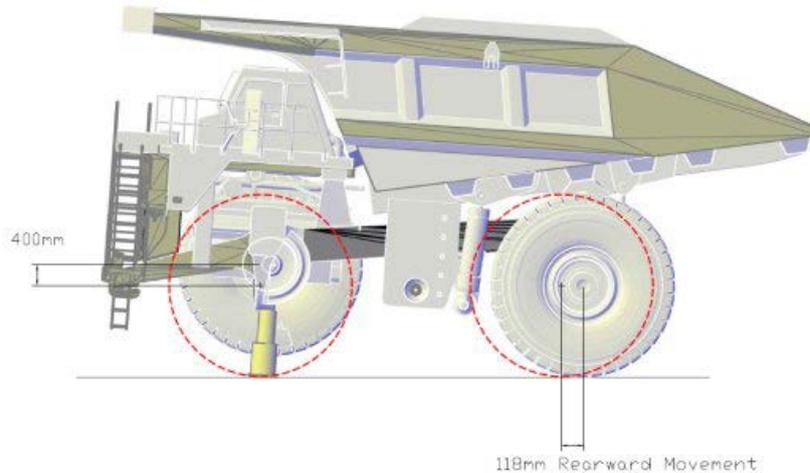


DIAGRAM NOT DRAWN TO SCALE. REFERENCE ONLY



Away from tyre bay (in pit or in workshop)

- Area lighting sufficient for the task.
- Communications with pit users and demarcation of the plant.
- Equipment should be parked away from traffic, people, and hazards; a clear area to perform the task.

Many items may be needed to be transported to the site, they include:

- mobile remote inflation/deflation and pressure monitoring ability (RIDS – remote inflation deflation station) so that persons are not positioned in the high-risk zone of an air blast from an uncontrolled assembly failure (during inflation/deflation)
- JSAs and procedures
- first aid equipment, fire-fighting equipment
- lock out equipment
- wheel chocks
- transport of tyre, wheel or rim assembly to and from the worksite
- spare tyre or assembly
- consumables e.g. wheel nuts, cleats etc.
- tyre handler, or tyre handler machine
- communications equipment
- lift and lock jacks and vehicle stands (timber cribbing and blocks should not to be used as loadbearing members)
- jacking plates
- demarcation equipment for establishing an exclusion zone around the work area to prevent unauthorised entry
- woggles hats
- compressor
- hand tools
- jacks and stands
- torque tool
- pressure gauge (checked against a master gauge)
- signage.

4.4 Tyre maintenance facility

A fit for purpose tyre maintenance facility is important for the safe fitting and removal of tyres. The maintenance facility specific needs should be considered by utilising a risk assessment process and be completed prior to fitting and removal of any tyres on site. The type, location and design features of the facility should take into account the specific site and equipment requirements and would in usual circumstances include a permanent maintenance facility.

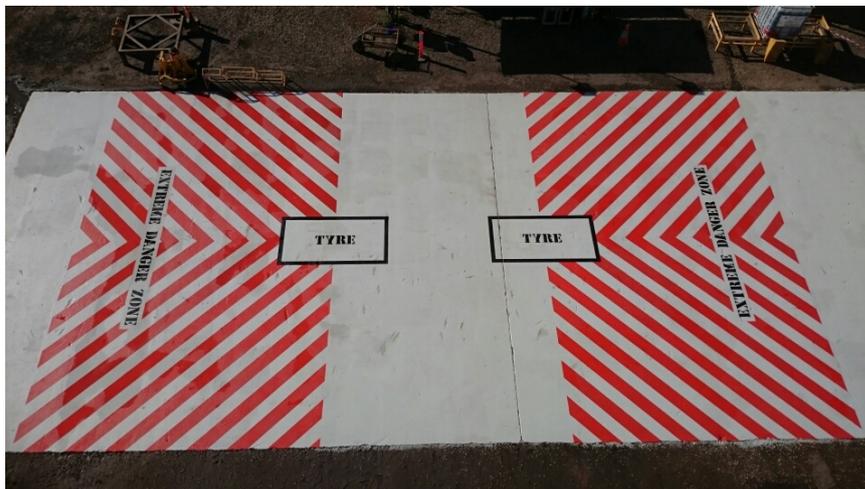
For a permanent facility there are a number of design principles that would support the ongoing safe fitting and removal of tyres, these considerations should include the following.

Building and surrounds

A level concrete slab should be provided that is large enough for the largest item of equipment to be serviced. The slab should be designed with appropriate drainage and with consideration of the weight of the largest equipment, particularly point loading during jacking and using safety stands. A slab provides a stable platform for jacking. The maintenance facility should have a roof in order to protect workers from the elements yet appropriately ventilated, this roof may extend over a building and equipment service area, having regard to the prevailing wind direction. The roofed area should be large enough to provide safe access to both sides of the truck or plant.

The control of the hazard of rapid tyre deflation or uncontrolled release of the wheel or rim components during inflation or deflation should include, where appropriate:

- demarcation to show no-go zones (may be temporary indicators such as marker tape or reflective cones or the workshop floor may be permanently marked. Size and shape of the zone should reflect the size of the tyre and the pressure it contains
- engineered hard barriers to segregate people from any zone of risk
- a system of gates and interlocks to restrict personnel access.



A parking area for a tyre handler, trucks or plant and light vehicles adjacent to the facility shall be designed to minimise vehicle interaction and not be within the blast direction angle (preferably located at 90 degrees to the facility). Laydown, storage or parts staging areas for tyres, wheel and rim components are to be designated and clearly signed. They need to be in close proximity to the work area to encourage selection of a replacement for high frequency items (rather than refit a questionable item).

Provision of good visibility lighting where critical steps in the assembly of components are conducted and general lighting to all other areas, including parking, without causing glare, AS1158.3 and

AS1680 may be used to provide guidance. Artificial ventilation should be considered when inflating or deflating nitrogen filled tyres.

Tools

- Appropriate FFP work benches including sufficient number of power and air outlets at the workbench.
- Designated areas and cabinets for the storage of consumables, tools and tyre maintenance documents (e.g. manuals, maintenance procedures, standard operating procedures and material safety data sheets).
- Display and notice board - Charts – documenting cold inflation pressure and torque charts, wheel and rim profiles, image of exclusion zones and dispensation criteria.
- Tools to measure tolerances and dimensions of wheel and rim (to compare with predetermined wear limits).
- Sufficient number of rubbish bins, spillage kits and metal recycling bin.
- Lift and lock jacks and vehicle stands (timber cribbing and blocks should not to be used as loadbearing members).
- Jacking plates.
- Certified tyre inspection stand.
- Work platforms – various to allow for largest equipment.
- Wheel or rim fitment stand.
- Certified safety inflation cage to suit assembly size. Located to redirect air blast and contain ejected wheel or rim components (a clearly identified restricted area during the inflation process).
- Tyre additive – reticulation system, distinctive colour of additive provides critical indication of leaks (slow puncture or wheel or rim cracking).
- Jacking extensions not to be used.

Compressed air/nitrogen and water

- Compressors and Air Receivers should provide sufficient pressure and volume for the tyres in use (cater for the largest volume and highest pressure) and sited away from personnel and mobile machinery.
- Consideration of an air dryer sufficiently rated to minimise moisture entering the wheel or rim assembly. Moist air is appropriate if tyre additive is used.
- Air used to inflate tyres should be oil free.
- Air receivers and safety valves to be tested as per AS3788.
- Any other valves, air fittings and air lines fitted to the compressed air system shall be rated to withstand the highest air pressure the compressor can produce (AS1271).
- A regular service program should be implemented for the compressor and air dryer as per OEM recommendations.
- Remote inflation/deflation (fitted with noise suppression) and pressure monitoring ability (RIDS – remote inflation deflation station) so that persons are not positioned in the high-risk zone of an air blast from an uncontrolled assembly failure (during inflation/deflation).
- Separate compressed air lines/reels for air tools and tyre inflation.
- Water supply lines to be able to reach all of the tyre bay.
- Nitrogen or an inert gas are alternatives to compressed air inflation.
- All lines to clearly identify the fluid (for instance compressed air for tools and dry, oil free air for inflation).

Safety

- CCTV to record work on both sides of equipment.
- Communication system – two way, phone, distress alert buttons.
- Firefighting equipment/system.

4.5 Maintenance and upkeep of tyres, wheels and rims

General

Risk assessments should be undertaken for each activity, for instance the hazards of being in close proximity of a pressurised tyre when inspecting for separation, delamination or cuts.

Inspections of the tyre environment looking for tyre damaging conditions in the loading area, roads, dump and stockpile areas. The people conducting inspections should include supervisors of the locations listed and operators of the vehicles working in those areas. Also an examination of the area where a tyre handler, crane, water truck or service vehicle will be used. In an underground location the roadways should be examined for materials on the road that can cause tyre damage. Inspection frequencies should be dependent on the history of the tyre, wheel and rim performance at each mine.

Recording of the results of inspections will guide future inspections. All activities associated with tyres, wheels and rims should be recorded as part of the maintenance history and the scheduling system to predict future maintenance work. Life cycle records will assist in the purchase of new and replacement tyres wheels and rims. In-situ wheel and rim maintenance during tyre changes is incredibly important as it provides critical information of whether the test frequencies should be changed to accommodate increases in operating severity.

For protector and traction chains, readjustment and tightening presents a unique risk profile, the controls for this task should be assessed using the expertise of the manufacturer or supplier.

Tyres

Inspection of tyres is the first step in tyre maintenance. Documented frequency of inspections and recording and analysis of the results will assist in purchase of replacement tyres or confirm the choice of tyre in the application at the mine.

Tyre condition monitoring includes:

- regular visual inspection by vehicle operators
- examination for separation, delamination and cuts
- routine tread wear measurements
- thorough external and internal inspection by tyre technicians at each tyre change.

Results of tyre inspections will indicate removal for re-use, such as matching with a similar dual, discard, recondition or re-tread. Wear and damage are triggers for removal of the tyre; a chart that includes photographs of tyre damage posted at the tyre bay will guide the tyre technician when a tyre should be reconditioned or discarded or at the very least to question the tyre manufacturer whether it should continue in service. The tyre supplier, manufacturer or tyre repair facility would provide guidance on recondition and discard of tyres. AS 4457.2 is the reference document for earthmover tyres and AS 1973 for passenger, light truck and truck/bus tyres, the Standards provide guidance on continued use or ability to repair.

Readily available consumables should be in the tyre bay. For instance replacement valves, valve caps, swivels, extensions, studs and nuts. Also a ready supply of tyre additive and corrosion inhibitor, where used on site, should be available or reticulated in the tyre bay. The tyre additive has a distinctive colour that may assist in discovering a slow leak from puncture or crack in a wheel or rim.

(The use of a tyre additive or corrosion inhibitor may not be warranted where nitrogen is used to inflate tyres).

Pressure in a tyre is critical to its load carrying capacity and fatigue life. TPMS (tyre pressure monitoring systems) are beneficial in keeping the tyre pressure within its stated pressure envelope. Some monitoring systems also include temperature monitoring of the tyre air chamber. The capability to inform the vehicle operator (by remote sensing) of a tyre pressure outside of the envelope can ensure swift action to correct the situation or prevent tyre damage. The introduction of TPMS to haulage fleet tyres on mine site vehicles has been recommended by the Queensland Coroner in a recent fatality inquiry (Appendix 2). This should also be considered for earthmover and light vehicle tyres.

A process and schedule for taking pressure readings of earthmover and large vehicle tyres should be in use at mines. Recording of the results should form part of the maintenance history of the mine. Inflation pressures not within the inflation pressure envelope for the tyre are to be adjusted as required. This is not an easy task as the correct pressure of a tyre is always taken 'cold' (manual or TPMS). The hot pressure must be confirmed as over inflated (greater than a normal hot pressure would be) before pressure bleeding. Pressure bleeding can result in an under inflated tyre once the tyre cools. For accessibility the inner dual tyre shall have extended inner valve stems. If TPMS is installed on a vehicle, its integrity should occasionally be ensured by manually checking the pressure and comparing against the TPMS reading.

A TARP for tyres should include pressure as a trigger for response. For earthmover and large tyres in operation the triggers should include:

- low pressure, less than 70 per cent of the tyres cold inflation pressure will require the tyre to be removed and inspected internally (running at low pressure can cause fatigue loading in the tyre structure) AS 4457.2 expands this point. The adjacent dual tyre should also be removed and inspected as this tyre will have been overloaded and may have suffered structural fatigue if it has been operated next to a low pressure tyre
- high pressure, above the pressure envelope should be investigated
 - over inflated due to error or defective pressure gauge
 - heat from tread separation (some TPMS also include temperature monitoring)
 - speed, overload (TKPH)
 - road conditions or design.

Wheels and rims

As with tyres the first level of wheel and rim maintenance is inspection. Regular visual inspection by vehicle operators (at the same time as tyre inspection) provides an early indication of problems and thorough visual inspection of cleaned wheel and rims at each tyre change by a tyre technician will highlight cracks, areas of wear, corrosion and fretting. Results of the latter inspections should be recorded in the maintenance history files or may require the wheel or rim to undergo further inspection, possibly non-destructive testing.

Earthmover wheels and rims that have had damage or fatigue identified by the inspection may require non-destructive testing to establish the competence of the wheel or rim. These wheels and rims should also undergo a non-destructive test schedule throughout their life. AS 4457.1 is the guidance document for testing and recondition of earthmover wheels and rims but can also be used as an information document for other wheels and rims. The frequency of NDT may require adjusting depending on results of previous testing and component deterioration. Wheels and rims must be checked to ensure fitting and wear tolerances in multi-piece wheels or rims are not exceeded; they may need to be reconditioned or discarded. For two-piece lock rings a condition acceptance

document should be developed in conjunction with the manufacturer, measuring wear tolerances is complex in this design.

Wheels should be examined for damage to the wheel stud holes, cracking of wheel spokes, corrosion and damage. Passenger and light truck vehicle wheels and rims may also be tested (non-destructive testing) however these are usually considered consumable items and discarded if cracked, corroded or worn beyond continued use. Hot work (welding or cutting) and heat application to fasteners is prohibited with tyres mounted (including deflated tyres).

4.6 Operation and hazardous conditions management

In operation a number of hazardous conditions can be encountered. It is essential to develop a documented plan for dealing with these conditions before they arise. A risk assessment detailing the control measures should form part of the tyre, wheel and rim management system. It is equally important that mine workers who will come in contact or will manage the hazardous condition be trained in the recognition of tyre, wheel and rim hazards and their controls.

Mobile equipment operators are most likely to identify hazardous conditions during pre-start or in-shift inspections. Check sheets shall be developed so that guidance is given on what to look for and how to report the defect or condition.

General controls

If a defect is identified or suspected by an operator during an inspection, the suspect area of the component clearly marked and supporting documentation prepared (to eliminate confusion of the defect location). The vehicle must not be taken into the tyre bay until the defect has been inspected by a competent tyre person. This reduces the exposure of mine workers to a potential hazardous situation.

During removal of a wheel or rim assembly from a vehicle or machine, if a defect is discovered, remove the defective component from service and send for testing and repairs if warranted, (Reference AS 4457.1 for earthmover wheels and rims). Unsafe or damaged, non-repairable wheels and rims or their components are to be permanently rendered unusable by cutting apart, to prevent the component from being inadvertently re-used. Damaged or deformed lock rings are not to be re-used. Where there is evidence of cracking or movement of a wheel or rim assembly, the removal process (for single or dual fitment) should be stopped and the tyre(s) immediately deflated to zero.

Prior to loosening securing fasteners, any tyre fitted to a wheel or rim assembly should be deflated to zero pressure or nominal handling pressure. If the pressure is to remain above zero, undertake a risk assessment to consider the risk from the hazards. This assessment should include comparison of the handling difficulties of assemblies at zero pressure with catastrophic failure or disassembly of wheel or rim components at pressures above zero.

For dual assemblies (specifically multi piece rims) both tyres shall be deflated.

No fasteners should be removed from a rim until all cleats/wedges have been released/loosened and the rim loosened on the hub taper. When removing fasteners (incl. cleats and wedges), ensure sufficient number of fasteners are left on the assembly to prevent uncontrolled movement of the assembly, until the assembly is held securely by mechanical means e.g. tyre handler.

A useful control prior to deflating a tyre is to check the pressure and chalk it onto sidewall this will alert the tyre technician if the pressure was below 70 per cent of normal cold pressure, therefore needing a more stringent inspection of the tyre (possibility of carcass or casing damage). This control will also alert the technician, when selecting an assembly to be fitted, that a tyre stored at a nominal storage pressure has leaked in storage.

Hazardous conditions (not an exhaustive list)

Hot tyre

- Causes: operating outside TKPH / OEM limits, poor road condition, potentially overloaded tyres (including duals)
- Identification: pressure build-up exceeds maximum permissible OEM operating pressure of tyre, high pressure alarm triggered from the TPMS
- Controls: prevent tyre operating above OEM limits, redirect vehicle to slower or shorter cycle or lower payload until alarms have deactivated or tyre pressure and temperature (taken manually) have reduced to acceptable levels (normal hot running pressure)

Side wall bubble

(follows on from previous, tyre generally hotter)

- Identification: smell of hot rubber due to separation, visible smoke or bubbles, series of crescent shaped marks on the tyre near the shoulder, sometimes known as 'eye brow' marks.
- Controls: park vehicle in safe area as soon as possible, tyre technician to assess the tyre condition and effect of temperature, monitor vehicle until visible smoke has ceased. Water cart may assist in cooling the tyre, when tyre has cooled, truck to return to the tyre bay and tyre removed. TPMS will show if excessive internal heating is present.
- A side wall bubble should be marked for identification and size. If the bubble enlarges from the initial size mark, the tyre manufacturer should be consulted to determine the action required.

Note: If over inflation of the tyre is suspected then the equipment is to be parked to let the tyres cool, pressures are to be adjusted only after the tyres have cooled, (tyre pressure must not to be adjusted while the tyre is hot).

Tyre fire

- Causes: external heat source such as hot spoil, ground coal spontaneous combustion, vehicle fire, spilt fuel or oil, hot work on truck, cut separations in tyres, friction from delamination, tyre rubbing against other components of the truck, excessive haul distance or payload (TKPH).
- Identification: external smell, smoke and flames.
- Control: operator awareness, fire suppression (e.g. engine fire), permit to work, fire blanket, TARP for working in spontaneous combustion conditions,
- Stop or place vehicle in safe area as soon as possible, evacuate driver, quarantine e.g. spatial separation (>300 m), cooling of assembly if safe to do so (truck NOT to return to the tyre bay), park and deluge where safe to do so, (using water cart cannons, reversing towards the fire), procedures, emergency response teams trained in tyre emergency techniques.
- Note the TPMS may be disabled, if vehicle is electrically isolated.
- Abnormal temperature rise may trigger diffuser valves or diffuser plugs to deflate the tyre (particularly for a slow temperature rise).
- Hot work (welding or cutting) and heat application to fasteners is prohibited with tyres mounted (including deflated tyres).
- Nitrogen filled tyres may reduce the possibility of an internal fire, however maintaining purity inside the chamber becomes critical to continued protection.

Electrification, arcing, internal tyre fire

- Causes: suspected or actual contact with electrical power source, suspected or actual (witnessed) lightning strike, welding, dragging or seized brakes, hot wheel motors, contaminants (wood, rags, flammable lubricants) and pyrolysis inside tyre air chamber.
- Identification – very difficult to identify, no smell, tyre pressure and temperature monitoring technology the prime alert mechanism (TPMS may not respond to a rapid temperature rise in time to alert to a potential explosion).
- Controls: In the event of potential internal tyre fire the following mitigating controls should be implemented.
- If the source is a power line, firstly de-energise the power line.
- Immediate park in a safe location and evacuate all personnel, de-energise and quarantine the vehicle for 24 hours, exclusion zone as per risk assessment (>300m). TPMS (monitoring) provides knowledge of the escalation or otherwise of an internal fire (if not disabled when vehicle is electrically isolated).
- If monitoring technology identifies a slow internal temperature rise but pressure is not excessive then deflation of the tyre may be considered (if safe to be carried out).
- Hot work (welding or cutting) and heat application to fasteners is prohibited with tyres mounted (including deflated tyres).
- Nitrogen filled tyres may reduce the possibility of an internal fire or tyre explosion, however maintaining purity inside the chamber becomes critical to continued protection.

Unable to deflate

- The hazard is the stored pressure energy that cannot be reduced to a safe level, no actions can be performed on a tyre that cannot be deflated.
- Mainly affects large and earthmover tyres

Connect the deflation tool to a remote inflation line, and 'open valving for inflation', confirm that the tyre is not deflating. The following escalating steps should be followed:

- pressurise the inflation line to a nominated pressure (less or equal to OEM cold inflation pressure)
- stop inflation, bleed and disconnect inflation line
- check pressure in the tyre is equal or greater than the nominated inflation pressure
- continue to deflate, check pressure intermittently and verify it is decreasing.

If pressure is not decreasing, the blockage has not been dislodged, attempt to clear blockage using the above approach by repeating several times.

If pressure is still not decreasing (blockage may be rubber nodules in the valve stem or the tyre inner liner creating a flap over the valve hole):

- competent person to insert a probe (or a similar method) to achieve full deflation, after carrying out a risk assessment
- attempt deflation by removing valve from rim/wheel base, or fusible link/burst disc.

As last resort, consider spiking:

- after risk assessment carried out
- set up exclusion zone > 300m (for persons other than the operator)

- jack up vehicle and remotely lower tyre onto hollow spike or reverse vehicle onto a plate that has a hollow spike welded at an angle.

4.7 Removal and disposal of tyres, wheels and rims

4.7.1 General

Risk assessments should be undertaken for each activity, for instance removal of a hot tyre, suspected cracked wheel or rim and electric arc. There are many reasons for the removal of a tyre, wheel or rim for instance:

- worn tyre, beyond further use or for tyre matching
- puncture
- tyre repair, tread or lug separation, cuts and delamination
- scheduled testing of wheel or rim
- damage to wheel or rim
- suspected crack in wheel or rim
- hot tyre or suspected electric arc
- replacement tyre to suit changed operating conditions.

The site should document the activities involved in the removal, particularly when the reason is a confirmed or suspected hazardous condition, the manufacturer or supplier should be consulted to assist in preparation of the document. Wear and damage limits should be determined with tyre manufacturers or suppliers.

A manual showing the fitting and wear tolerances for wheel and rim components will guide the tyre technician in deciding to refit, recondition or discard; these may be OEM manuals or guidelines. Alternatively the site may choose to use an off-site facility for examination and repair.

4.7.2 Triggers

Scheduled examination of earthmover wheel or rim, non-destructive testing including fitting and wear tolerance measurements may result in recondition or discard.

Wear and damage are triggers for removal, a tyre removed because of wear or damage may be reconditioned but may result in discard.

Documented criteria for repair or discard should be prepared and communicated; a chart that includes photographs of tyre damage posted at the tyre bay will guide the tyre technician, the criteria may be different for each tyre type and manufacturer.

An under inflated operational tyre must trigger a response. For earthmover and large tyres in operation, low pressure, will require the tyre to be removed and inspected internally as running at low pressure can cause fatigue loading in the tyre structure, (low pressure is less than 70-80 per cent of the tyres cold inflation pressure, tyre manufacturer's guidance will provide the appropriate figure for their tyres).

Inspect both tyres of a dual assembly. An examination may result in discard of the tyre. For truck/bus tyres the examination may include inflating the tyre to 120 per cent of cold inflation pressure (in a cage) to ensure 'zipper' failure of the sidewall does not occur in use. This test was recommended by the Queensland Coroner in a recent fatality inquiry (Appendix 2) but should only be carried out in consultation and agreement of the tyre manufacturer. (Truck/bus tyres are those listed in the Tyre and Rim Association Standards Manual). An over inflated tyre resulting from a hot tyre caused by tread separation or tyre fire must be removed from service.

4.7.3 Disposal

A defined area should be chosen where all damaged, worn or suspect tyres, wheels and rims can be located prior to inspection and processing for re-use, reconditioning or disposal. This will remove confusion as to their condition and prevent them being put into service before they have been examined.

Scrap tyres may be disposed of on site, e.g. burial or stored on site for future recycling, alternatively they may be taken off site but in this case they should be rendered unserviceable to prevent further use. Pods of buried tyres should be kept small to reduce the size and effect of tyre fires in a dumped area. These locations should be surveyed and entered onto mine plans for future re-cycling.

Unsafe, damaged and non-repairable wheels or rims and componentry are to be rendered unusable by cutting up so they cannot accidentally be reused. Damaged or deformed lock rings are not to be reused. Cracked, damaged nuts or studs and stretched studs are not to be reused. Chains that are cracked, damaged or worn are not to be reused. Metal disposal means to be placed into scrap metal bins for recycling in a manner that ensures the component cannot be put into service.

4.7.8 Information, documentation and tracking

A documented tyre, wheel and rim management system when implemented, contains provision for storage of information and records, facilitates the tracking of tyres, wheels, rims and plant and provides readily available relevant information to the end user. The system is to include all plant and equipment fitted with tyres. Information may be stored electronically or in hard copy.

The system:

- contains risk assessments used to determine the controls contained in the safe work procedures
- safe work procedures
- critical task/control checklist (hold points/signoff)
- records information in a format that ensures ease of data entry, retrieval and reporting
- provides an effective mechanism for handover of information between successive maintenance crews
- contains OEM tyre, wheel and rim data (including dispensations) to ensure they are fit for purpose and satisfy the operations envelope. For instance;
 - tyre, wheel and rim details
 - equipment details
 - installation details
- has maintenance details of handling equipment
- records the status, identity and history (from purchase to disposal) of tyres, wheels and rims
- where a OEM or supplier provides information regarding tyre pressures, for example increase or decrease in air pressure due to operating environment, the information must be in writing and appropriately recorded at the mine site.
- contains further controls for the tyre, wheel or rim (size or application) that are identified by risk assessment
 - wheel and rim assemblies shall be permanently marked with a unique, unambiguous and clearly visible identification. Such identification shall be visible after the tyre has been fitted and inflated. (Refer AS 4457.1 – Sect 2.3)
 - provides tyre temperature pressure monitoring system (TTPMS) or tyre pressure monitoring system (TPMS) as an added alert system for high and low pressure monitoring and possible tyre air chamber temperature monitoring (Recommended by the Coroner following Wayne MacDonald fatality 2010, Appendix 2).

Records of all tests, inspections and audits:

- pressure checks, manual and remote (TPMS, TTPMS)
- tyre tread wear
- tyre condition (by exception)
- inspection and calibration information for specialised tooling such as: Jacks, torque tools, stands, master gauges, and support equipment (tyre manipulator, forklifts, HIABs, compressor(s), tyre bay work platforms, airlines, tyre service truck, ute etc)
- TKPH reports
- audit and validation of TPMS (reliability and accuracy).

Records of all repairs:

- tyre repairs e.g. 'patches', re-lugs, re-treads and re-grooves etc. (AS 4457.2 Earthmover, AS1973 Passenger car and light truck/buses)
- component repairs/replacements for wheels, rims and structural load handling equipment (tyre handlers, forklifts, cranes, cages).

Record of work performed:

- tyre, wheel and rim work performed
- 'checked by' information
- NDT tests, rim test methods and results.

4.9 Competency

4.9.1 Structure

The mine's training and management structure shall include onsite people with competencies in line with the current Resource & Infrastructure Industry Competency Standards and AURT equivalent, including assessment requirements such as performance and knowledge evidence. Persons undertaking tyre maintenance tasks must also be trained on the specific requirements for the tyres and rims used on site. Where tyre maintenance is done offsite, the same competency principles shall apply.

- tyre, wheel and rim competencies:
 - remove and fit wheel assemblies- RIISAM210, AURKT J002
 - remove, repair and refit tyres and tubes- RIISAM211, AURKT J001
 - demount, inspect, repair and mount agricultural equipment tyres and tubes- AURHT J2004
- site SSE to validate that a person is competent to perform tyre maintenance task (performance or challenge test)
- where the coal mine worker is to use equipment for tyre fitting, they should be assessed against the mine site procedures and specifically for the tasks to be undertaken prior to being authorised. Task competencies shall be dependent on the equipment to be utilised e.g. tyre handler, truck mounted handler, forklift, tyre press
- the mine will have training procedures and training needs analysis, in accordance with Recognised Standard 11
- authorisation by SSE and challenge test performed prior to authorisation
- verification of Competency training (Refresher) every five years at a minimum
- training shall be provided for any new equipment before it is used

- general awareness of tyre, wheel and rim and hazards for all site employees (including contractors) who are to work in the vicinity of inflated tyres.

4.9.2 Training

Personnel that work on or around mobile equipment who do not possess the required competencies, (operators, supervisors of tyre bay and maintenance personnel e.g. technicians), shall receive awareness training in basic tyre, wheel and rim hazards, 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, wheel and rim hazards and taking effective precautions (focus on critical controls!). Site training and education units should be determined by risk assessment.

Content should include such topics as (not an exhaustive list):

- tyre, wheel and rim safety
- tyre hazardous conditions and response e.g. tyre fires, hot tyre, sidewall bubbles, operator evacuation, park-up, lightning strike, potential tyre explosion
- tyre, wheel and rim care and maintenance
- plan & Prepare For Tyre Fitting Operations
- hand Tools & Equipment
- non-earthmover tyre fitting e.g. light vehicles, truck, cranes
- TARPS e.g. removal reasons (worn out and damage)
- specific instruction for operators of trucks where loading has been permitted to exceed the tyre load rating.

Due to the complex nature of wheels and rims, it is strongly recommended that training should be provided on wheels and rims by the manufacturer and or their agents.

4.9.3 Contractors

Mine management shall ensure that onsite contractors comply with site competency requirements and the sites single SHMS. Consideration needs to be given to the risk associated with delivery vehicles.

4.9.4 Off-site assembly

Off-site assembly introduces a third party latent risk, effective controls should be in place for the mine to manage these processes (reconditioning, assembly, inspection), for tyre, wheel and rim assemblies that will be used onsite. For instance; tyre, wheel and rim management system auditing, facility inspections, training needs analysis, QA document reviews, NDT record reviews will confirm the competence of the personnel involved in the off-site processes.

4.9.5 Protector and traction chains

Training conducted in fitting and adjustment of tyre chains for appropriate personnel.

4.10 Systems review

A tyre, wheel and rim management system or systems will encompass the elements for those parts of the mine SHMS that deals with the hazards and risks of tyres, wheels and rims on a mine site and will include documented systems. The system is to have regard for the guidance given in Section 4 of this Standard that covers the life cycle of tyres, wheels and rims from procurement to disposal.

The system is to include:

- schedules for review and auditing
- compliance and effectiveness audits (applicable to Sections 4.1 to 4.9 of this standard)

- audit of contractors on site and where applicable off site (e.g. tyre fill, wheel and rim assembly and maintenance)
- records of completed audits/inspections/checklists with remedial action plans.

5 Definitions

AURT	Training package for Auto Skills Australia (nomenclature AU-automotive, R-retail, service and repair, T-transport)
CCTV	Closed circuit television
DNRM	Department of Natural Resources and Mines
FPP	Fit for purpose (specifically fit for mine site)
MSDS	Material Safety Data Sheet
NDT	Non Destructive testing
OEM	Original equipment manufacturer
QA	Quality Assurance
RA	Risk assessment (includes JRA, JSA, SLAM, WRAC, Take 5 etc)
RII	Resources Industry Infrastructure
SHMS	Safety and Health Management System
SOP	Standard Operating Procedure
TARP	Trigger Action Response Plan
TKPH	Tonne, kilometre per hour (duty cycle calculation or rating)
TMS	Tyre management system
TNA	Training needs analysis
TPMS	Tyre pressure monitoring system
TTPMS	Tyre temperature pressure monitoring system
Compatible components	Components that are intended to be assembled as per their design; components of the same design from different manufacturers may not be compatible.
Incompatible components	Incompatible components are components that are not intended to be assembled together as per their design and are known to create a mismatch (not a matching set). Components that are said to be mismatched: <ul style="list-style-type: none"> • do not physically fit together correctly or

- can be inadvertently assembled but are not intended by design to be assembled together.

This mismatch compromises the integrity of the assembly and can create dangerous situations.

Rim	The assembly on which the tyre is mounted and supported. A typical rim comprises a number of components, e.g. back section, centre section and gutter section (which are welded together to form the rim base) and flanges, bead seat band and lock ring. A rim is mounted to a vehicle or plant by a system of wedges or cleats.
Rim assembly	Rim plus tyre.
Size (tyre, wheel, rim)	<p>Earthmover is used to mean rims/wheels fitted to earthmoving machinery.</p> <p>Large is used to mean tyres, wheels and rims that cannot be handled safely by manual means and are fitted to trucks, cranes etc. (tyre handlers, or forklifts are needed to handle them).</p> <p>Passenger or light truck are used to mean tyres, wheels and rims that can be manually handled and are fitted to passenger vehicles, light trucks and machinery.</p>
Wheel	A rotating load-carrying member between the tyre and axle. It usually consists of the rim base and the wheel disc/nave plate that is mounted to vehicle or plant by nave plate and studs/nuts.
Wheel assembly	Wheel plus tyre.
Wheel disc/nave plate	Part of the wheel which is the supporting member between the axle or hub and the rim base.
Industrial 2 piece (Split rim)	



6 References

AS 4457.1-2007 Earth Moving machinery - Off the road wheels, rims and tyres -Maintenance and Repair - Part 1 Wheel assemblies and rim assemblies

AS 4457.2-2008 Earth Moving machinery - Off the road wheels, rims and tyres- Maintenance and Repair - Part 2 Tyres

AS 3788 – 2006 Pressure equipment - In-service inspection

AS 1271 – 2003 Safety valves, other valves, liquid level gauges, and other fittings for boilers and unfired pressure vessels

AS/NZS 1158.3.1 – 2005 Lighting for roads and public spaces – Pedestrian area (Category P) lighting – Performance and design requirements

AS/NZS 1680.0 – 2009 Interior lighting – Safe movement

AS1973 – 1993 Pneumatic tyres – Passenger car, light truck, and trucks/bus – re-treading and repair

Safe Work Australia – Guide for split rims December 2015

WA Department of Mines and Petroleum- Guideline Tyre safety for earth-moving machinery on Western Australian mining operations

ACARP report 51036 'Fit for purpose' tyre maintenance equipment and management practises for non-earthmover vehicles. Author Dr Tilman Rasche

ACARP report C13049 'Tyre Fires and Explosions of Earthmover Tyres' Author Dr Tilman Rasche

ACARP report C15046 'Tyre Related Accidents and Incidents - A Study with Recommendations to improve Tyre & Rim Maintenance and Operational Safety of Rubber Tyred Earthmover Equipment' Author Dr Tilman Rasche

EMESRT - Design philosophies DP 2 – Tires and rims

International Council on Mining and Metals (ICMM), Critical Control management Implementation Guide; <http://www.icmm.com/document/9722>

Tyregate; <http://www.mirmgate.com/index.php?gate=tyregate>

7 Appendices

7.1 Appendix 1 Risk assessment outline

Outline of the risk assessment conducted as part of the Recognised Standard development (Tyre, wheel and rim management). The table below shows the steps and sub steps that were assessed.

<p>Scope: Provide an underpinning risk assessment for the Recognised Standard Tyre, wheel and rim management</p> <p>Context: Risk assessment to cover risk and safety management - working with and around tyres and rims/wheels(pneumatic and solids, all sizes and applications), over the life cycle of tyres, rims, wheels etc. - Qld coal mining industry</p> <p>Assumed maximum reasonable consequence for all activities: Serious injury or fatality, single or multiple persons.</p> <p>Assumptions: Appropriate PPE will be worn at all times. Tyre servicemen have been appropriately trained using industry training package (refer to Rec standard) OEM manuals are available for ALL equipment and tools.</p>	
Step in Operation Or Issue	Sub-step
Fitment of tyre to rim or wheel - assembly	Tyre selection and procurement - application
	Loose Tyre inspection prior to fitment
	Tyre preparation
	Rim/wheel & components selection
	Rim/wheel & components inspection and preparation prior to fitment.
	Preparation of the fitment area
	Assessing immediate tyre/rim assembly, and area hazards.
	Preparation of vehicle incl. parkup
	Standing and Jacking
	Mounting tyre onto rim or wheel <u>on ground</u> , including <u>inflation</u>
	Removing tyre assembly(s) off vehicle
	Stripping / Disassembly assembly (removal and demounting)
	Fitting <u>wheel</u> assembly to vehicle
	Fitting <u>rim</u> assembly to vehicle
	Use of mechanical aids
	Competent people
Hazardous Tyre and Rim conditions 'Critical hazard'	<u>Potential</u> Hot tyre Heat affected
	<u>Potential</u> Tyre fire – external
	<u>Potential</u> Tyre fire – internal (leading to tyre explosion)
	Electrical contact incl. lightning strike
	Sidewall bubbles
	Damaged components eg rim cracks, bead seat bands, etc.
	Components dislodgement e.g. lockring
	Loose wheel
	Missing wheel nuts/studs. (fasteners)
	Unable to deflate
	Working with Chemicals / fumes/solvents - tyre repair materials (Buffing liquid, glues)
	Working environment (operational environment)

Maintenance of Tyre chains, or removal fitment of chains during tyre maintenance.	Tyre stockpile fire risk – fires in stock area (laydown area) Nitrogen N ₂ Inflation
Competencies	
Equipment with low hours/low usage	
Water filled/ ballasted tyres	

7.2 Appendix 2 Coroner’s recommendations

Peter Marshall

Coroner’s recommendations

Zinifex Century Zinc Mine – Peter Whitoria Marshall 9 February 2004

Recommendation 1 - An analysis of the safety culture at the mine

I recommend that Zinifex Century and REJV engage a competent consultant with an industrial or organisational psychology background to review the safety culture of the operation with a view to better informing management of how safe work practices can be internalised by staff of the mine.

Recommendation 2 - Supervision of autonomous skilled workers

I recommend that the Mines Inspectorate investigate how meaningful supervision can be delivered to a heterogeneous workforce of skilled autonomous workers engaged on a disparate site and that they publish their findings and practical examples applicable to various mining activities

Recommendation 3 – Continued development of AS 4457

I recommend that the Mines Inspectorate, SIMTARS and industry participants continue with the revision of AS 4457 and that special attention be given to tyre handling, lock ring retention and rim maintenance.

Shane Davis

Coroner’s recommendations

Foxleigh Mine – Shane William Davis 7 August 2005

I recommend that:

1. The coal mine operators critically review the effectiveness and implementation of their mine safety and health management system as they are obligated to do under section 41(f) of the Coal Mine Safety and Health Act 1999. It is recommended that particular attention be paid to how the mine system controls the activities of contractors and ensures they are carrying out their task in a safe manner.

2. 2.1 That senior site executives of coal mines be required to have a competency such as MNCG1107(a) establish and maintain the mine occupational health and safety management system.



2.2 The safety and health advisory counsel consider the range of competencies required for supervisors and persons charged with the development of safety and health management systems.

2.3 All SSEs of coal mines develop a system to ensure that all supervisors are able to and are effectively applying risk management competencies in the performance of their duties. That consideration be give to amending section 44(6) of the Coal Mining Safety and Health Act 1999 to require that manufacturers and suppliers inform the regulator, as well as their customers, in the event they become aware of the hazardous aspect of, or defect in the equipment that the supplier has supplied to a coal mine.

3. That consideration be give to amending section 44(6) of the Coal Mining Safety and Health Act 1999 to require that manufacturers and suppliers inform the regulator, as well as their customers, in the event they become aware of the hazardous aspect of, or defect in the equipment that the supplier has supplied to a coal mine.

4. That a body such as the Resources and Infrastructure Skills Counsel develop a suite of competencies for persons providing advice on safety and health management systems in the coal mining industry.

5. 5.1 The earthmoving committee of Standards Australia review the suitability of retaining rim sizes as a limiting factor in determining the applicability of Australian Standard 4457.

5.2 Standards Australia should review all associated tyre and rim standards and, if necessary, introduce a standard in similar terms to AS5547 which applies to all multi-piece rims irrespective of size and industry application.

6. 6.1 That all coal mines employing contractors create a senior position for the control of contractors. Duties should includes monitoring contractors, implementation of the mine safety and health management system including familiarisation and training of the contractor's workers and compliance with the mine safety and health management system.

6.2 This position should be included in accordance with section 55 of the Coal Mining Safety and Health Act 1999 in the management structure of the mine as a senior position and the role and responsibilities of the position should be specified.

7. 7.1 That a system be established by all coal mines to ensure the next of kin of any person involved in a serious or fatal accident can be expeditiously contacted and kept informed of the developing situation. The system should address the name and contact details of the next of kin and be kept current, how the next of kin should be informed and by who, guide on how and under what circumstances the next of kin should be kept informed of developments.

7.2 That the protocol between the Inspectorate and the Queensland Police Service be reviewed to ensure effective and timely communications between the organisations during the investigation.

And

8. That the Inspectorate liaises with other departments, industry, and professional bodies to ensure that the safety message relating to the hazard of uncontrolled release of stored energy from tyres, particularly when affixed to multi-piece rims and the need for training of those exposed to the hazard is disseminated across all industries and applications of the equipment.



Wayne MacDonald

Coroner's recommendations

Foxleigh Mine – Wayne MacDonald 18 December 2010

In consideration of the evidence of this case, and for the reasons I have set out above, I recommend the following:

- 1) That management of mine sites, and their engaged contractors, review all tyre management practices to ensure that tyres on their mine sites are being operated within their specific design parameters applicable for their use. This review needs to occur within three months, and then annually the mine site needs to ensure that compliance is being maintained.
- 2) That any jack used by an operator has a handle of sufficient length to allow the operator to safely use the jack without the operator being in, or under, the truck or trailer, or within close proximity of the vehicle's tyres whilst jacking occurs.
- 3) That the industry investigate, and implement within two years, remote, or wireless, tyre pressure sensing equipment to allow operators to monitor tyre pressures from within the cabin of the truck.
- 4) That until remote or wireless tyre pressure sensing equipment is introduced for these mine site tyres that the practice of tyre tapping should not be continued, and that accurate, calibrated, pressure gauge should be used to check correct tyre inflation whenever operational requirements dictate that pressures are to be checked.
- 5) That an Australian Standard for up to 24 inch diameter truck tyres be investigated, created, and, if considered appropriate, implemented into law by regulation within a period of two years, and if no Australian Standard is created within two years then a Recognised Standard under Part 5 of the Coal Mining Safety and Health Act 1999 be implemented within one year.
- 6) That whenever a tyre supplier grants a dispensation from the designed operating parameters of a tyre, that the tyre supplier provide, and receive written acknowledgement of from the customer, an appropriate and formal information package which clearly specifies the approved conditions of operation of that dispensation.
- 7) That whenever a tyre supplier grants a dispensation which a mine site operator uses, that the equipments owners and operators incorporate into their written training and operating procedures the specific details of those dispensations.
- 8) That whenever a tyre manufacturer grants a dispensation from the designed operating parameters of a tyre, that the variations be permanently embossed (alternatively termed 'tyre stamping') on the sidewall of the tyre, and that the embossing be completed in a method which is not readily removable, and remains legible, throughout the tyre's serviceable life.
- 9) That every tyre, whether new or repaired, undergo integrity testing by its inflation in a suitable tyre inflation cage, to a pressure of 120% of the tyre's recommended minimum cold operational inflation pressure, and then left for 20 minutes to test its integrity, before its pressure is then reduced to its recommended minimum operating pressure before the tyre is then fitted for use.