

TYRE AND RIM MANAGEMENT



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11 TYRE AND RIM MANAGEMENT

Intent

The intent of this Protocol is to eliminate or minimise the potential for fatalities, injuries and incidents arising from risks related to tyre, rim and wheel assembly fatal hazards.

Related Life-Saving Behaviours

1. Always come to work drug and alcohol free.
2. Always use or wear critical safety equipment.
4. Only operate equipment if trained and authorised.
6. Never modify or over-ride critical safety equipment without approval.
7. Always seek and obtain clear approval before entering mobile equipment operating zones.
8. Never enter danger zones without approval.
9. Always report injuries and HPRIs.

Key actions

1. Record the types of mobile equipment operating at your site, detailing wheel assembly design and rim diameter (see Section 11.8).
2. Conduct a risk assessment to identify and evaluate tyre and rim related risks and confirm their controls.
3. Develop, implement and maintain a Tyre and Rim Management Plan that applies to on-site and off-site activities.
4. Include relevant requirements of this protocol within the Plan and apply them to equipment, facilities and how work is carried out.
5. Assign accountability for implementing and maintaining these processes.
6. Provide Tyre and Rim management training and awareness information for persons at risk, assess their competency and understanding.

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11.1 General Requirements

- 11.1.1 A risk assessment must be conducted and documented to identify the hazards and assess the risks associated with tyre and rim management considering:
- a) Catastrophic disassembly during inflation, deflation, handling, or while in service;
 - b) Moving and storing tyres, rims and wheel assemblies;
 - c) Failure of load bearing plant and equipment e.g. jacks and stands;
 - d) Pedestrian interactions with tyre handlers and other mobile equipment;
 - e) Wheel assembly pyrolysis explosions, caused by hot work with tyres still mounted, mobile equipment fires, tyre operating parameter exceedances, contact with power lines or struck by lightning;
 - f) Tyre bursts e.g. side wall zipper failure;
 - g) Loss of a wheel from operating mobile equipment; and
 - h) Occupational illness or chronic injury exposures for tyre service and maintenance personnel.
- 11.1.2 A Tyre and Rim Management Plan must be developed, implemented and maintained that addresses the identified risks, and meets or exceeds regulatory and legal obligations for tyre and rim management.
- 11.1.3 The Plan must include or reference the processes and controls that prevent or mitigate risks including:
- a) Site rules and procedures;
 - b) Tyre and Rim Management service provider rules and procedures;
 - c) Manufacturer (OEM) tool, plant and equipment guidance; and
 - d) Recognised standards.
- 11.1.4 The Plan must be reviewed:
- a) After high potential tyre, rim and wheel assembly incidents;
 - b) Before significant operational changes, e.g. engagement of tyre maintenance contractors, deployment of new mining equipment, changes to haul distances etc.
 - c) Before the introduction of new technology for operations or maintenance e.g. battery powered equipment or robot technology for wheel assembly removal; and
 - d) On a regular basis, at least annually.

11.2 Rules and Procedures

- 11.2.1 The rules and procedures for tyre maintenance equipment and components must include requirements for:
- a) Finding and applying reference resources for:
 1. Operating tyre pressures;
 2. Assessing acceptable tyre wear and damage while in service;

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- 3. Manufacturer (OEM) recommendations for wheel assembly and wheel nut torque settings; and
 - 4. Wheel assembly component tolerances e.g. lock rings.
 - b) Inspection and technology checks of equipment and plant, based on OEM advice and operating site requirements;
 - c) Pre use tool and plant checks;
 - d) Using specialist tools, plant and equipment e.g. jacks, stands, jacking plates, bead breakers, nut runners, tyre presses, compressors, tyre handlers, torquing tools etc.
- 11.2.2 The rules and procedures for tyre maintenance work processes must include requirements for:
- a) Loading, unloading and transporting tyres and rims;
 - b) Shifting and storing tyres, rims, components and wheel assemblies including site location, stacking height, and anti-roll storage;
 - c) Wheel assembly tasks covering:
 - 1. Personal protective equipment requirements by task step;
 - 2. Cleaning, identifying and matching components;
 - 3. Inspecting and identifying components for damage e.g. corrosion pitting, wear, deformations and cracks;
 - 4. Identifying defects on new, used and repaired tyres such as perishing, de-lamination inside or outside, wavy tyre walls, and sidewall damage to casings that may lead to zipper failures;
 - 5. Labelling and isolating rejected components;
 - 6. Confirming that multipiece wheels are correctly assembled before inflating.
 - d) Safe inflation covering:
 - 1. Staged inflation to handling pressure with multiple lock ring seating checks;
 - 2. Safe handling, transport and storage pressures based on wheel assembly type e.g. single piece wheels and wheel assemblies with 24-inch or less rims are usually stored at operating pressure;
 - 3. Identifying wheel assembly types that must be mounted to the hub of mobile equipment before inflating to operating pressure;
 - 4. The position of mobile equipment during inflation to operating pressure e.g. behind a blast barrier;
 - 5. Remote monitoring from outside the line of fire during inflation to operating pressure;
 - 6. Never inflating a tyre being clamped by a tyre handler as this can result in structural failure of the clamp.
 - e) Safe inflation for wheel assemblies with 24-inch or less rims covering:
 - 1. Using a designed, rated and correctly installed tyre inflation cage;
 - 2. Monitoring inflation from outside the line of fire using a long air hose fitted with a dump valve capable of rapidly deflating the tyre;

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- 3. Carrying out site approved integrity tests for potential zipper failures;
 - 4. Re-inspecting wheel assemblies for defects before removal from inflation cage e.g. tyre bulges, inadequate seating, incorrect component assembly etc.
 - f) Deflating tyres before releasing tension on the rim fastenings for split rims, divided wheels and multi-piece rims:
 - 1. Deflate to zero for demountable wheel assemblies that are secured by cleats;
 - 2. Nominated handling pressure (typically 35 kPa or 5 psi) for wheel assemblies with discs secured by wheel bolts;
 - 3. Never deflate a tyre being clamped by a tyre handler as this can cause a loss of grip.
 - g) Cleaning and inspecting mobile equipment covering:
 - 1. Load or hang up in truck tray;
 - 2. Rocks trapped in dual wheel assemblies.
 - h) Mounting and unmounting wheel assemblies from mobile equipment;
 - i) Re-inflating in service tyres that have lost pressure:
 - 1. Tyres below 70 percent operating inflation pressure must be deflated, demounted, stripped and inspected;
 - 2. For dual assembly positions, if one tyre is below 70 percent operating inflation pressure then the companion wheel assembly must also be deflated, demounted, and inspected.
 - j) Hot work on rims or fasteners – the tyre must be completely removed before heat is applied;
 - k) Planning for and carrying out non-routine tyre service and maintenance tasks e.g. working unusual rim sizes or fitting tyres provided by a new supplier;
 - l) Tyre maintenance area management and housekeeping:
 - 1. Controlling access to tyre maintenance areas;
 - 2. Managing pedestrians during tyre handler and other mobile equipment operations.
- 11.2.3 The rules and procedures for mobile equipment operators must include requirements for:
- a) Prestart inspections for under inflated tyres, tyre or rim damage, and loose or absent fasteners, nuts and wheel studs;
 - b) Optimising tyre life;
 - c) Tyre emergency response covering tyre heating, equipment fires, contact with power lines, and lightning strikes:
 - 1. Notifying, parking up and exiting equipment with compromised tyres;
 - 2. Quarantine distances of a minimum of 300 metres for potential tyre pyrolysis explosions.

11.3 Equipment, plant and tools - specifications and maintenance

- 11.3.1 As a minimum, the following site processes must be in place for specifying, selecting, approving and tracking the operational use of tyres, rims, and wheel assembly components:

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- a) Tyre, rim and component specifications are prepared by knowledgeable and experienced people who are familiar with site production and operating environment demands. The specifications must consider:
 - 1. Where the mobile equipment will be operated (operation type, road surface and condition, gradient and profile, turn radii, and climate);
 - 2. How the vehicle will be operated (e.g. average and maximum speeds, average and maximum wheel load, tonne kilometres per hour, weight distribution, cycle length empty and laden, shift duration, and number of cycles per shift);
 - 3. Manufacturer (OEM) recommendations for wheel assembly components, tyre size and ratings;
 - 4. Manufacturer (OEM) recommendations for non-destructive testing (NDT) of rims; and
 - 5. Specialist mobile equipment requirements e.g. use of solid or non-pressurised tyre fill for elevating equipment.
 - b) Tyre, rim and component specifications apply when:
 - 1. Purchasing new or used tyres, rims and wheel assembly components;
 - 2. Inspecting new-to-site rubber tyre mobile equipment e.g. equipment hires or contractor equipment; and
 - 3. Returning repaired or reconditioned tyres to service.
 - c) Multipiece wheel assembly components are stamped or branded with a unique serial number and manufacturing date;
 - d) Repaired or reconditioned tyres are not used as steering tyres and repairs must be inwards facing.
- 11.3.2 There is an inspection and approval step, carried out by competent and experienced personnel, that confirms repaired, reconditioned, NDT tested, or new to site tyres, rims, and wheel assembly components meet specifications and are registered, before going into service.
- a) The register tracks and records the operational and maintenance history of site tyres, rims and wheel assembly components.
- 11.3.3 When required for operating environment demands, mobile equipment tyre, rim and component specifications are extended to include:
- a) Using double gutter wheel assemblies for rim diameters greater than 57 inches to reduce maintenance requirements;
 - b) Use of tyre chains;
 - c) Nitrogen inflation;
 - d) Specialised tyre handling modules for underground equipment to minimise manual handling;
 - e) Working beyond manufacturer or tyre supplier recommendations for tyre operating parameters only when there is:
 - 1. Formal written approval specifying the approved conditions of operation; and
 - 2. Permanent tyre label that identifies the tyres that have been operated beyond standard

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manufacturer (OEM) or supplier recommendations.

11.4 Monitoring, Servicing and Maintenance

11.4.1 The following processes must be in place for specifying, selecting and approving for use tyre service and maintenance equipment, plant and tools:

- a) Tyre servicing and maintenance equipment, plant and tool specifications are prepared by knowledgeable and experienced people;
- b) Training and instructions on how to use the equipment, plant and tools provided by the manufacturer or supplier are part of the specification;
- c) Tyre service and maintenance specifications for equipment, plant and tools apply when:
 - 1. Purchasing new or used equipment, plant and tools;
 - 2. Transferring equipment, plant or tools to site;
 - 3. Hiring equipment, plant or tools; and
 - 4. Assessing contractor equipment, plant and tools.

11.4.2 There is an approval step, that confirms new to site tyre service and maintenance equipment, plant or tools meet specifications before going into service. As a minimum, this applies to:

- a) Jacks and jacking plates (rated for all types of plant);
- b) Tyre inspection stands (rated and matched to site plant);
- c) Work platforms;
- d) Tyre handlers confirming they are:
 - 1. Fitted with fall back arrest arms;
 - 2. Relief valves in tyre handler arms.
- e) Truck mounted tyre handlers;
- f) Fitting tools, including hydraulic presses, soft hammers, levers, etc.
- g) Inflation and deflation tools and equipment including, PPE, connections, gauges, remote fill points, deflation noise suppressors, and dump valves;
- h) Torque and torsion devices such as pneumatic percussive spanners and torsion wrenches;
- i) Inflation cages for wheel assemblies with rim diameters up to 24 inches;
- j) Inflation compressors, nitrogen sources, air valves, lines and fittings.

11.4.3 There must be a site process to confirm that fit-for-purpose tools, plant and equipment are available for tyre service and maintenance personnel, before they commence their work;

11.4.4 There must be site processes to check that wheel assemblies fitted to operating mobile equipment remain fit-for-use and includes:

- a) Pre-use inspections of mobile equipment by operators of;
 - 1. Tyre condition;
 - 2. Wheel assembly attachment, consider using wheel nut tension indicators on light vehicles.

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- b) Scheduled in-field inspections and servicing of tyres by experienced and competent personnel.
- 11.4.5 The installation of tyre pressure and temperature sensor systems that measure and log tyre operation trends and issues must be considered. When used they should be supported by:
- a) Information and training on expected operator response if there are local alerts and alarms;
 - b) Remote monitoring.

11.5 Establishing a Safe Operating Environment

- 11.5.1 Knowledgeable and experienced people approve the location, design and construction of permanent site tyre maintenance areas that include:
- a) A level concrete slab that:
 1. Can fit the largest item of mobile equipment operating at site;
 2. Has adequate foundations for maximum point loading during jacking and using safety stands;
 3. Has suitable drainage.
 - b) A general layout that:
 1. Allows efficient access control;
 2. Minimises mobile equipment interactions;
 3. Considers line of fire for catastrophic wheel disassembly;
 4. Provides adequate parking for tyre handler, mobile equipment, service trucks, and light vehicles; and
 5. Provides adequate laydown, storage and parts staging areas for tyres and wheel assembly components.
 - c) Suitable lighting for:
 1. Inspection and assembly areas; and
 2. Other work and storage areas.
 - d) Adequate ventilation requirements for inflating or deflating nitrogen filled tyres when required.
- 11.5.2 Road networks are designed and maintained, including loading and dumping areas to minimise acute tyre damage;
- 11.5.3 Equipment duty cycles are established and managed within safe tyre operating parameters e.g. tyre load speed rating as tonne kilometre per hour (TKPH);
- 11.5.4 Changes in operating conditions affecting tyre integrity are identified and managed.

11.6 Interfaces during Tyre Servicing

- 11.6.1 The following processes must be in place to the manage interactions between tyre service and maintenance personnel and mobile equipment:
- a) Supervision, training and procedures for all tasks that require personnel on the ground to work alongside a tyre handler, forklift or truck crane;

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- b) A traffic management plan for the tyre service and maintenance area that includes:
 1. Segregated or dedicated walkways for pedestrians protected by windrows, bunds or other physical barriers;
 2. Access control and the delineation of no-go and danger zones for pedestrians;
 3. Demarcated zones used during inflation and deflation.
- c) Procedures and training on how to service or repair mobile equipment tyres in production areas that include:
 1. Parking equipment away from traffic, people, and other hazards with a clear area to perform the task;
 2. Area lighting for the task;
 3. Demarcation and ongoing communications with operations;
 4. Confirming that the surface under a vehicle can support the load without subsidence.

11.7 Training and Competency

- 11.7.1 Tyre service and maintenance personnel, mobile equipment operators, maintenance and logistics personnel must be trained, competent and authorised. A training plan must be developed and include:
- a) Criteria for selecting and appointing tyre service and maintenance personnel, mobile equipment operators, maintenance and logistics personnel;
 - b) Tyre, rim and wheel assembly hazard management training needs analysis based on work role for:
 1. Personnel who carry out tyre servicing and maintenance activities;
 2. Mobile equipment operators;
 3. Mobile equipment maintainers and other maintenance staff e.g. boiler makers;
 4. Logistics personnel.
 - c) Training content prepared by competent and experienced personnel based on:
 1. Site rules and procedures;
 2. Tyre, rim and wheel assembly supplier and manufacturer guidance;
 3. Manufacturer (OEM) guidance for the safe and productive use of tools, plant and equipment used for servicing and maintaining tyres; and
 4. Recognised standards.
- 11.7.2 All personnel, employees, contractors, and visitors receive awareness information or training relevant to their work role.
- 11.7.3 Training for personnel who routinely access operational areas that includes:
- a) Awareness of catastrophic wheel disassembly and tyre explosion line of fire;
 - b) Expected bystander emergency response, *notify, do not approach, retreat 300 metres* when

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rubber tyre mobile equipment:

1. Is on fire and the operator has evacuated;
2. Has contacted power lines; and
3. May have been struck by lightning.

11.7.4 Training is competency assessed and records are kept.

11.7.5 There is an authorisation, appointment or licensing step, before trained and competent tyre fitters carry out servicing or maintenance work that is not directly supervised.

11.7.6 Only trained, competent and authorised personnel can carry out tyre servicing and maintenance tasks.

11.7.7 All other personnel working in or visiting tyre maintenance and storage areas are supervised.

11.7.8 There is a periodic review of awareness information, competency requirements, training needs, training content and approaches.

11.8 Requirements - Wheel Assembly Design and Rim Diameter

11.8.1 For mobile equipment with up to and greater than sixty-one (61) centimetres (24 inches) diameter rims, all requirements apply.

11.8.2 Where the rims in use are all sixty-one (61) centimetres (24 inches) in diameter or less, then at least these protocol requirements apply:

- a) The rules and procedures for tyre maintenance equipment and components must include requirements for finding and applying reference resources (*see 11.2.1 a-1, a-2, a-3, a-4*);
- b) Rules and procedures for tyre maintenance work processes must include requirements for loading and unloading (*see 11.2.2 a*) and shifting and storing (*see 11.2.2 b*);
- c) Rules and procedures tyre maintenance work processes must include requirements for wheel assembly tasks (*see 11.2.2 c-1, c-2, c-3, c-4, c-5, c-6*);
- d) Safe inflation for wheel assemblies with 24-inch or less rims (*see 11.2.2 e-1, e-2, e-3, e-4*);
- e) The use of a designed and certified inflation cage (*see 11.2.2 e-1 and 11.4.2 i*);
- f) Deflating tyres before releasing tension on the rim fastenings for split rims, divided wheels and multi-piece rims (*see 11.2.2 f and 11.8 Definitions*);
- g) No hot work on rims unless tyres have been removed; (*see 11.1.1 e and 11.2.2 j*);
- h) Some 24 inch or less wheel assemblies can be handled, transported and stored at the cold operating pressure (*see 11.2.2 d-2*);
- i) Tyre service and maintenance personnel, mobile equipment operators, maintenance and logistics personnel must be trained, competent and authorised (*see 11.7 Training and Competency*);
- j) Inspection, integrity checks and service approaches for zipper failures (*11.1.1 f, 11.2.2 c-4, 11.2.2 e-3 and e-4, and Definitions*)

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11.9 Additional Requirements for Catastrophic Risk (PMC 5) Situations

11.9.1 Wherever there is a potential for a catastrophic incident related to tyre and rim management e.g. location of tyre maintenance area, tyre failures on buses etc. the following requirements apply:

- a) A risk assessment must be conducted to identify specific hazards and their controls; and
- b) Critical controls must be identified, and monitoring and verification processes must be implemented as per Glencore's Catastrophic and Fatal Hazard management Policy.

11.10 Definitions

Casing

Structure and components of a radial ply tyre.

Integrity testing of wheel assemblies - up to sixty-one (61) centimetres (24 inches) diameter rims

Inflation in a suitable tyre inflation cage to a pressure of 120% of the tyre's recommended minimum cold operational inflation pressure and left for 20 minutes to confirm tyre integrity. Post integrity testing the tyre is reduced to its recommended cold operating pressure for storage or fitting.

Lock ring

Part of a wheel or rim which retains the components when a tyre is mounted to the wheel/rim base.

Rim

The outer circular part of a wheel or a rim where the tyre is fitted. Rims can be either single-piece or multi-piece. The part of the tyre assembly that uses a taper seat arrangement to affix to the wheel motor or hub of an earthmoving machine.

Rim Base

Part of the Rim that is attached to the hub.

Single piece wheel

A wheel assembly that does not have components that can be dismantled - used in motor cars and some light trucks.

TKPH

The load speed rating of a tyre, which helps determine the tyre's suitability for an operation, is measured as tonne kilometre per hour (TKPH). As tyres flex during rotation, heat builds up within the tyre. The rate of heat build-up depends on the load on the tyre, average haul speed, ambient temperature and distances travelled. Based on the tyre's ability to withstand the heat generated while it is working, the manufacturer assigns a TKPH rating that sets a limit on how hard the tyre may work before there is likely to be a detrimental effect on the tyre's life.

Tyre burst

Instantaneous release of stored energy within a tyre's air chamber.

Tyre explosion

Auto-ignition of an explosive gas mixture within a tyre's air chamber resulting in a large over pressure leading to catastrophic tyre failure and rapid release of hazardous energy.

Tyre pyrolysis

Thermochemical decomposition of the tyre's inner liner producing gases that may form an explosive mixture within the tyre's air chamber.

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Wheel

An assembly made up of a rim and a centre plate. Components of some wheel assemblies can be dismantled. There are three major categories: single piece wheels, divided wheels (split rims) and multi-piece wheels.

Wheel assembly

Comprises a rim base, flanges, bead seat band, lock ring and wheel disc or nave plate welded to the rim base.

Zipper failure

Zipper failure means a circumferential fracture of the tyre side wall usually caused by fatigue. Over loading or excessive side wall flexing when the pressure drops below 80 per cent of recommended causes fatigue, zipper failure can result in tyre bursts. Tyre bursts have caused workplace fatalities.

Tools (See Glencore HSEC Intranet)

Tools provided will include:

- Tyre and Rim Management Assessment Worksheet,
- Tyre and Rim Management Protocol Assessment Workbook,
- Tyre and Rim Management Assessment Workbook for Off-Site Providers of Wheel Assemblies at Cold Operating Pressure.
- Tyre and Rim Management Protocol Toolbox Talk.

Note: Application of this Protocol must also comply with the General Mandatory Requirements outlined in Section II of the Glencore Life-Saving Behaviours and Fatal Hazard Protocols publication.

11.11 Document consulted to develop this protocol

Department of Mines and Petroleum, 2015, *Tyre safety for earth-moving machinery on Western Australian mining operations* — guideline: Resources Safety, Department of Mines and Petroleum, Western Australia, 63 pp. ISBN 978 1 92 1163 81 4

Department of Natural Resources, Mines and Water, 2016 *Recognised standard 13, Tyre, wheel and rim management* – Recognised standard: Department of Natural Resources, Mines and Water, Queensland, Australia, 28 pp.

Dwyer Jami G, 2004, *Tyre Safety in the Mining Industry* - Conference presentation Critical Issues and Train the Trainer Combined Conference: Institute for Mine Health and Safety, International Society of Mine Safety Professionals. Salt Lake City, UT USA, 35 slides.

EMESRT, September 2019, *Control Framework for Tyre and Rim Management* – cloud platform: Earth Moving Equipment Safety Round Table

EMESRT, 2012, *Design Philosophy 2 Tires and Rims* – Design Philosophy: Earth Moving Equipment Safety Round Table.

Glencore, 2013, *Protocol 11 Tyre and Rim Management Version 1.0* – SAFEWORK Protocol: Glencore HSEC, Document ID: G-S-PTC-0014

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Rasche T and Klinge T, 2007, *Tyre Related Accidents and Incidents - A Study with Recommendations to improve Tyre & Rim Maintenance and Operational Safety of Rubber Tyred Earthmover Equipment* – ACARP report: Australian Coal Association Research Program Final Report C15046, 126 pp

General: Thirty-two multi-jurisdictional, regulator tyre and rim incident reports and alerts.

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Team	Accountabilities
Glencore Corporate	<ul style="list-style-type: none"> Maintain and update this protocol. Use the protocol as a basis for relevant corporate audits.
Department	<ul style="list-style-type: none"> Oversee the implementation of this protocol within the Department and apply assurance processes.
Asset management	<ul style="list-style-type: none"> Apply the requirements of this protocol to their Management Plans.
All employees/contractors	<ul style="list-style-type: none"> Comply with relevant requirements of site Management Plans and procedures related to this protocol.

Property	Value
Approved by:	Lucy Roberts
Document owner:	David Mellows
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Version	Date Reviewed	Review Team	Nature of Amendment(s)
V1-0	29/10/2013	HSEC Leads	First published version
V2-0	17/03/2020	Vehicle Interaction Working group, Consultant - Risk Mentor. David Mellows.	Combination of the three-implementation stages into one. Inclusion guidance based on: <ul style="list-style-type: none"> Research and incident analysis by EMESRT and other groups as referenced. Mapping requirements to EMESRT Tyre and Rim Management Control Framework.
V2-1	29/10/2020	Engineering and HSEC personnel in Zinc, Coal, and at Glencore Corporate	Updated following a detailed review of an incident that occurred at another mining company. The FHP now confirms that Tyre and Rim Management Plan applies to relevant off-site activities e.g. providers of < 24-inch wheel assemblies supplied at cold operating pressure.

			Integrity testing of < 24-inch wheel assemblies definition added