ACARP

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# FINAL REPORT

# Tyre Related Accidents and Incidents - A Study with Recommendations to improve Tyre & Rim Maintenance and Operational Safety of Rubber Tyred Earthmover Equipment

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ACARP

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# Review and Analysis of

# Tyre Related Accidents and Incidents

# A Study with Recommendations to improve Tyre & Rim Maintenance and Operational Safety of Rubber Tyred Earthmover Equipment

Project Number C15046

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**May 2007**

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## 1. EXECUTIVE SUMMARY

Tyre, rims and wheel assemblies are safety critical items which must be maintained and operated correctly to provide a safe working environment.

Unfortunately less than adequate (LTA) awareness of 'off the road' (OTR) tyre and rim related hazards, and lack of application of correct and proven approaches to deal with these hazards, in both the maintenance and operations areas continue to cause tyre and rim related accidents and incidents across the industry, some of them fatal.

This review has shown that OTR tyre maintenance and service work in particular is a high risk activity as it involves working with a number of high potential energy and hazard sources. At the immediate work interface, tyre maintenance by its nature requires the tyre serviceman to use compressed air to inflate tyre assemblies, use heavy manual and hydraulic tooling such as very large vehicle jacks and various other equipment, often air over hydraulic to break apart wheel assemblies and utilise bulky tyre handlers to manipulate the very large and heavy earthmover tyres and rims, to mention a few hazards that have played part in the causation of many incidents and accidents. Inflated tyre assemblies both off and on vehicles pose another important set of hazards.

One of the key differences between passenger and highway transport industry tyre maintenance, and maintenance required for OTR tyre assemblies, apart from physical differences, is that OTR tyre and rim assemblies are in the most part 'multi component' assemblies. As such they consist of the tyre, a rim or wheel base and its components - flange rings, bead seat band, O-ring, and lockring, while passenger and non OTR tyre assemblies are single piece, i.e. consist of a tyre mounted to a single piece rim. Attachment of the OTR assembly to the vehicle is either achieved through wheel nuts/studs for tyre/wheel assemblies, or cleat type/wedges/ wheel nut systems for rim/ tyre assemblies. OTR rim manufacturers offer several designs all of which, as a critical attribute rely on the correct selection/ matching, fitment of all components and inflation to considerably higher inflation pressures compared to passenger tyres, to deliver the overall integrity of the assembly 'system'.

Given the criticality of correct fitment, and the much higher inflation pressures, working with OTR rim/wheel assembly systems carries much higher risks than working with passenger and

truck tyres where risks have largely been 'designed out' through the ongoing evolution and improvement to large volume production passenger and trucking vehicles .

Examination of the data and actual or potential injury outcome suggests that OTR tyre and rim related work results in a disproportionately high incidence, larger than 80%, of fatal or potential fatal outcomes for the personnel involved requiring strict controls at the management and team level, and by the individual carrying out the task.

The risk of sustaining severe or fatal injuries is further amplified in that any damage to OTR tyres and rims can often not be readily identified, which if not observed/corrected, will result in a safety issue. Risks here do not only expose tyre maintenance personnel, but also operations personnel. Operation of a mining vehicle with incorrectly fitted or damaged OTR tyres and rims, and operations outside the tyres design operating envelope is extremely hazardous and will continue to cause incidents and high consequence accidents.

This review has shown that 51% of incidents and accidents occur during, or are based in 'LTA tyre and rim related maintenance', followed by 'LTA awareness, competence and behaviour' (17%), 'LTA operations, crisis and emergency management' (each contributing 8%), and 'LTA design, construction and commissioning' (7%).

Based on these statistics, the following recommendations are offered which, if implemented, will assist in making working with tyre and rim assemblies safer.

It should be noted that while many of these recommendations call for 'soft' controls at both the organisational and individual level, preferred and far more effective mitigation would be through changes in the design of wheel/rim and wheel/rim components hardware as these will have the most significant impact on making working with tyres and rims safer.

At an industry level

1. The industry induction processes should include specific tyre and rim awareness sections that ensure that all personnel within the industry are made aware of the hazards at the beginning and throughout their employment within the mining industry.
2. Tyre awareness sessions, particularly during times of a global OTR tyre shortage should also be promoted through seminars, workshops and conferences.
3. Seek to continuously improve the level of registered training programs.

4. The 'Hierarchy of Control' methodology suggests that most effective safety improvements are best achieved through incorporation of safety features at the design stage.
    a. The design of most OTR rims and wheels in use across the world can be considered 'dated'. In view of the number of incidents and accidents directly associated with issues around rim design and some maintenance practises, designers and manufacturers ought to, as a priority, consider design changes that achieve the following:
        i. Longer rim and rim component fatigue life – this will reduce the exposure to fatigued rims and components.
        ii. Elimination of 'sprung' lockring systems that rely on the 'shape' of the lockring to provide the required integrity of the final assembly. The development of '2 piece lockring' systems appear to have overcome some of the inherent safety concerns associated with sprung lockrings.
        iii. Reduce or eliminate where possible the need to remove wheels/rims from vehicle hubs to effect tyre change, while this issue has successfully been resolved by the development of 'double gutter rim types' more mine sites need to take up this solution.
        iv. Design modifications that require the positive removal of the valve thereby achieving deflation of the assembly, and its dual, before a wheel can be physically removed.
    b. Tyre and rim manufacturers, and rim users ought to consider and implement a consistent Standard to identify rims and rim components which reduces the likelihood of unsafe mismatch. Ideally such guidelines are encapsulated in an International Standard.
    c. Tyre maintenance involves the frequent use of often heavy pneumatic tooling. Effects of whole body vibration on tyre servicemen, as a separate study group should be assessed and where required, tools producing safe levels of vibration should be designed.
    d. Several indents and accidents were caused through fatigue damage of structural components on tyre handlers and manipulators. A non destructive fatigue testing regime ought to be considered which reliably assesses each machine for fatigue damage. Such a regime should be provided as an International Standard and adopted by all owners and users of such equipment.
    e. Given the considerable number of incidents and accidents involving dropped tyres and assemblies, it is suggested to carry out a comprehensive review of all

available tyre handler/manipulator designs aiming to improve handling and safety capabilities.

5. Introduce an annual review process of tyre and rim related incidents and accidents, with feedback to the industry. The ongoing data population and analysis ought to remain consistent with this study so that year to year performance changes and priorities can be established.
6. As a project initiative, encourage industry to report all tyre and rim related incidents and accidents, near misses and mishaps as well as operational damage, e.g. 'hot tyres' (as compared to tyre fires) , without exception for inclusion in this database.

At an organisational Level

1. General awareness of tyre and rims must be improved covering areas of maintenance, operations, technical and managerial alike. This should occur during the site induction, and periodically during the employment phase for every person.
2. As most incidents and accidents occur during tyre and rim maintenance, specific accredited training programs and refresher training delivered by registered training organisations (RTOs) must be provided to all personal involved in tyre and rim maintenance.
3. Similar training should also be offered to all supervisory staff to raise their understanding and hazard awareness.
4. Furthermore additional training packages must be tailored aimed at target groups such as operations and mine planning to cover other tyre and rim related aspects so that specific hazards are covered, understood and are addressed by each work group.
5. Implementation of reliable non destructive testing regimes for rims and rim componentry in accordance with relevant standards, such as AS4457:1997 – Earth-moving machinery – Off-highway rims and wheels- Maintenance and repair, must be achieved. These regimes must be backed through reliable rim tracking and reporting systems, ideally electronic, that can provide instant feedback on rim fatigue levels and testing status.
6. Furthermore, these NDT regimes should also include all structural components of tyre manipulating equipment.
7. Workable mine haulage design and operational standards that provide tyre friendly operating conditions must be created.

8. Provision and ongoing maintenance of written vehicle specific safe work procedures that cover safety critical tasks such as isolation, chocking, jacking (incl. supporting) of the vehicle), deflation and safe tyre manipulation practises must be in place.
9. Regularly test the sites emergency preparedness in case of tyre and rim related incidents.

At a maintenance management level

- A number of specific maintenance practises must be provided by the tyre and rim maintenance management systems including :
  - Use of heat to loosen wheel fastening systems must be eliminated.
  - Deflation and pressure reduction of tyre/rim assemblies before removal off the vehicle as required by AS4457:1997.
  - Maintenance and upkeep of a reliable NDT testing regime ensuring the ongoing structural integrity of the rim and rim component asset, and tyre manipulation equipment. This must ensure ongoing recording and reporting of NDT status so fatigued rims and rim components do not remain in service.
  - Reliable matching of tyres and rims, and their components to ensure total integrity of final assemblies.
  - Preventative maintenance to eliminate occurrence of hot brakes, or overheating wheel motors must be implemented.

At an operations management level:

- General awareness of tyre and rims must be provided to all operators, supervisors, and management personnel.
- Specifically, operational training must be given that provides guidance on tyre friendly operating practises, and on safe actions and protocols required during tyre and rim emergency situations.
- Mine haulage design standards must be used to provide tyre friendly operations conditions at all times.

While the above are largely generic recommendations, Appendix 2 – Data provides the reader with not only the data used in this study but also detailed recommendations for each individual issue without having to source the original source report.

Klinge would like to thank ACARP for the opportunity to carry out this study. Particular thanks also goes to the projects industry monitors, Ron Groenland , Peter Cronin (both BHP Billiton) and Tony Egan (Xstrata) for their ongoing support.

## 2. INTRODUCTION AND OBJECTIVES

Incidents and accidents related to tyre and rim maintenance and operation continue to occur with the industry. Because of the energies involved such mishaps often result in serious injury, or even fatal outcomes as demonstrated by at least 6 fatalities in the Australasian region over the last few years (e.g. [6-9]).
Even near misses, when properly assessed for their true risk potential can often be classified as 'high potential' events.
Working with tyres and rims has gained additional significance due to the global earthmover tyre shortage in that tyre owners and managers are required to consider not only higher frequency tyre maintenance (and therefore exposure to tyre and rim related hazards), but also use 2$^{nd}$ hand, repaired or retreaded tyres, or tyres of untried performance which have created a new set of hazards unknown to most tyre servicemen. .

While there are a number of documents available that provide sound advice on tyre and rim maintenance and application, these may not provide the background on why, and for what reasons, in order of priority, certain actions are required. Also, this advice is often only aimed at the tyre maintenance service provider, i.e. the tyre fitter, who may often not be able to address the true incident or accident root cause, such as issues with product design.

This study provides the industry with an objective up-to-date 'all in one' analysis and summary of its incident and accident experience, as it is available in the public domain.

Specifically it aims to provide an insight into the real root causes (acts and conditions) that need to be addressed proactively to improve safety of tyre and rim maintenance, and the use of tyres and rims in the field.
As an immediate deliverable the study provides a range of information, potential solutions and flag opportunities that can be used to improve safety of tyre and rim maintenance and use of rubber tyred equipment at any mine site, or related operation or service.

## 3. PROGRAM AND WORK METHODOLOGY

The following steps were taken in completion of this report.

1. Collection and Review of available incident and accident information.

   In total, 82 cases of tyre and rim related incident and accident information is included in this study.

   The data originated largely from sources such as safety alerts, and accidents reports published by mining industry regulators worldwide and are available in the public domain.

   Australian data sources included:

   - Queensland Government Department of Mines and Energy
   - Mineral Resources New South Wales
   - Department of Industry and Resources Western Australia ,
   - Department of Consumer and Employment Protection , Government of Western Australia
   - National Occupational Health and Safety Commission.
   - Conference and workshop publications.
   - Safety Alerts, available from the Klinge Webpage (www.klinge.com.au), the latter largely covered near misses and non reportable incidents thereby providing a further and more comprehensive insight into the range of possible mishaps related to tyre and rim maintenance and operations.

   While initially planned, incident and accident data from mining organisations e.g. 'SiteSafe' incident and accident record databases was not incorporated in to the study database. Available data was scrutinised but deemed unsuitable for inclusion in the incident and accidents database largely due to data inconsistency.

   International data sources included:

   - United States Department of Labour Mine Safety and Health Administration (MSHA)
   - Worksafe - British Columbia, Canada

   This reports reference section provides a full list of sources used.

2. In order to provide a user-friendly data structure allowing subsequent analysis for this study and ongoing population with future incident and accident information, the data

was arranged and tabulated using a simple taxonomy based largely on the BHP Billiton Incident Cause Analysis Method (ICAM) Investigation guidelines, specifically the 'ICAM Categories and Factors'.

The ICAM methodology provides the following logic towards incident and accident causation shown Figure 1 and supports the notion that most incidents and accidents are caused rarely by a single act or condition, but rather by a number of factors working together.

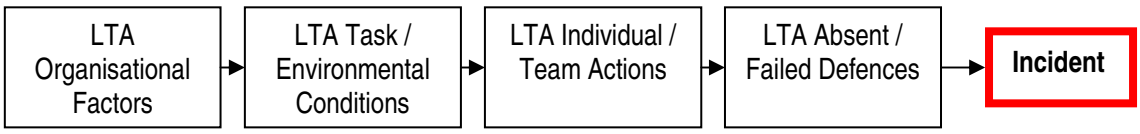



**Figure 1 - ICAM Categories & Factors Chart,** after Fig 5 ICAM Investigation Guideline

This approach was chosen as the ICAM methodology is well understood and widely accepted across industry and would most likely be chosen as the key investigation tool for the type, complexity and severity of incidents and accidents discussed in this study. Adopting this methodology also allows subsequent and further population of the incidents/accident database as they become available in the future.
In this context it is important to note that because the data was provided in a variety of narrative formats, often with considerable differences in length, detail and apparent accuracy. To make the information easier to interpret, each incident and accident was studied and interpreted by the author and then tabulated using the ICAM taxonomy structure. It is acknowledged that this (subjective) approach may introduce some variability into the resultant dataset, however as the data was reviewed 'as one' this effect is believed to be minimal resulting in a consistent and objectively presented set of data.

The categorisation and breakdown of incidents and accidents was facilitated by a set of given ICAM guidewords. It should be noted that subsequent graphical presentation is based around these guideword categories with commentary given for each graph and category.

It is important to note that as this study is only based on a sample of incidents and accidents, not all hazards and risks are likely to be covered or presented by this review.

This is particularly true as most of the incidents and accidents captured in this study are classified as 'reportable' under the various mining legislations, which by default exclude much of the lower level/less severe incidents or near miss information data. This report is therefore 'biased' towards severe events.
Also as this study centres on incidents and accidents this report does not provide general maintenance or operational advice.

A detailed description of the database structure used in this report is provided in Appendix One.
Using MS Excel basic data analysis tools, Pivot Chart reporting/charting and normal charting, the dataset was presented in a number of graphical views showing the consequences as well as the underlying root and contributing causes for tyre and rim related incidents and accidents. The latter are presented as the four ICAM categories – Organisational Factors, Task/Environmental Conditions, Individual/Team Actions, and Absent/failed defences.

Summary graphics for each category and associated ranked Paretograms showing the number of contributing causes, as an indicator of likelihood, of the four ICAM categories are also given. Comments are provided for the 'vital few[3]' shown in those Paretograms.

3. Upon completion of this study, the data used for this study will be provided as a complete and open database for industry access through the MIRMgate portal already set up by the University of QLD Minerals Industry Safety and Health Centre (MISHC).

[3] The 'Vital Few', simply put, are those items, that if addressed would eliminate 80% of the issues.

## 4. FINDINGS - CONSEQUENCES TO TYRE AND RIM RELATED INCIDENTS & ACCIDENTS

AS4360 Risk Management [10] stipulates that 'risk is the product of likelihood and consequence'. While a discussion on 'likelihood' will be provided later in this report, a review of actual outcomes to tyre and rim related incidents and accidents is provided first as it puts into perspective the real threat of LTA tyre and rim maintenance, and poor operational practises that can lead to tyre and rim related incidents and accidents.

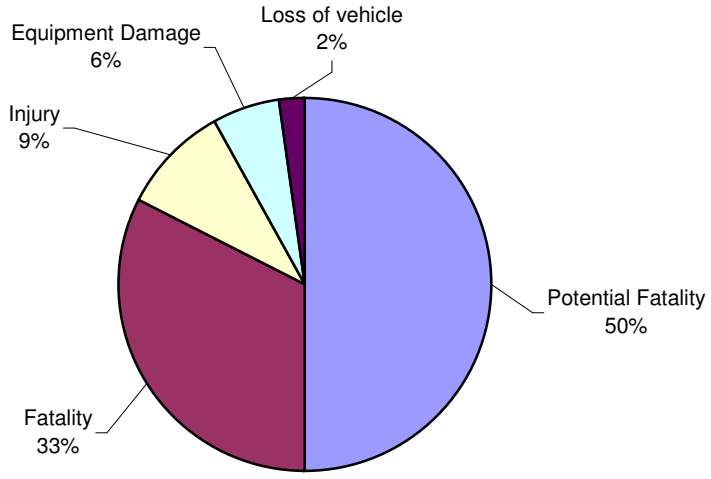
As shown in Figure 2, 33% of all cases covered by this review resulted in the death of the tyre serviceman or personnel involved in the work.

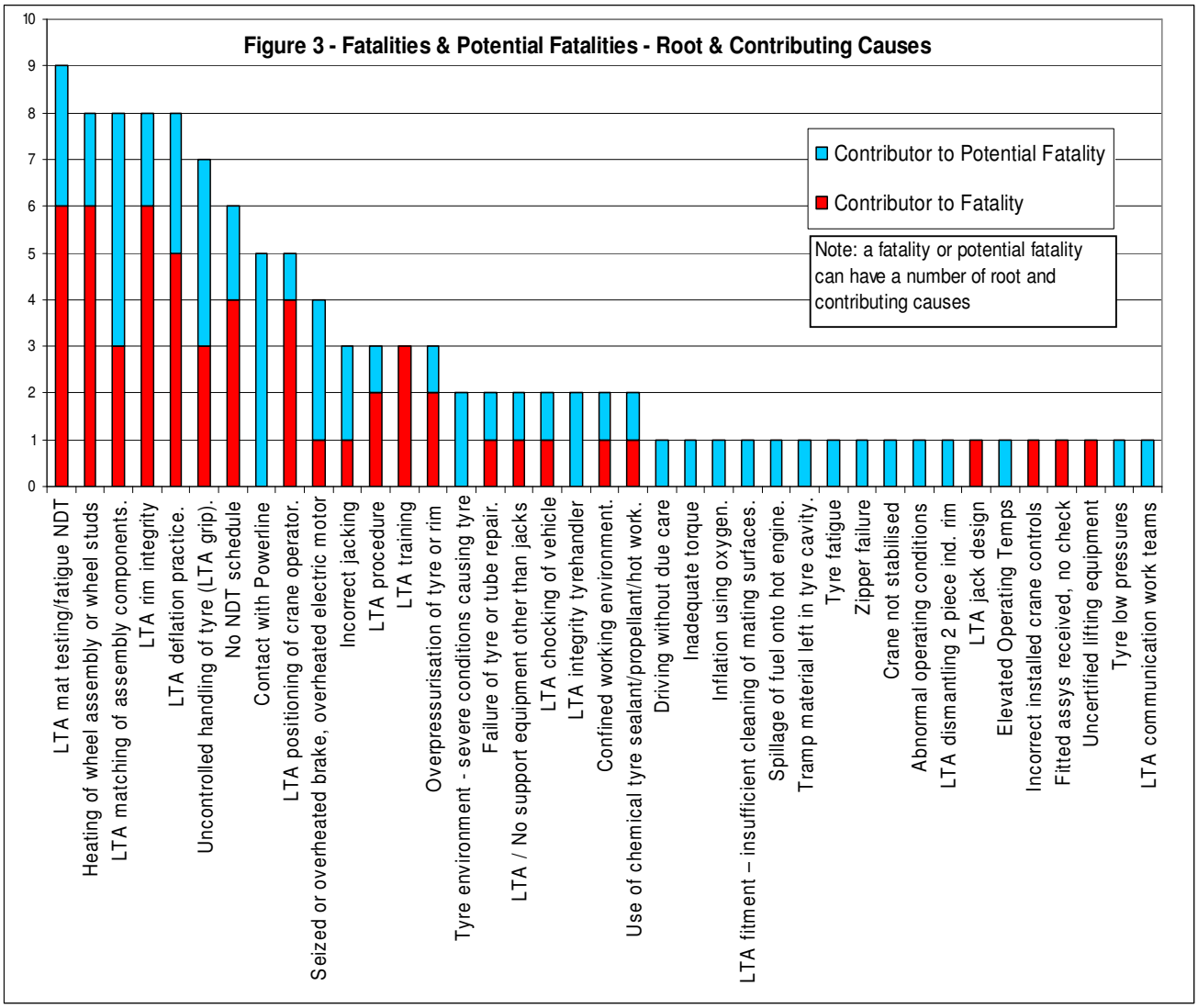
A further 50% of all incidents and accidents were classified as potential fatalities based on their similarity to other fatality cases.

The combined percentage of 83% - actual and potential fatal outcomes - clearly indicates that working with tyres and rims in either a maintenance setting, or subsequent operational setting must be effectively controlled through a number of (independent/redundant) initiatives at a number of levels.

The remaining consequence portion of 17% is made up of injury, 9%, equipment damage 6%, and loss of vehicle, 2% respectively.

**Figure 2 - Actual & Potential Consequences to Tyre & Rim related Incidents & Accidents**





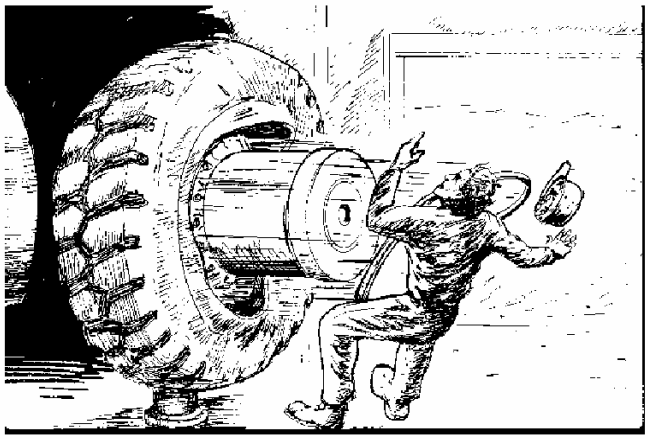

A further breakdown as to the underlying acts and conditions leading to the main consequence categories, fatalities and potential fatalities, is provided in Figure 3.

As a key fatality prevention initiative the following main areas must be addressed.

- Heating of fitted tyre / wheel assemblies using any heat source such as an oxyacetylene flame, to loosen tight or seized corroded wheel fastening system, i.e. nuts and studs, must me eliminated. Such heating may produce pyrolysis in the tyre chamber (even when fully deflated) which is known to escalate into a high energy and violent chemical explosion. Alternative safe methods to loosen wheel nuts or studs, e.g. using hydraulic tools must be sought. As shown in Figure 4, pyrolysis

tyre events contribute 21% to the overall incident and accident count and is therefore one of the root sources of harm.

- Poor fitting practises resulting in the mismatching of rims, rim components and tyres will create assemblies that are unsafe and unpredictable throughout the lifecycle of the assembly, i.e. during assembly, inflation, fitment to the vehicle, operation, operational checking and maintenance, and removal. This can only be addressed by providing proven accredited tyre serviceman training and refresher training schemes. Better industry wide rim and rim components identifications schemes should also be considered.
- Absent or deficient rim and rim component testing allowing LTA rim integrity must be controlled through rigorous, systematic and reliable rim and rim components testing programs as stipulated by AS4457:1997. Failure to have such systems in place will allow the use of defective rims and rim components which when pressurised can fail dangerously at any time. Such management systems must ensure that the information is readily available at the work interface and personnel are aware of the need to accurately record, track and manage the service and NDT history of each rim base.
- Handling of rims, tyres and fitted assemblies must be reviewed including the suitability and structural integrity of the handling equipment. This assessment must also include a review of operational practises which includes positioning of the person operating the tyre manipulator.
- Operational situations that may result in contact with powerlines must be eliminated. Similarly situations involving lighting strike to rubber tyres vehicles must be considered also and included in a review of vehicle operational and mines rescue practises. The review should also include other scenarios known to cause conditions conducive to tyre fires and pyrolysis events such as seized or overheating of brakes or wheel motors.
- Mandatory deflation/pressure reduction of tyre assemblies prior



Failure of rim/locking mechanisms during wheel maintenance is one of the highest cause of all tyre maintenance fatalities (sketch from [2])

to removal off any vehicle, as required by AS4457:1997 must be in place, particularly when considering the high frequency of incidents involving LTA integrity of rims, and rim componentry. Both factors combined have caused several fatalities in the last few years in Australia.

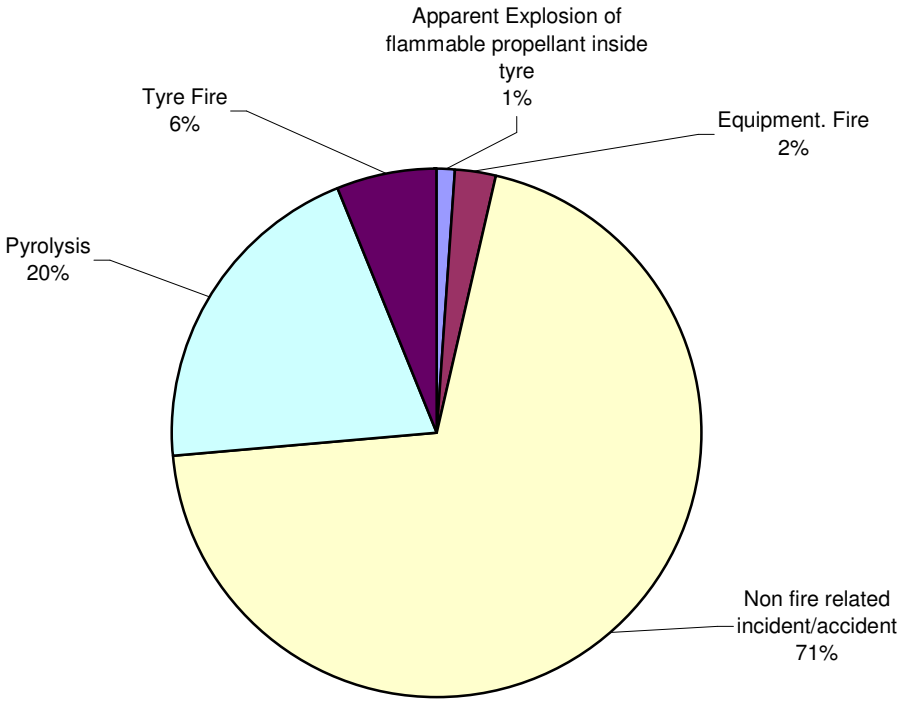
## 5. ESTIMATION OF INCIDENT AND ACCIDENT LIKELIHOOD

Figure 4 shown an overall breakdown of the main incident and accident categories, 'non fire', 'pyrolysis', 'fire', 'equipment fire'. 71% of all incidents and accidents are non fire related.

Pyrolysis events account for 20% of the incident and accident sample, with 6% linked to tyre fires. The comparatively high percentage of pyrolysis events highlights the real need to better control this particularly hazardous situation.

Causes of OTR tyre fires and tyre explosions formed the focus of a previous ACARP study conducted by the author, interested reader are referred to [11].

**Figure 4 - Main Categories of Tyre and Rim Related Incidents & Accidents**




## 5.1. ORGANIZATIONAL FACTORS

Organisational factors, in this studies context, are those aspects which can be implicated in producing the task/environmental conditions, individual or team actions, or absent/failed defences that have allowed the incident or accident to happen.

As such they are the underlying features (arising from organisational shortcomings) that produce the conditions affecting performance at the workplace; these can lie dormant or undetected within an organisation until they combined with the local conditions and errors or violations to breach the systems defences [12].

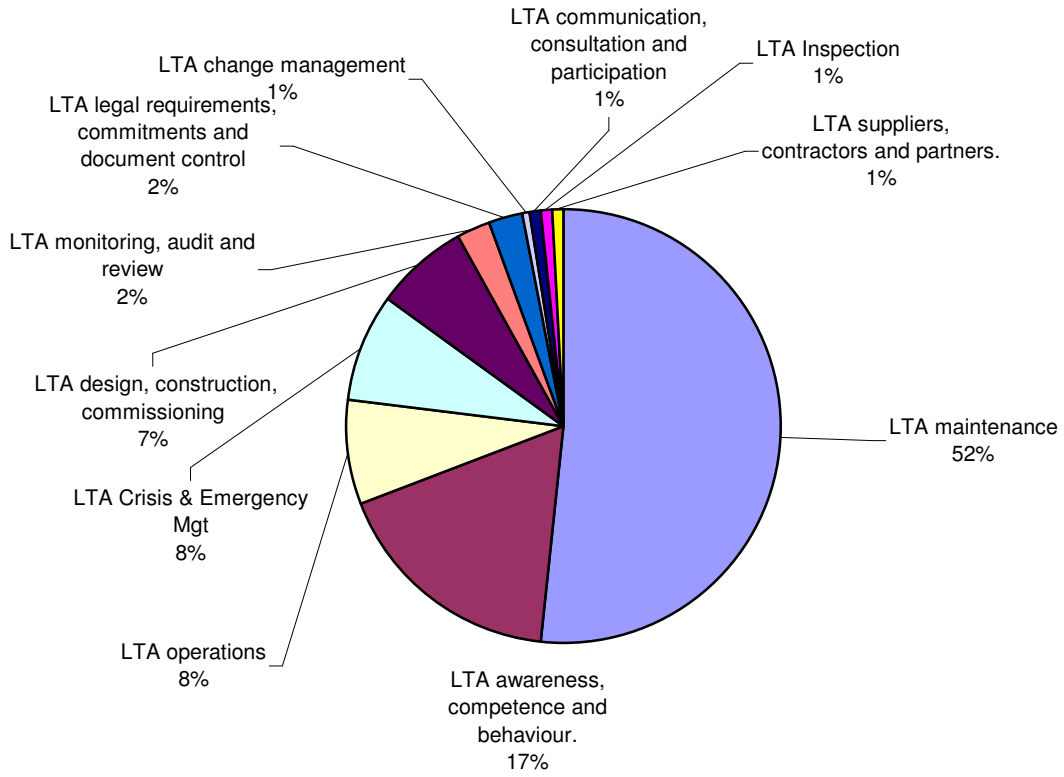
Basic organisational factors include leadership and accountability, legal requirements, commitments and document control , risk and change management, planning, goals and targets, awareness, competence and behaviour, health and hygiene,

communication, consultation and participation, business conduct, human rights and community development, design, construction and commissioning, operations and maintenance, suppliers, contactors and partners, stewardship, incident reporting and investigation, crisis and emergency management, monitoring, audit and review.

As the name implies, organisations factors are controlled by the organisation itself and improvement of those factors can only be achieved through utilisation and constant upkeep of the management systems in place.

Figure 5 provides a summary graphical breakdown of those organisational factors assessed to be responsible for the incidents and accidents described in this report.

**Figure 5 - Organisational Factors**




Each of the categories contained in Figure 5 are further analysed to provide an insight as to their underlying root and contributing causes, Paretograms for each providing this breakdown including comments are provided below.

### 5.1.1. LTA MAINTENANCE

Over 50% of the incidents and accidents can directly be related to LTA maintenance of tyre and rim assemblies.

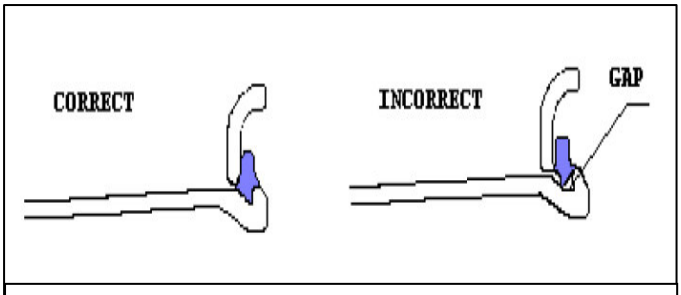
Key maintenance issues, shown in Figure 6, that require reliable controls as part of the overall maintenance management system are as follows:

- Rim integrity generally must be assured throughout the lifecycle of the rim assembly. A strategy to achieve this must incorporate, as a minimum, reliable non destructive testing (NDT) regimes in accordance with Australian Standards, OEM and industry guidelines and a higher level of understanding of the issue and underlying hazards. The strategy must also include accurate recording, tracking and reporting of the NDT and fatigue status/history so rims/wheels can be withdrawn before their permissible fatigue limit is reached.

Photograph 1: Fatigue damage of rim and rim components, if not detected, such as this flange ring can have catastrophic consequences.

- Heating of wheel assembly fasteners during the removal process must be eliminated as it remains one of the key causes of tyre servicemen fatalities.

- Deflation of rim/wheel/tyre assemblies, as required by AS 4457 must be institutionalised before any rim/wheel/tyre assembly can safely be removed from any vehicle.



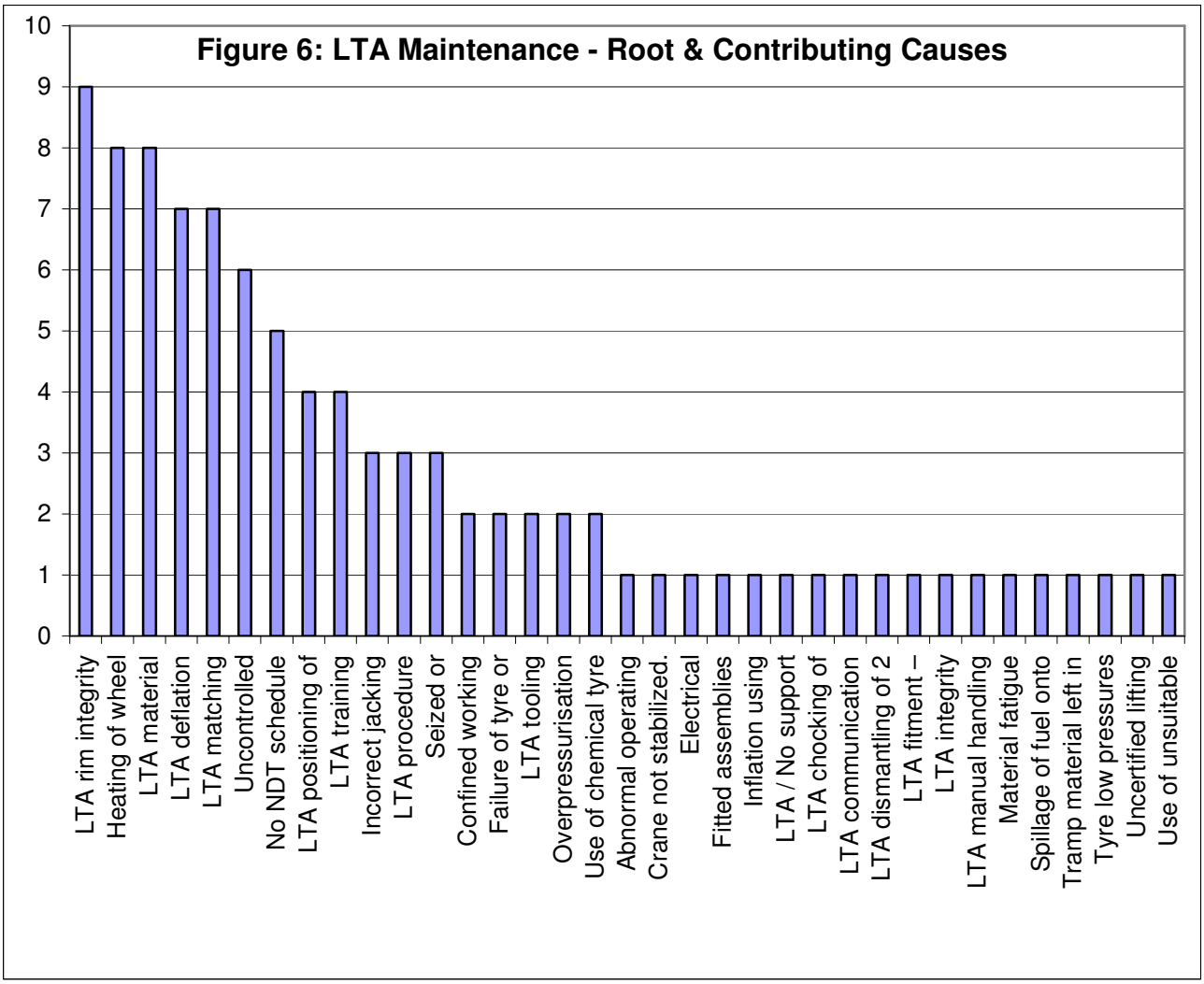

Incorrect matching and assembly of tyres, rim and rim components, as shown, must be eliminated to ensure the safety and integrity of the assembly. (sketch from [1]

- Matching of tyres, rims and rim components must be ensured to achieve full operational safety and performance after assembly.

- Safe load shifting practises including safe position of the operator of the crane manipulator/crane must be achieved,

- Accredited training and refresher training provided by registered training organisations must be provided to all personnel including supervision and management involved in tyre and rim maintenance.

- Safe jacking practises must be institutionalised through correct methods utilising OEM recommended jacking and vehicle support points using appropriate and fit for purpose lifting and standing equipment only.

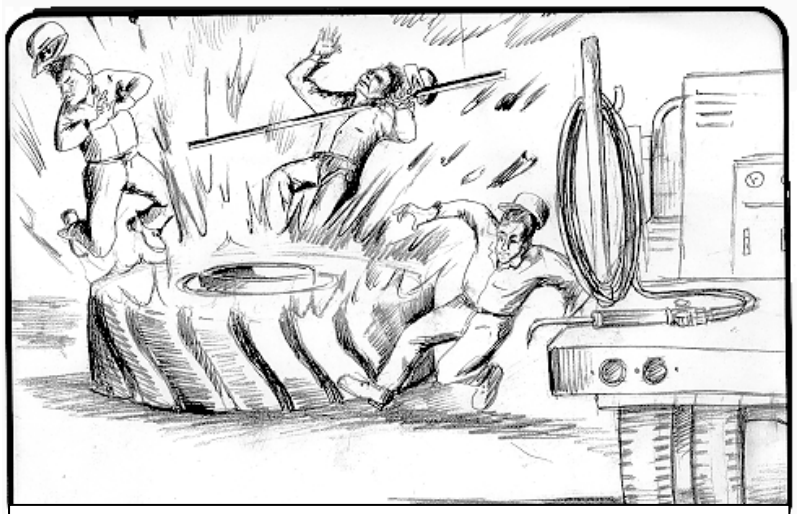



### 5.1.2. LTA AWARENESS, COMPETENCE & BEHAVIOUR

Underlying issues of awareness, competence and behaviour are almost identical to the systematic failures of mines' safety and maintenance management systems.

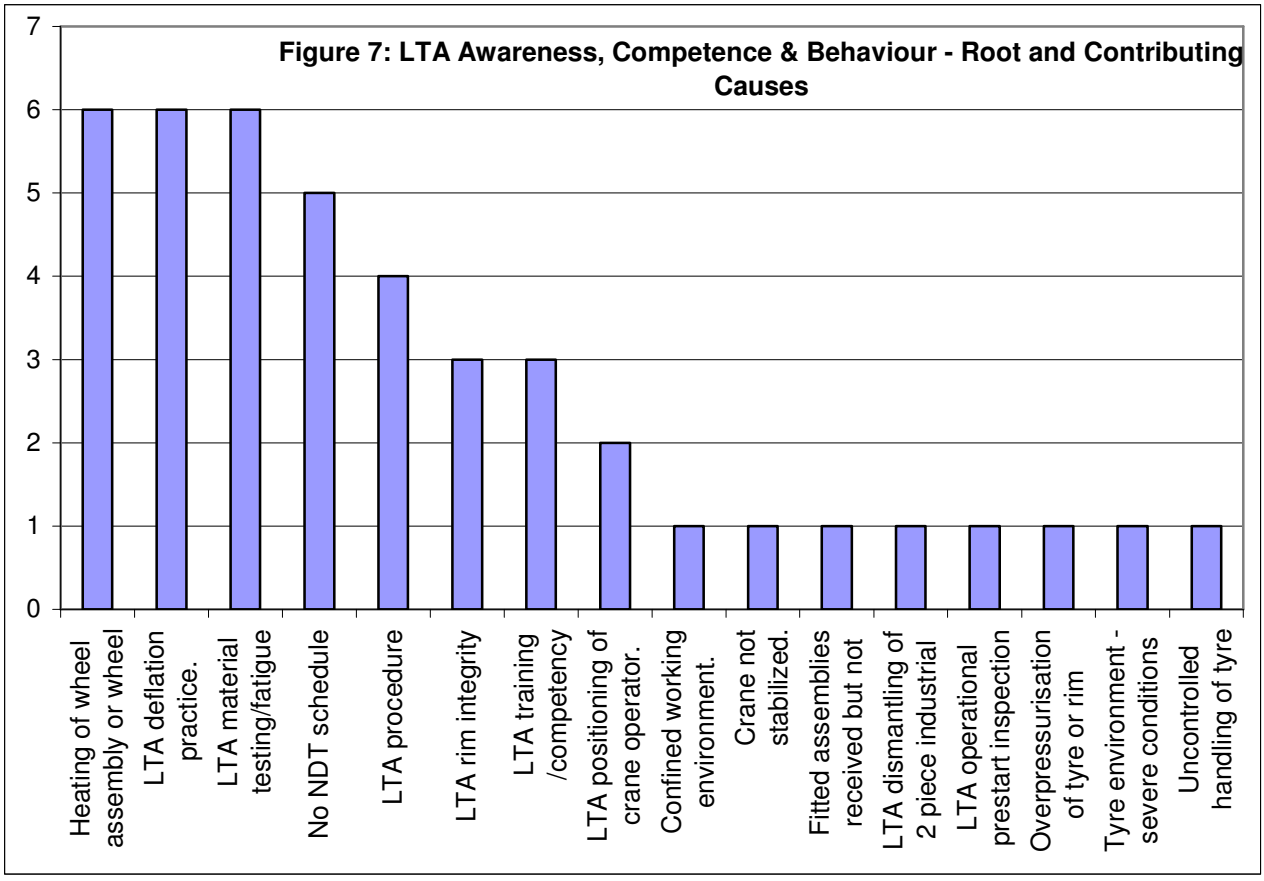
Because of the high severity potential of any tyre and rim related incident, highest possible awareness must be provided to all stakeholders.

To achieve this required high levels of awareness, competency and safe behaviour the following areas of concern, as shown in Figure 7 must be addressed as part of the mines safety and training management system:



Heating of wheel fastening systems is a key root cause to many tyre and rim related fatalities. This work practise must be eliminated. Sketch from [4].

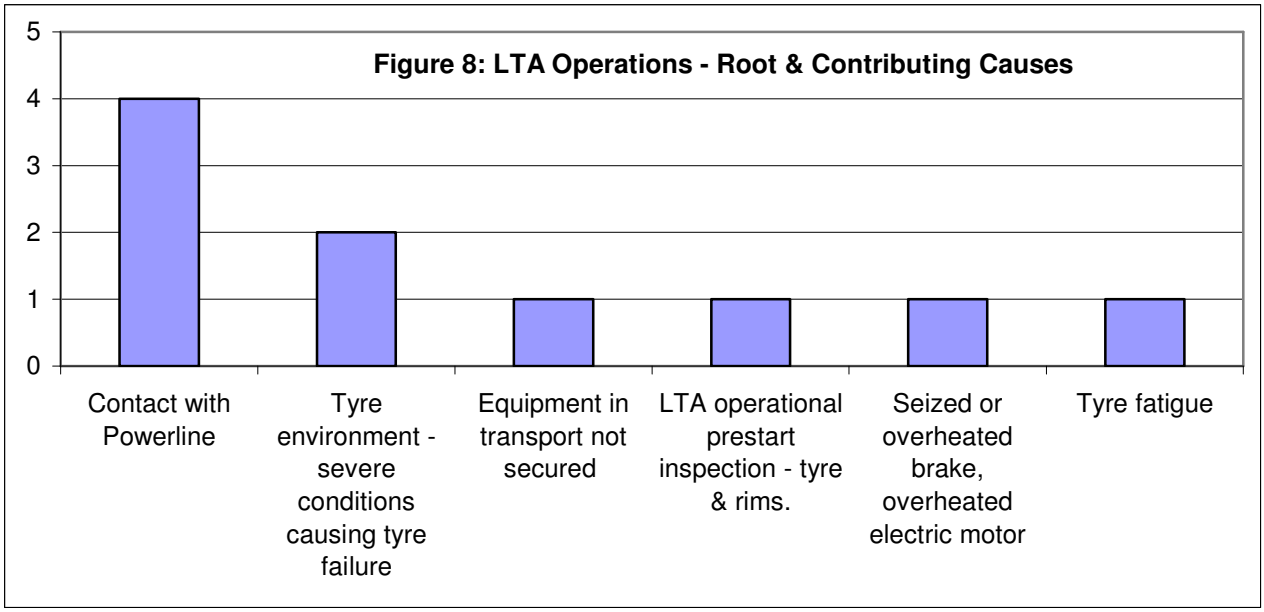
- Heating of wheel assembly fastening components appears to be widespread practise within the industry, common knowledge and understanding must be imparted on all personnel that this practise is extremely dangerous and cannot be tolerated.
- Knowledge and understanding that deflation of wheel assemblies prior to removal off the vehicle is required. Failure to do so will continue to cause high potential incidents, accidents including fatalities to tyre servicemen.
- Safety through deflation of tyre and rim assemblies prior to maintenance can be significantly improved through raising tyre services personnel's understanding of the causes and consequences of metal fatigue in rims and rim components which as a minimum control measure must include non destructive testing concepts and approaches
- Accredited training and ongoing provision of refresher training by registered training organisations must be provided to all personnel involved in tyre service work including supervisory and management personnel.
- Training and competency must be assisted by raising the need to follow safe procedures; these should cover all aspects of tyre maintenance including load shifting of tyres and rims.




### 5.1.3. LTA OPERATIONS

There are a number of operations specific areas shown in Figure 8 that must be addressed by providing safe and sound operating practises through an operations management system.

- Operator education and training practises must include mandatory actions in case of contact with powerlines.
- Mine design and vehicle operation standards must be created, implemented and maintained by the mines' operations management system that ensure that the tyre environment does not deteriorate to a level where continued operations will cause damage to tyres that create immediate unsafe conditions, or cause latent unsafe conditions e.g. through tyre fatigue, rim base and or rim component damage.
- Transportation of tyres, rims and tools on site must be controlled through appropriate systems ensuring carried items are securely restrained during transport.
- The system must also ensure that vehicle prestart checks including a check of tyres, rims and attachment systems are in place and are carried out. This initiative may require the inclusion of proven operator training and awareness sessions.




### 5.1.4. LTA DESIGN, CONSTRUCTION & COMISSIONING

There are a number of general design and traffic engineering issues, shown in Figure 9, which should be considered in a management system to assist in reducing tyre and rim related incidents.

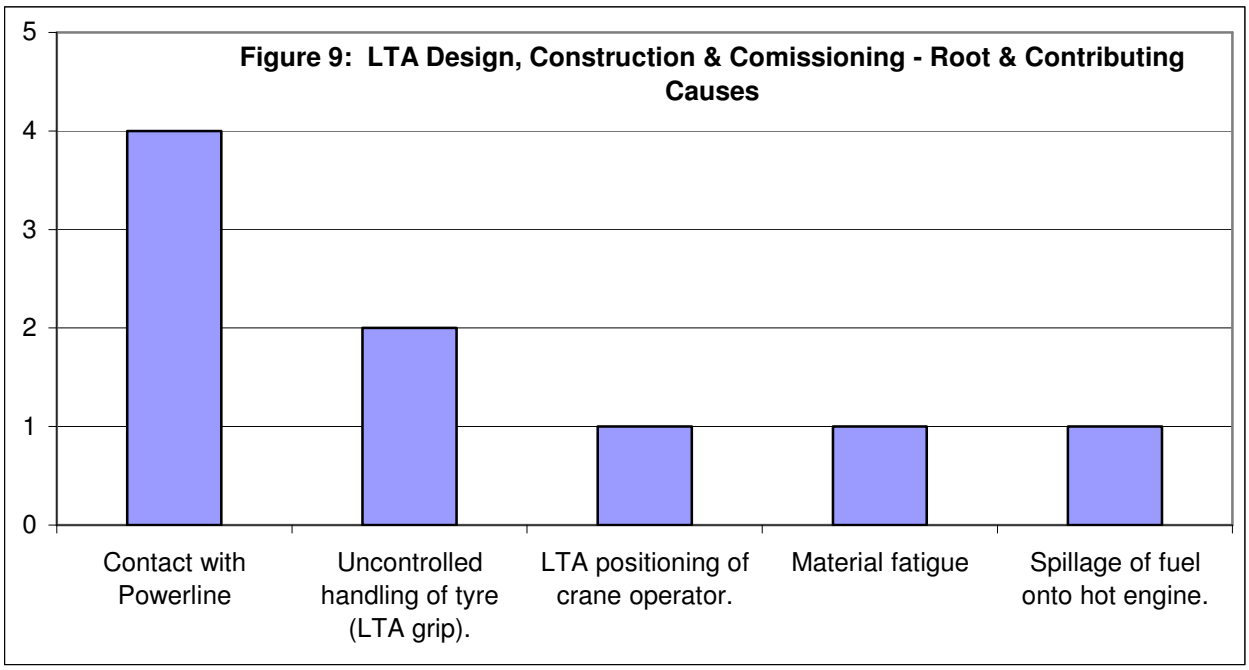
Accidental contact with overhead powerlines, or electrification by lighting strike is known to cause pyrolysis and subsequent violent explosion of in some or all vehicle tyres. This hazard can be best eliminated by designing roads away from powerlines. (sketch from [3])

Where possible these design measures should be considered before any hardware is purchased or installed to have the greatest benefit, but can also be used retrospectively to identify existing hazardous conditions that can give rise to an incident or accident.

- One key operational issue directly related to LTA design of mine layout is the positioning and routing of powerlines. Accidental contact by mining equipment with powerlines will not only put the operator at a very real risk from

electrical shock, but may also initiate pyrolysis[4] in the tyre cavity of any of the vehicles tyres which can result in a extremely violent chemical explosion of the assembly. As such no traffic should be routed under powerlines, and where this is unavoidable routing must be designed using appropriate codes and standards with the main aim being to prevent accidental entanglement.

- A number of tyre service men have been injured or killed through uncontrolled handling of tyres as a result from LTA design of tyre manipulators causing the tyre to slip out of the grip of the manipulator and fall onto the operator.
- It is likely that the latter underlying design issues is at least a contributing factors to those instances where tyre service personnel is injured or killed through LTA positioning of the manipulator operator in relation to the tyre.
- Simple design modifications to relocate fuelling points away from tyres are recommended to prevent accidental ignition of tyres from fuelling related fires.




4 Pyrolysis is the decomposition/breakdown of tyre rubber from heat. This breakdown process is reported to start when rubber reaches a temperature of
~250 degC, with auto ignition and subsequent explosion of the breakdown products reported to take place above 400 degC.

## 5.1.5. LTA LEGAL REQUIREMENT, COMMITMENT & DOCUMENT CONTROL

A key issue, shown in Figure 10 that must be addressed by the mines' safety and management system is the testing and verification of any safety critical engineering items that may be vulnerable to fatigue damage throughout their lifecycle such as rims/ wheels and load bearing structures of tyre manipulators.

- Such a management system must not only ensure that such scheme exists, but that it is based on relevant Standards which are appropriate (e.g. AS4457-1999) and thorough enough so that the integrity of the engineering item e.g. the rim, wheel or tyre handler can be reliably established.
- This scheme also needs to offer a comprehensive range of safe work procedures covering the full range of tyre and rim maintenance related tasks including jacking.

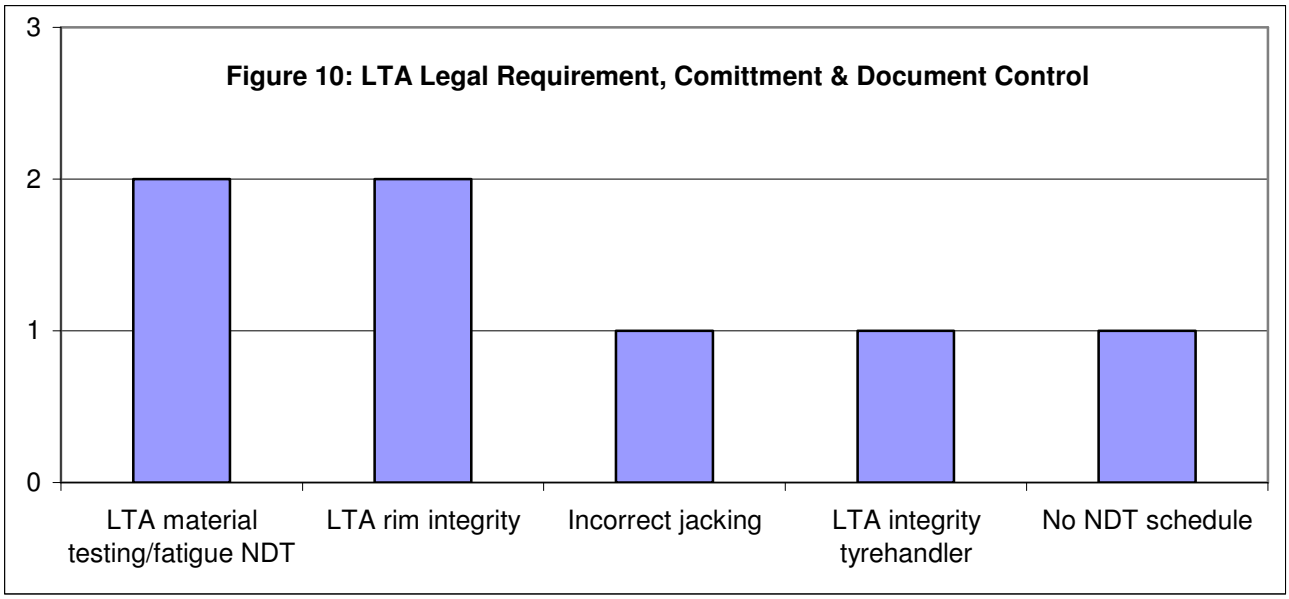


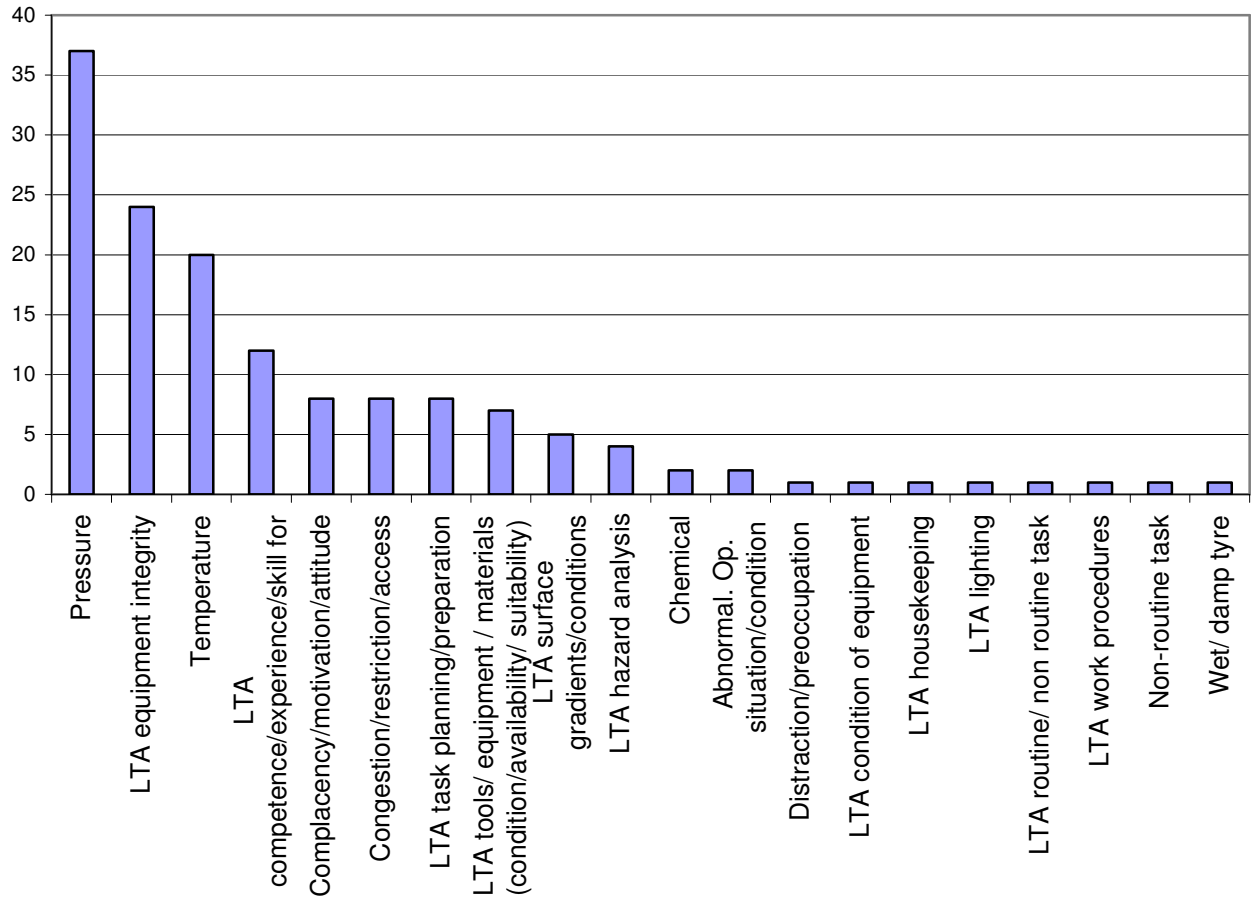

**Figure 10: LTA Legal Requirement, Comittment & Document Control**

## 5.1.6. TASK & ENVIRONMENTAL CONDITIONS

Task and environmental conditions are those conditions in existence immediately prior to or at the time of the incident that directly influence human and equipment performance in the workplace.

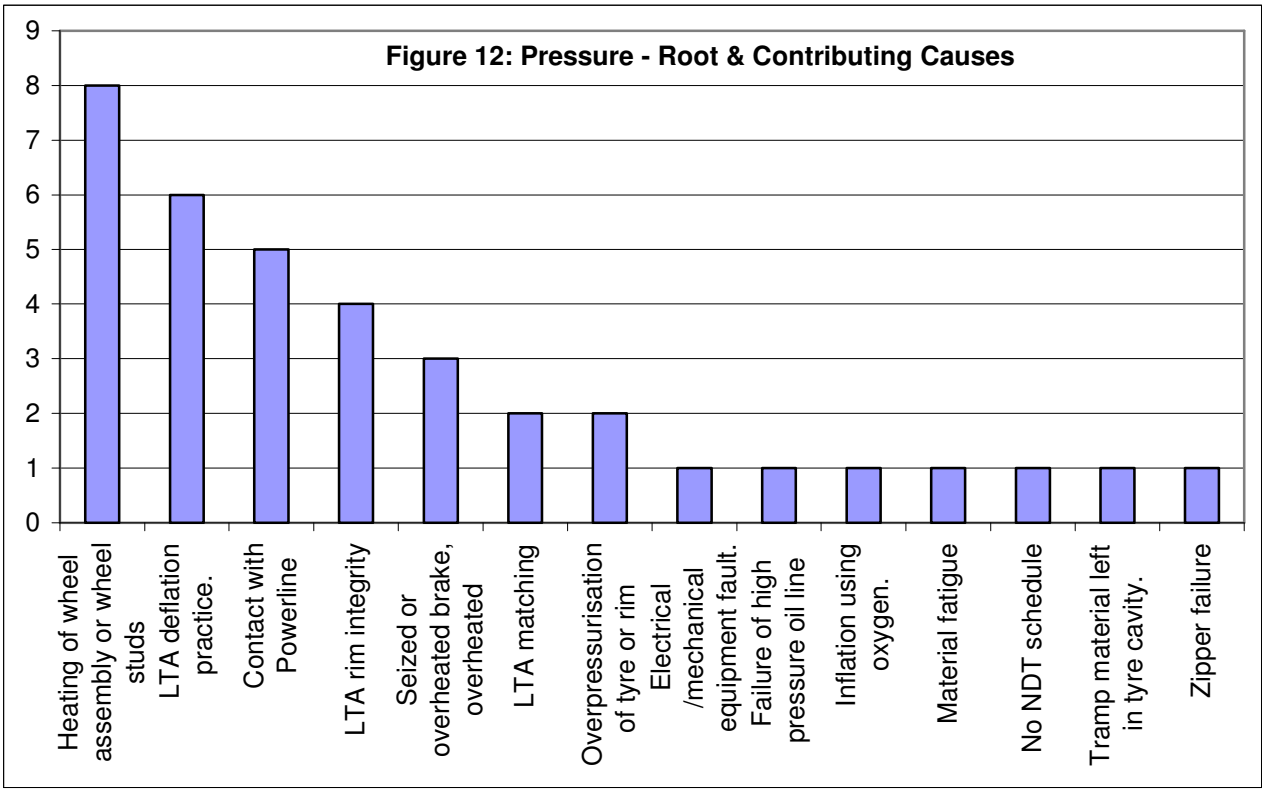
In the context of this study these were interpreted to incorporate workplace and human factors, but also specific equipment issues or factors that contributed to the incident or accident, as shown in Figure 11.

**Figure 11 - Task/Environmental Conditions**



### 5.1.7. PRESSURE

Tyre maintenance and service work in particular is a high risk activity as it involves working with a number of high potential energy and hazard sources which if not controlled can result in severe injury or death of the tyre service personnel.




One of the key hazards is the pressure contained in a tyre and rim assembly which as show in Figure 12 can have a number of origins and causes. It should be noted that most of the incidents and accidents related to excessive pressure were not due to accidental over-pressurisation of the assembly during the inflation process but were caused as a secondary effect from deliberate or accidental heating of some parts of the tyre assembly.

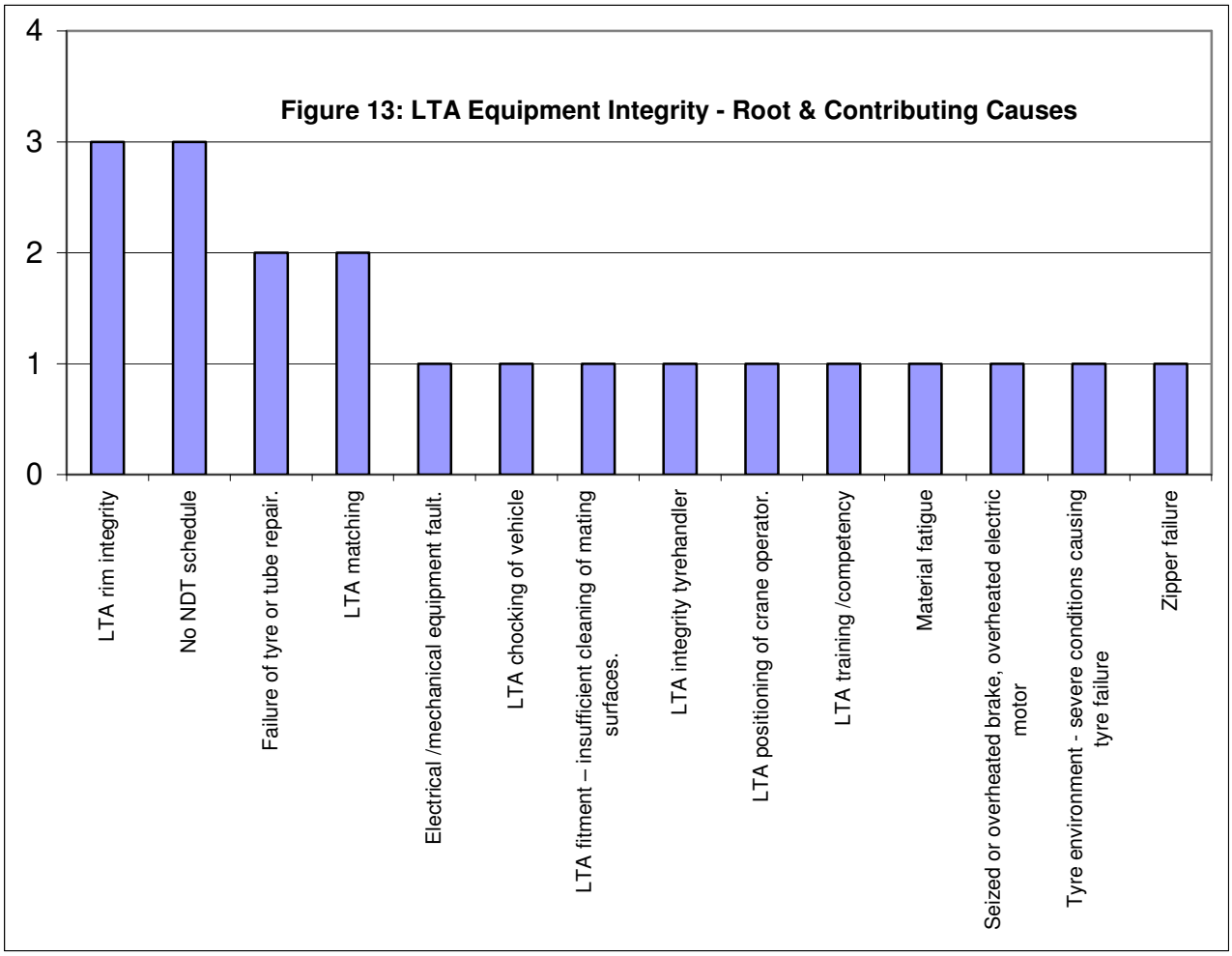
- As already mentioned, heating of the wheel assembly or fastening systems, as a means to loosen them, may initiate pyrolysis followed by a chemical explosion within the tyre cavity which will exceed normal inflation pressure regime by several magnitudes resulting in violent explosion of the tyre and rim assembly.
- The same pyrolysis and extreme explosion pressure hazard will also present itself if a vehicle comes into contact with a powerline, is accidentally struck by lighting, or rim components become excessively hot e.g. from a seized or overheating brake, or a hot wheel motor.

- Ideally, the vulnerability of tyres and tyre assemblies to any form of heat above OEM recommendations as a trigger to cause over pressure scenarios should be fully understood and acknowledged and incorporated into the overall (risk) management approach practised on any mine site.
- LTA rim integrity, as the result of not carrying out NDT of rims assemblies and components, combined with not deflating the assembly before it is removed from the vehicle, as mandated by AS4457:1999 are both known hazards related to inflation pressure that must be effectively controlled.

### 5.1.8. LTA EQUIPMENT INTEGRITY

For tyre and rim assemblies to function safely and correctly, their integrity and that of associated or supporting systems, e.g. tooling, cranage, other maintenance equipment and the equipment fitted with the assemblies must be assured. Root and contributing causes causing issues of equipment integrity are shown in Figure 13.

- LTA rim integrity due to rim and componentry damage, poor fitment practises or lacking NDT schedule are key root or contributing causes.
- Poor rubber repair practises for tyres and tubes must be eliminated in order to provide ‘near new’ and safe tyres and tubes.
- Incorrect matching of tyre to rim assembly components causing the overall integrity of the assembly to be jeopardised must be eliminated. The safe assembly of at least rim components may be achievable through an industry wide standardised identification system that assists tyre servicemen in the selection and assembly of matching components. Issues with LTA matching of assemblies should also be integrated into tyre servicemen and supervisory training initiatives. This specialised training should also reinforce some of the basic maintenance practises that will ensure proper fitment of tyre assemblies to vehicles such as correct surface preparation of rim/wheel and fastener mating surfaces.
- Further initiatives to improve the integrity and performance of equipment that will assist tyre serviceman safety need to include procedures on the proper use of wheel chocks, use of fit for purpose tyre manipulators as well as the correct positioning of tyre handling machinery.




### 5.1.9. TEMPERATURE

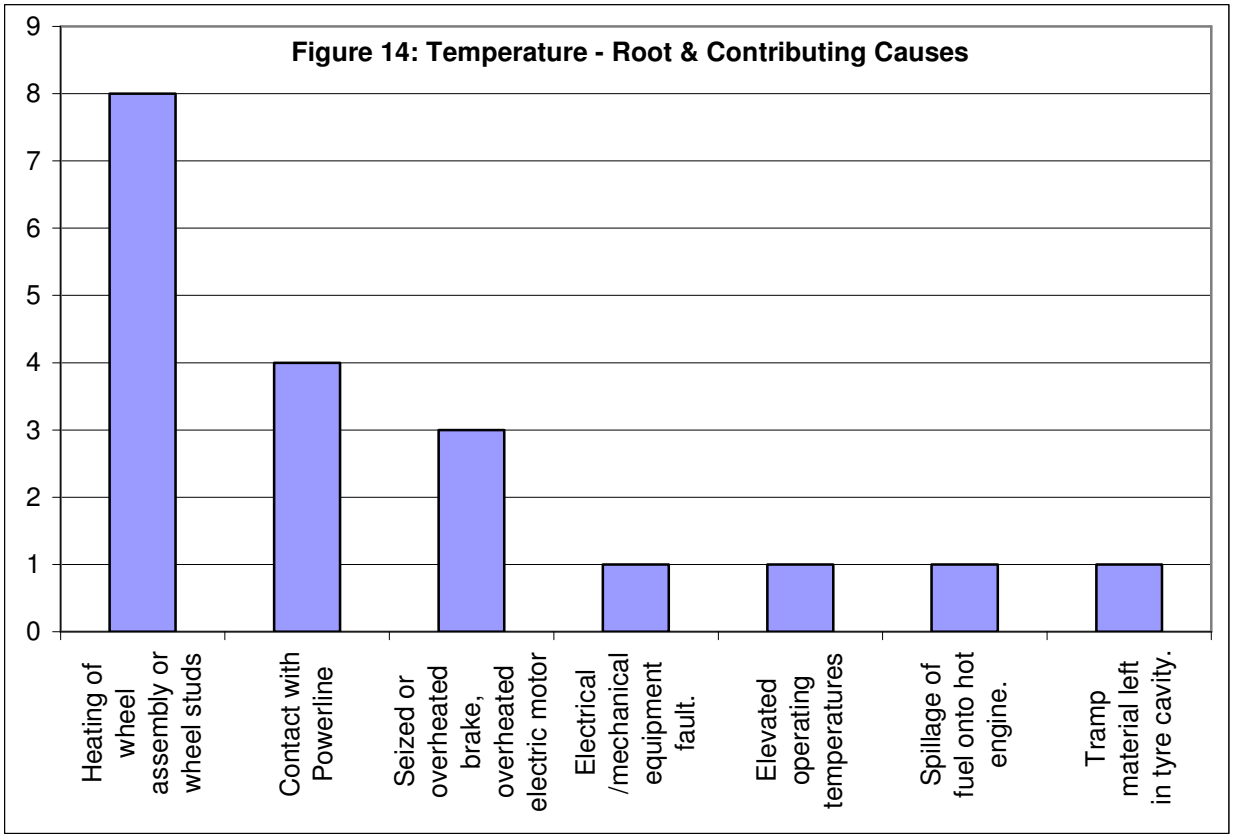
Exposure of tyres and rim components to elevated temperatures above tyre OEM acceptable levels through a number of mechanisms and sources, operational or during maintenance, must be eliminated to prevent possible escalation into pyrolysis events. Excessive temperatures, through LTA operation or in service maintenance of tyres (e.g. poor tyre pressure maintenance) may also lead to overheating of tyres which will cause irreversible tyre damage.

Knowledge that heat and heat sources must be eliminated ought to be communicated and enforced with all tyre service, supervision, operations and maintenance personnel, at a maintenance and safety management system level.

In particular the following three key hazards must be addressed by the system:

- Heating of wheel assemblies and its fastening systems may cause pyrolysis resulting in a catastrophic explosion of the assembly being worked on.
- Contact with powerlines, apart from possible electric shock to the vehicle operator and any personnel providing assistance, may also cause pyrolysis resulting in the catastrophic explosion of some or all of the vehicle tyre assemblies at any time after the electrification. The same hazard will present itself if the vehicle is struck by lighting.
- LTA maintenance or mechanical problems resulting in seized/overheated brakes, or overheated electric wheel motor may also cause pyrolysis resulting in the catastrophic explosion of the vehicle tyre assemblies and must be controlled and eliminated through proactive maintenance programs and processes, and through proactive prestart checks.

A fourth key hazard, not mentioned in the incident database are heat related tyre bursts typically caused by operational acts and conditions. As a general suggestion, it is recommended to investigate all tyre and rim related incidents in some detail based on the very real hazard potential such incidents and accidents can produce.

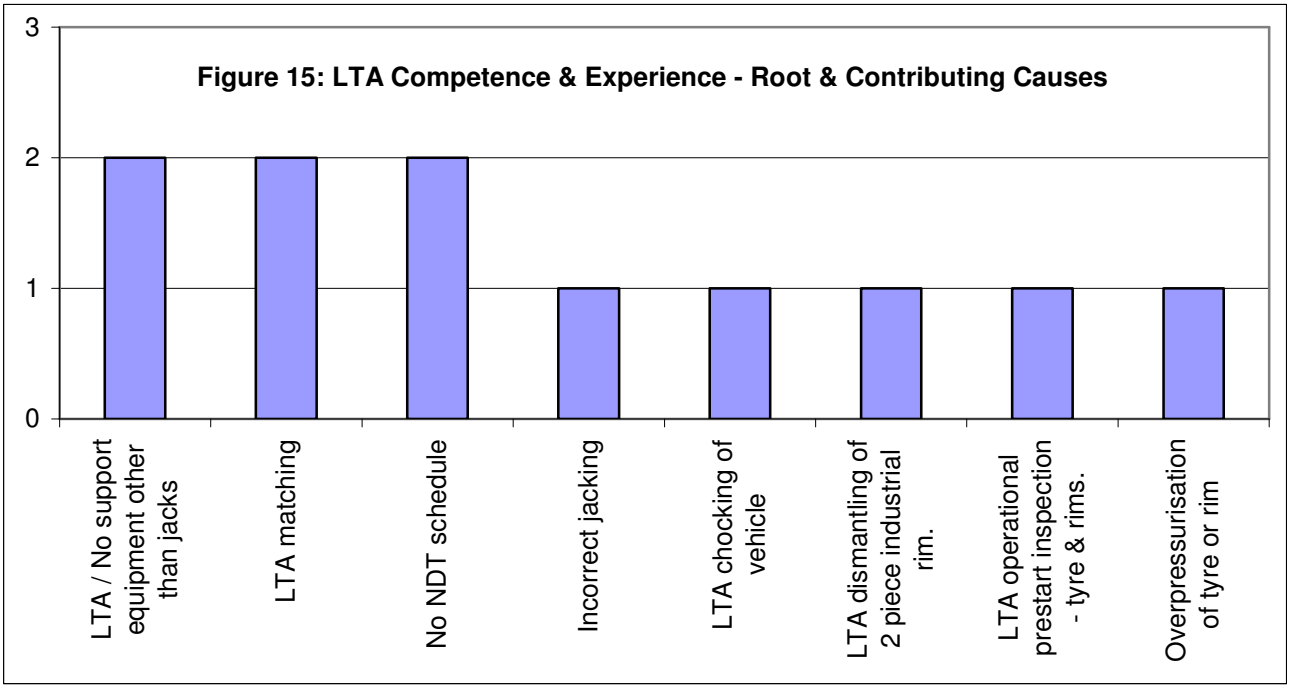


## 5.1.10. LTA COMPETENCE & EXPERIENCE

LTA competence and experience are known to be key contributors to the majority of any incident and accident.

The following hazards shown in Figure 15 relating to insufficient competence and experience were identified by this study. Accredited competency based training and refresher training including a mechanism to challenge test the personnel should cover the following issues:

- Correct chocking of the vehicle under maintenance, including the use of approved jacks and stands capable of supporting the vehicle weight and placed in the OEM approved locations under the vehicle must be achieved.
- Training also must cover issues of matching tyres to rims, and matching of rim components, and the importance of rim tracking and NDT schedules and systems.
- Introduction of new equipment with unknown characteristics e.g. 2 piece industrial rims must be controlled through a change management process which identifies and resolves any new hazards created through the introduction of the equipment.



## 5.1.11. COMPLACENCY, MOTIVATION & ATTITUDE

Like other human factor causes, complacency, low motivation and poor attitude can play a significant role in incident and accident causation. These factors are particularly critical when they occur in situations that are of safety or quality critical importance and require a high attention to detail. Some of those tasks or situations include:

- Handling of tyres and rims using tyre handling equipment must be fully controlled at all times to prevent accidental dropping of the carried load. With a possible combined rim/tyre assembly weight of over 7 tonnes for the largest assemblies any slip or lapse can have catastrophic consequences requiring that this type of work is carried out by trained and competent personnel utilising appropriate and fit for purpose equipment. Manipulation of tyres and rims also requires safe positioning of any personnel during the process, this is particularly important where tyre and rim assemblies are handled by vehicle loading cranes which put the operator within the immediate vicinity of the assembly being handled..
- Any activities that may introduce latent hazards need to be controlled, for instance incorrect torquing of wheel fastening systems will cause those assemblies to become loose during service creating a considerable risk for the vehicle operator.
- It is suggested that tyre and rim maintenance related procedures be made available that cover as a minimum those key hazards that must be controlled as an aid to reduce any effects of complacency, motivation and attitude.
- As most tyre bay or tyre workshop locations are often restricted, operation within ought to be controlled to prevent any vehicles collisions with personnel or equipment and infrastructure which may include preventing non-tyrebay personnel from entry.

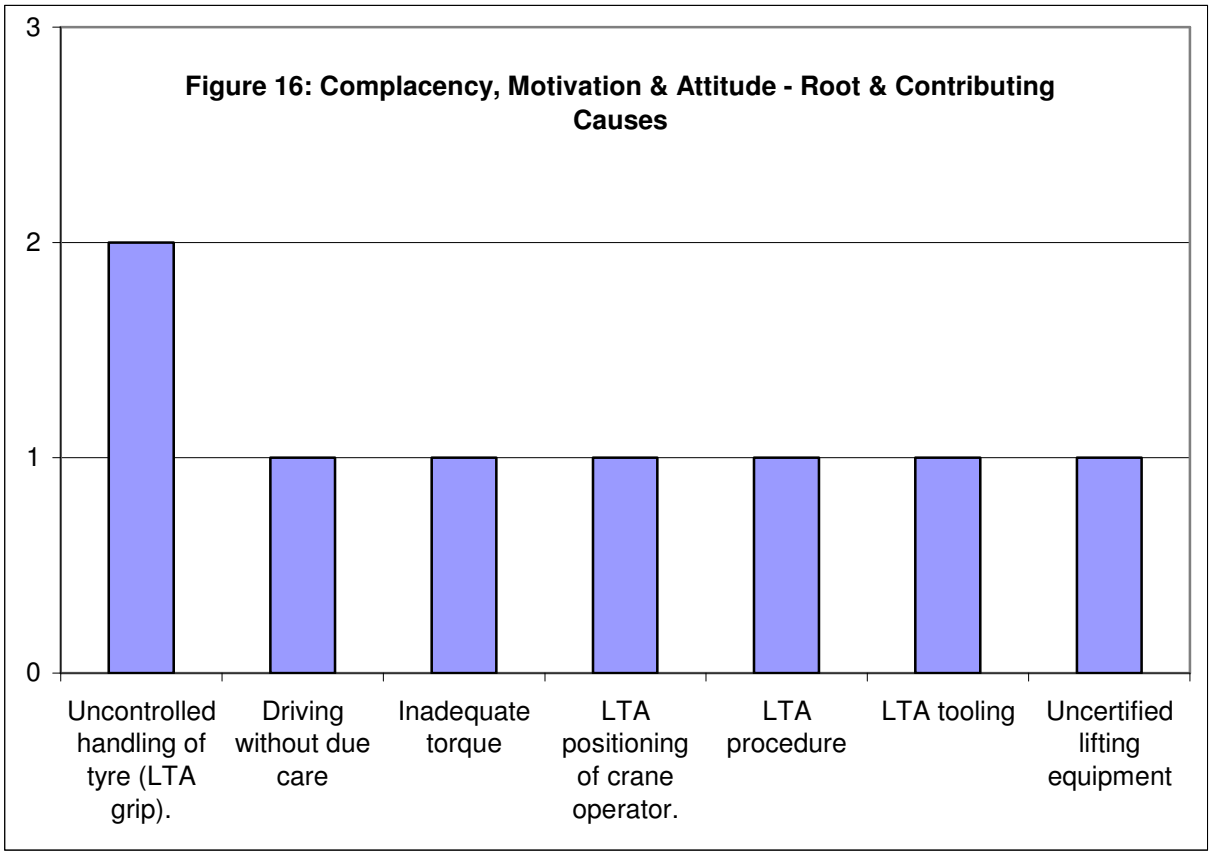



**Figure 16: Complacency, Motivation & Attitude - Root & Contributing Causes**

## 5.1.12. CONGESTION AND RESTRICTED ACCESS

As mentioned above, some activities require operation of equipment in congested or restricted work areas.

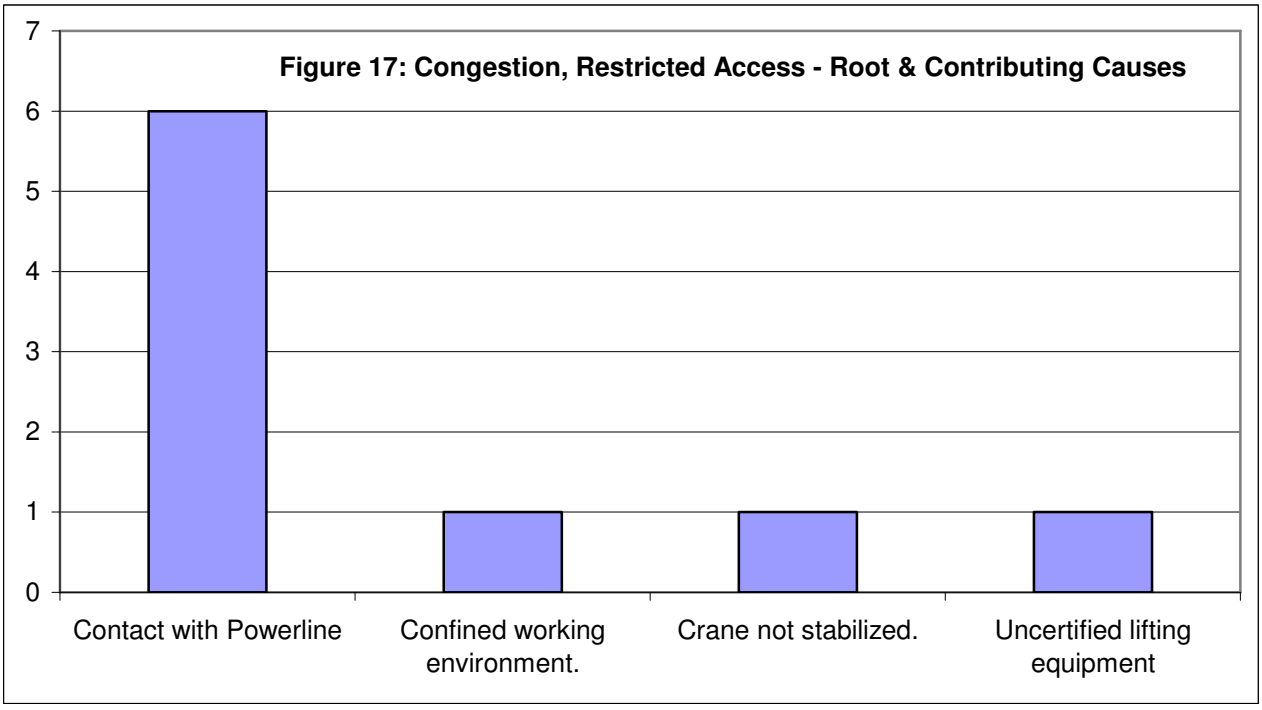
Given the hazard characteristics involved in working with tyres and rims, and associated equipment (e.g. explosion hazard, tyre and rim weight, issues with tyre manipulators and tyre handler) required for tyre maintenance the following tasks and situations, as shown in Figure 17 must be controlled.

- Accidental contact with powerlines must be eliminated to prevent escalation into a pyrolysis event. This is best achieved through adherence to set mine traffic design standards resulting in proactive traffic engineering, but must also include operational controls, in particular where vehicle operations may be conducted intermittently near or under powerlines that cannot be isolated or removed.
- Operational controls should be also introduced where tyre service work is carried out in restricted or congested areas which in most instances include operation of tyre handlers, and setting up of vehicles inside tyrebay workshops. Strict controls for

these areas are particularly important as these areas often house more personnel and are normally frequented by other personnel.

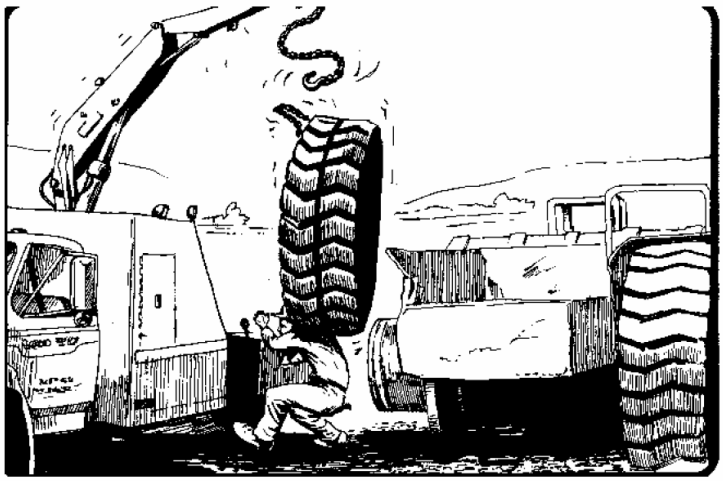
- A restricted or confined working environment may also give rise to personnel deciding to or 'being forced' to work in situations where they may expose themselves to suspended loads. Where such situations apply, separate risk assessments ought to be conducted and followed through. Unstable cranage equipment and uncertified lifting equipment must not be used at any time.

Photograph 2: Congestion in the workplace, combined with handling of tyres using cranage equipment is a prime cause for a number of fatalities. (image from [5])



## 5.1.13. TASK PLANNING

Poor task planning will inadvertently lead to problems during task execution, particularly during those tasks that are safety or quality critical. The review has highlighted that as a minimum the following situations shown in Figure 18 require effective control.



Handling of tyres and assemblies must be properly planned before the task is commenced. (sketch from [2]

- Handling tyres, rims and fitted assemblies, due to their sheer size and weight, must be properly planned before the lift is attempted using appropriate lifting methods and fit for purpose equipment at all times.
- Similar considerations must apply before jacking of any equipment particularly where jacking is carried out on mining equipment that has been modified. With such equipment original jacking and vehicle support points may no longer be readily accessible.
- The review has also highlighted that basic processes such a tying down of loads during transport ought to be reviewed and included appropriately in relevant procedures and training materials.

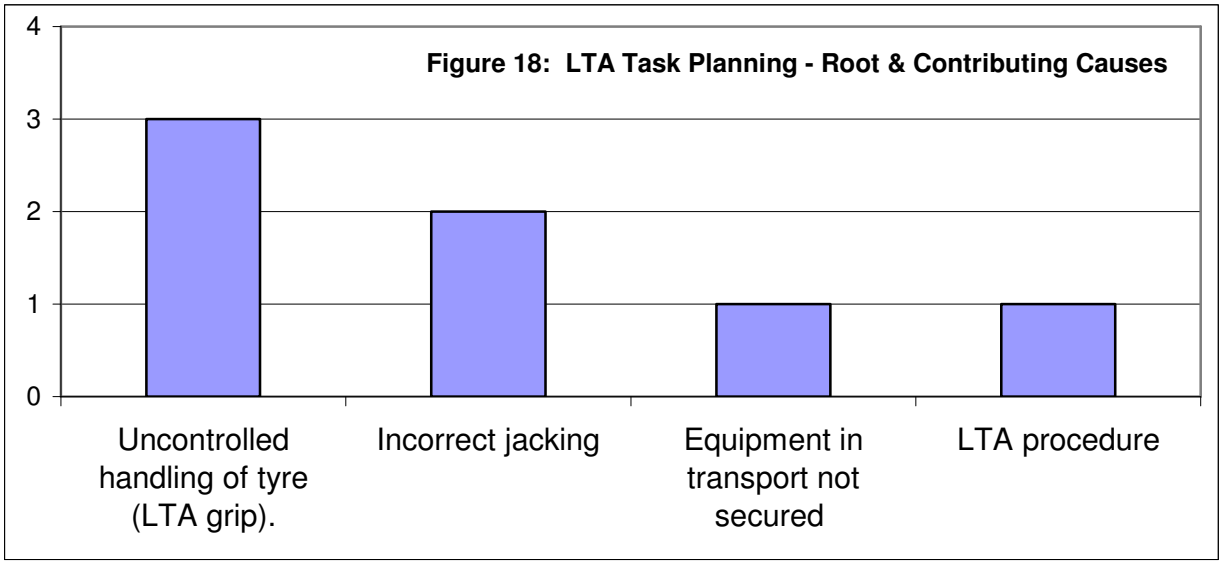



**Figure 18: LTA Task Planning - Root & Contributing Causes**

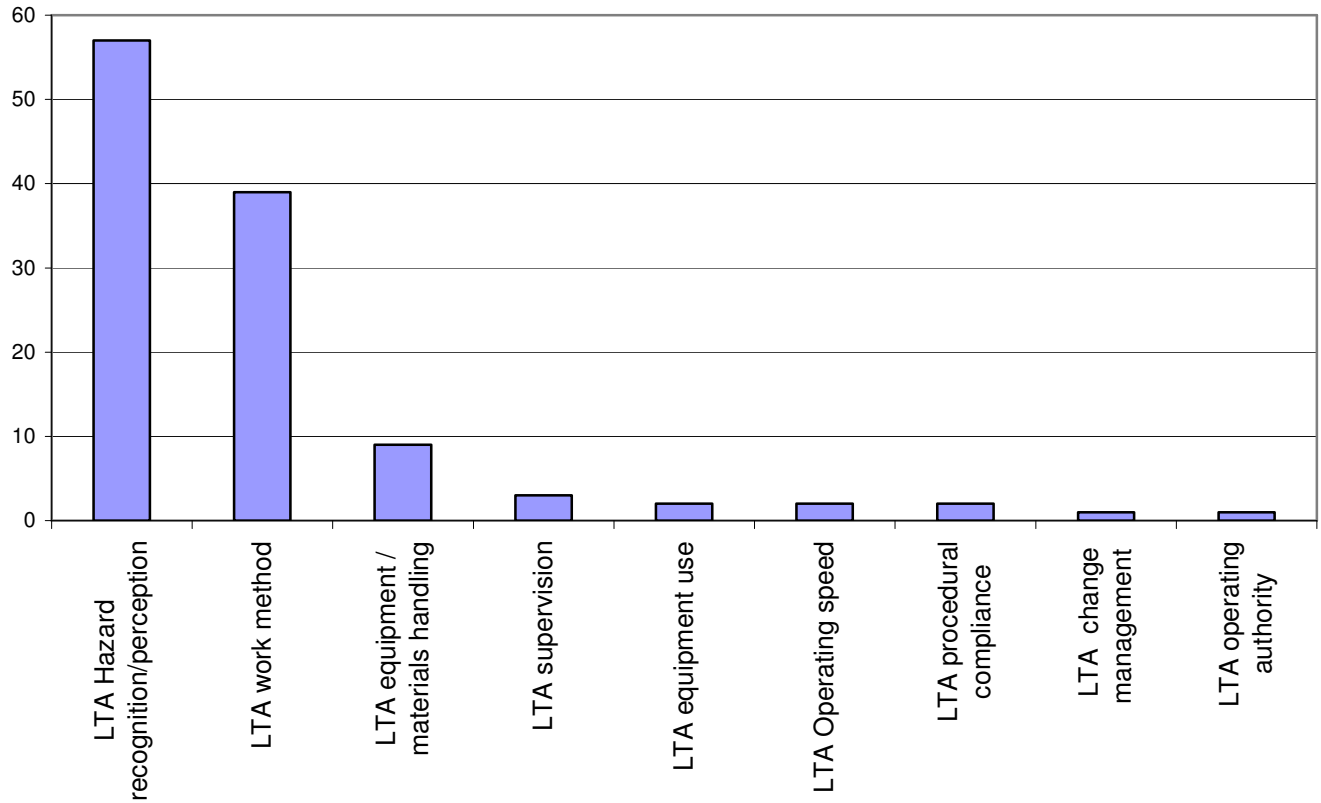
## 5.2. INDIVIDUAL & TEAM ACTIONS

The ICAM code describes these as those errors or violations that led directly to the incident. They are typically associated with personnel such as operators and maintainers having direct contact with equipment or material. They are always committed 'actively' (someone did or didn't do something) and have a direct relation with the incident' [12].

The following areas, as shown in Figure 19 are highlighted by this review:

- The review indicates that the majority of all incidents would have been prevented or outcomes minimized if personnel had a better awareness, skills of recognition and understanding of hazards related to tyre and rim maintenance and use.
- A higher level of awareness would also have assisted in improving maintenance work methods contributing to the incident and accidents covered by this review.

**Figure 19: Individual or Team Actions**

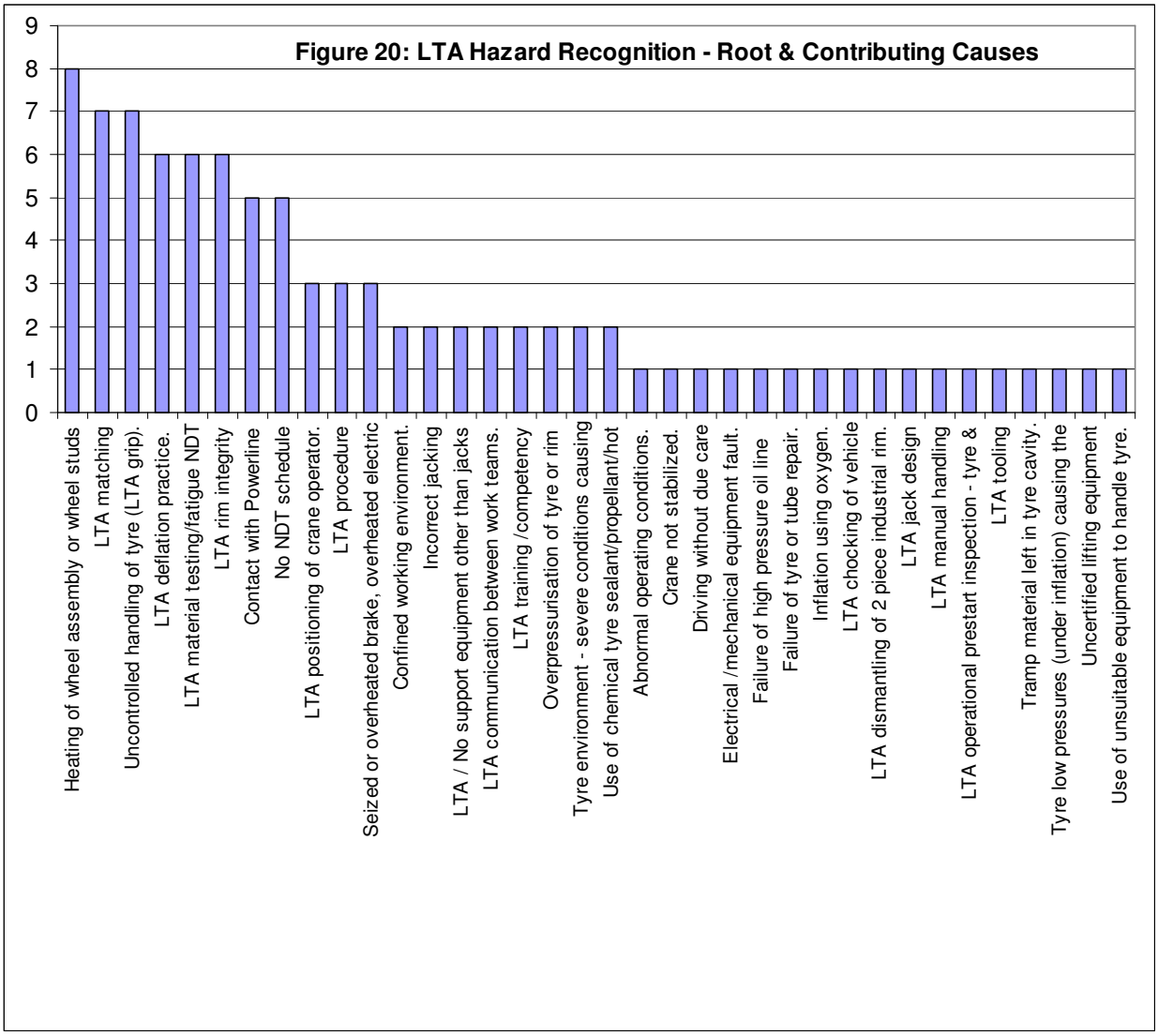


### 5.2.1. HAZARD RECOGNITION

One of the key personnel characteristics, at an individuals or team level that assists to prevent incident and accidents from occurring, is the ability to recognize and understand task hazards well in advance or during task execution allowing corrective steps to be taken that adequately addresses the hazard.

The analysis, as shown in Figure 20 has highlighted a number of scenarios and hazards that must be communicated to all stakeholders.

- Heating of wheel assemblies and their fastening systems, and possible escalation into a pyrolysis and tyre explosion event appears by far to be the least understood hazard.
- Effects of LTA matching of tyres to rims, or LTA matching of rim components needs to be understood by all personnel including supervisions engaged in tyre and rim maintenance.
- Hazards for uncontrolled handling of tyres, and unsafe positioning of operators while manipulating tyres needs to be communicated.
- Tyre assembly demounting hazards, i.e. violent disintegration of rim bases, strict tyre assembly deflation and non destructive rim and wheel testing requirements as mandated by AS4457:1999, enhanced by education covering rim integrity generally must be provided.
- Key maintenance and operational hazards arising from working in restricted (e.g. tyrebay) working environments including electrification from powerlines, use of tyre manipulating equipment, positioning of operators and issues with seized or overheated brakes and overheating wheel motors must be communicated.



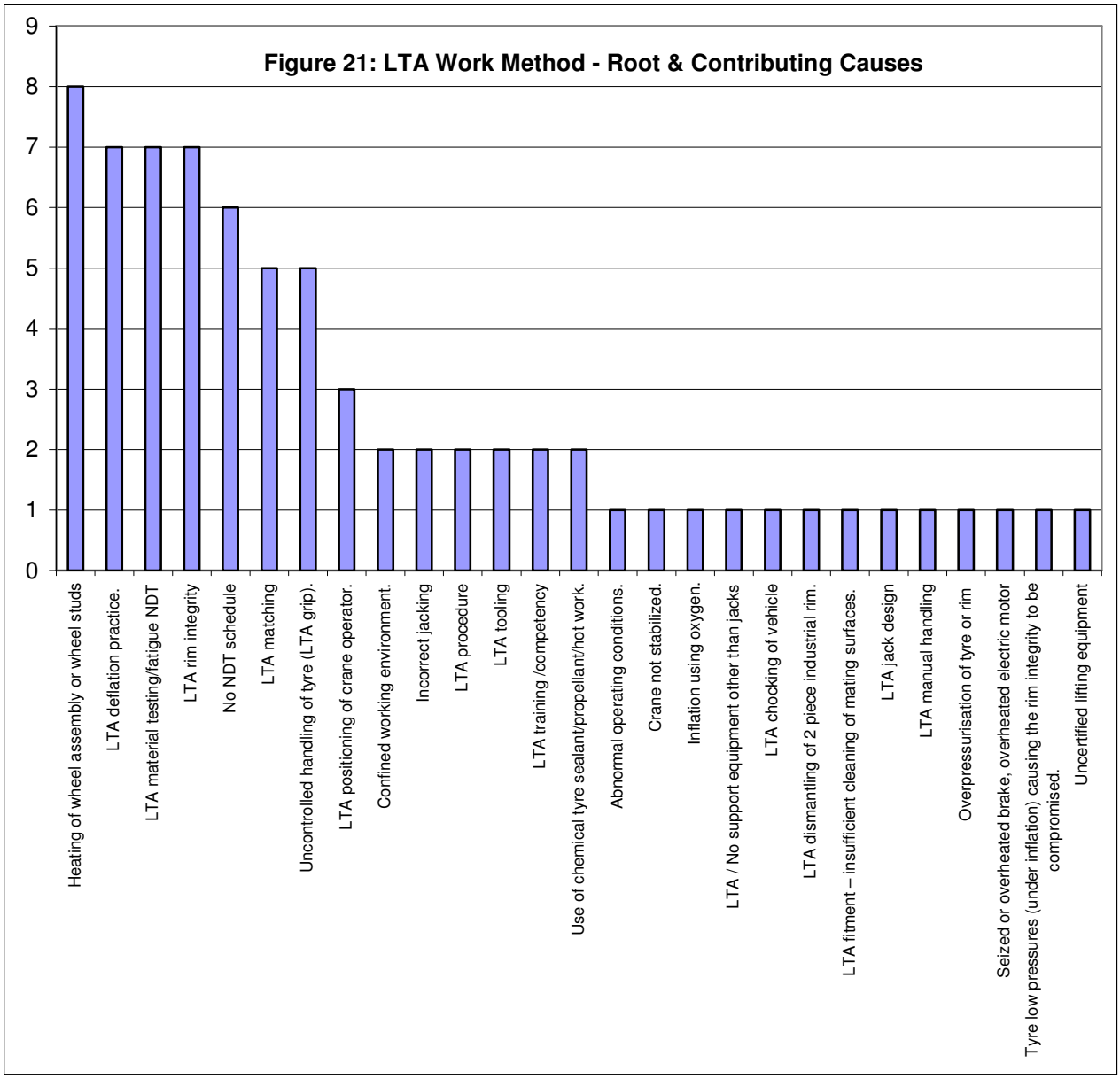

## 5.2.2. WORK METHOD

LTA hazard recognition often translates into LTA work method which will give rise to incident and accidents.

To improve safety, analysis has shown that the following work methods and approaches, as shown in Figure 21, ought to be implemented:

- Heating of wheel assemblies or fastening systems must be eliminated. Instead other methods of loosening corroded wheel fasteners must be researched and implemented.
- Deflation of tyre assemblies prior to removing assemblies off vehicles must be implemented as it is a key root cause for a number of fatalities.

- A dependable non destructive testing (NDT) regime in accordance with relevant standards must be implemented to ensure full integrity of the mines rim asset.
- Training initiatives and reliable work methods must be put in place ensuring tyre service personnel are able to match tyres and rims, and rim assemblies. Assembly of mismatched componentry will give rise to unsafe conditions during assembly, inflation, disassembly, maintenance and operation of the assemblies.
- Tyre maintenance practises should also include a review of tyre handling activities including the correct positioning of personnel to ensure safe handling of tyres, rims and assemblies.
- Those practises also need to incorporate correct jacking and vehicle support practises.



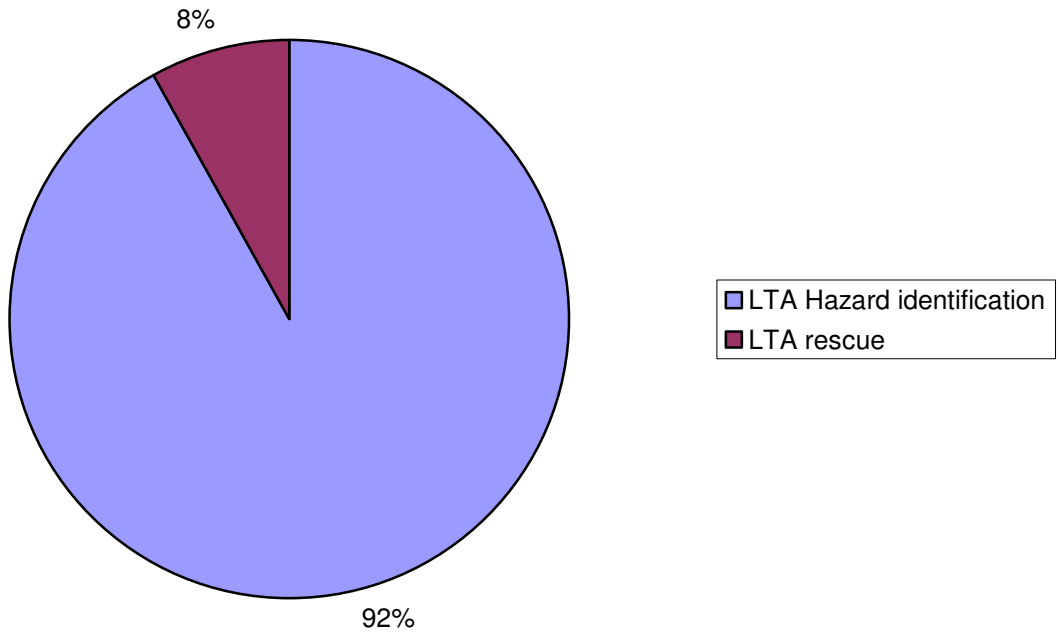

## 5.3. ABSENT FAILED DEFENCES

Absent or failed defences are described as the 'last minute measures which did not prevent the outcome of the incident or mitigate/reduce its consequences' [12].

The ICAM guide lists these as: detection systems, protection systems, warning systems, guards or barriers, recovery, escape, rescue, safety device operation, personal protective equipment, hazard identification and control systems.

This list is not arranged in priority order, and it should be noted that the majority of the measures referenced by the ICAM code could be described as 'engineering' type or 'hard' controls (i.e. detectors, sensors, guards etc.) rather than 'soft controls' such as induction, competency or communication protocols.

**Figure 22- Absent Failed Defences**




As typical earthmover wheel and rim systems are not equipped (yet) with any proven and reliable hardware type measures to flag any unsafe conditions or render the system safe, 'failure to detect and rectify unsafe acts and conditions was largely (95%) attributed to a breakdown in the hazard identification capabilities of the personnel performing the task, as shown in Figure 22. This is consistent with previous comments in this report.

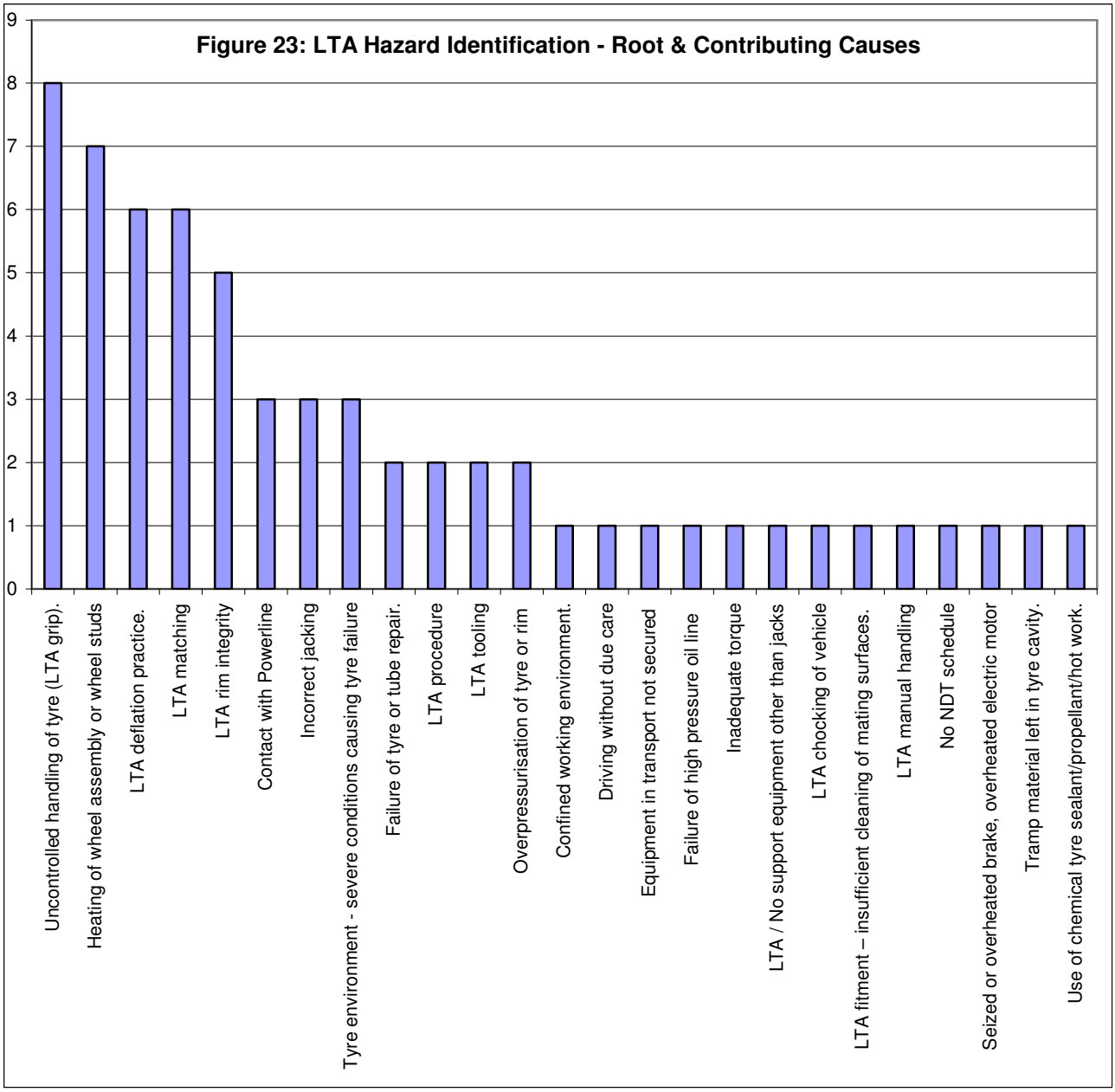
Reliance on personal experience to identify unsafe conditions in the absence of hardware controls present a high degree of vulnerability for the personnel actually involved in tyre and rim maintenance work and reinforces the need for structured, specialised training and refresher training of tyre service and supervisory personnel.

The remaining proportion of 5% was attributed to the inability to safely and effectively attend tyre emergency scenarios in some instances, such as vehicle/tyre fires resulting in severe or complete damage to the mining equipment involved in the incident.
Further comments are provided below for both categories.

### 5.3.1. LTA HAZARD IDENTIFICATION

This incident and accident analysis has flagged a number of scenarios and tasks with a range of hazards that, had they been detected and acted upon, would have eliminated the occurrence of the incident or accident.
As there are no real hardware solutions yet available that would flag unsafe conditions or render the system safe, reliance must be placed on the tyre serviceman's ability to recognize the following hazards identified by this study. Given the trend towards multi-skilling and high labour turnover consideration should be given to instil a general awareness covering the following hazards across the industry to have the largest impact (shown in Figure 23).

- In particular the hazards associated with the uncontrolled handling of tyres using tyre handlers, tyre manipulators incl. forklifts must be well communicated and understood.
- Heating of fastening systems, nuts and bolts, to loosen them appear a common practice in industry; however the hazards associated with heating wheel/rim bases and wheel fastening system of assembled tyre assemblies do not appear to well understood.
- Hazards associated with not deflating fitted tyre assemblies before removal must be understood by all personnel involved in tyre maintenance.
- Matching of tyres and rim assembly components, and general issues of rim integrity do not appear to be understood.
- Precautions and actions dealing with the hazards of working near powerlines, jacking and supporting vehicles during maintenance, operating in severe tyre environment conditions, not following procedures including accidental over-pressurization of tyre/rim assemblies also need to be covered in a education program.
- Hazards based in the failure of tyre and tube repairs must also be covered, particularly so as many companies are forced to consider second hand, repaired and retreaded tyres.




### 5.3.2. LTA RESCUE

Fortunately very few incident and accident cases, all of which were tyre fire cases, were identified where LTA rescue capabilities contributed to the outcome.

Some recommendations are provided:

- Full awareness of hazards and risks associated with tyre fires, e.g. extreme heat, sudden rupture of tyres and violent explosion caused by pyrolysis within the tyre

assembly cavity must be provided to all personnel that may be required to deal with such emergency situations, this should include equipment operators including water cart operators, supervisors, emergency response crews and management.

Photograph 3, while prevention is the best approach to reduce risks, emergency response to situations like this must be adequate and well rehearsed.

- Fire fighting and emergency rescue capability as related to tyre and rim incidents, both in terms of HR as well as equipment must be examined in view of potential scenarios on mining sites.

## 6. APPENDIX 1 – DATABASE STRUCTURE AND TAXONOMY

All data used for this study is tabulated in an Excel spreadsheet for ease of entry, manipulation and analysis including graphing. The database structure and taxonomy is based on both ICAM guidelines as well as other fields enabling better analysis.

1. Each incident and accident case is identified by a unique number, followed by its source or reference, a complete reference listing is provided at the end of the report.
2. A 'brief description and description of the consequences/outcomes' (where available) provides the reader with a snapshot description of the incident and accidents.
3. Where available, identified root causes are provided in a 'long description' (i.e. narrative).
4. Key root and contributing causes are then provided, in 'short form' allowing analysis by key word.
5. Each incident/accident case is identified as no fire (N), 'tyre fire' or 'pyrolysis event'.
6. Potential or stated outcomes to each incident/accident are given next.
7. The four ICAM Categories and Factors - organisational factors, task/environmental conditions, individual/team actions and absent failed defences, each populated using the ICAM provided guidewords for each category are used to provide necessary underlying detail.
8. The last data table column provides preventative, recommended or accepted steps of risk mitigation, and or points of interest. Where available, these are reproduced directly from the incident/accident report recommendations as such permit the reader to obtain first hand help with each issue without having to source the original source report.

# 7. APPENDIX 2 - DATA

| | Source or Reference | Brief Description (escalation of incident), & description of consequences/outcomes | Identified Root Causes – Long Description | Root & Contributing Cause(s) – short description | Actual/ Potential Fire or Pyrolysis Event | Stated or Potential Consequence | Org. Factors | Task or Environmental Conditions | Individual or Team Actions | Absent failed Defences | Preventative /Recommended /Accepted Steps of Risk Mitigation, Points of Interest |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | [8] | An operator was fatally injured when changing a tyre on a rear dump truck while using a radio controlled truck mounted tyre handler. | The operator was using a radio remote control transmitter to control the tyre handler, which was mounted on a service truck used for changing tyres on large earth moving machinery. A replacement tyre was being held in the clamps attached to the tyre handler. The operator became caught between the suspended tyre and the rear of the service truck. | LTA positioning of crane operator. | N | Fatality | | Congestion/restriction/access Fatigue | LTA Hazard recognition/perception | LTA Hazard identification | All mines using similar equipment should immediately review their operations.<br>The review should take into account:<br>• Potential failure modes of radio remote control equipment.<br>• Safe positioning of all personnel while remote controlled equipment is in use<br>• Possible risk factors arising from operator fatigue |

| | Source or Reference | Brief Description (escalation of incident), & description of consequences/outcomes | Identified Root Causes – Long Description | Root & Contributing Cause(s) – short description | Actual/ Potential Fire or Pyrolysis Event | Stated or Potential Consequence | Org. Factors | Task or Environmental Conditions | Individual or Team Actions | Absent failed Defences | Preventative /Recommended /Accepted Steps of Risk Mitigation, Points of Interest |
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| 2. | [9] | In February 2004, one person died and another was injured at a mine in Queensland. | The two were changing wheels on a truck when a split rim became dislodged and caused the tyre to move uncontrollably. It struck one person who sustained a broken jaw. The second person, who was pinned under the tyre assembly, suffered fatal injuries. CIRCUMSTANCES Two contractors were changing wheels on a 170-tonne truck around midnight when the split ring on the inner rear wheel became dislodged and caused the tyre to move uncontrollably, projecting the tyre | LTA deflation practice. | N | Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA Hazard identification | RECOMMENDATIONS<br>Numerous tyre burst/explosion incidents have occurred at NSW Mines and elsewhere. The following is a summary of the recommendations from these incidents:<br>• Conduct a risk assessment to identify and control all hazards associated with wheel rims and tyres.<br>• Major hazards should include at least:-<br>(a) Tyre and rim components violently bursting from the wheel.<br>(b) Tyre exploding violently.<br>• Risk Controls to prevent violent bursting of components should include at least:<br>Compliance with Australian Standard - AS4457 Earth-moving machinery–Off-highway rims and wheels–<br>Maintenance and repairs. This specifically includes the following before removal of the wheel assembly:<br>(a) Visual examination to ensure no immediate threat is posed by the wheel assembly.<br>(b) Deflation to a maximum pressure of 35Kpa (5psi). For dual wheels, both tyres are to be deflated before any wheel nuts are loosened. For demountable rims it is recommended that the tyre be fully deflated.<br>(c) Use of competent persons.<br>(d) Development and use of documented safe operating procedures.<br>Report No: SA 04 01<br>Date: 23/02/04<br>Prepared by: R Regan 02 9901 8591<br>For further information contact:-<br>W J Koppe 02 4275 9306 Mobile: 0417 241 466 or M Willoughby 02 6572 1899<br>Queensland Fatality During Wheel Removal /2 This standard also covers demounting, inspection, repair and mounting procedures and compliance with the written procedures of both the tyre and rim manufacturers.<br>Risk controls should also cover the Fatalities and serious injuries that have occurred due to violent bursting of both small and larger tyres and the resultant movement of the tyre assembly<br>components. This includes catering for or controlling:<br>(a) Corrosion, wear, metal fatigue, impact damage, over inflation, under inflation and incorrect assembly which can result in dislodgment of the locking ring from split rim assemblies whilst the tyre is being inflated, hit, transported, removed, replaced or in service. These issues can also result in |

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| 3. | [1] | INCIDENT: A tyre and new rim were assembled incorrectly and inflated. Approximately two hours later the assembly blew apart, one of the components landing eighty metres away and another hitting the building supports ricocheting around the unoccupied tyre bay. | CAUSE: A new multi piece rim and tyre were assembled but the locking ring was installed the wrong way around. The tyre was inflated to 35 kPa and the assembly checked. It was placed in a safety cage and inflated to 400 kPa in four stages , checking the assembly at each step. The tyre was then removed from the cage, approximately half an hour later, rolled to the storage area with other inflated tyres in the tyre bay. Over two hours later the assembly burst. It was evident from marks on the lock ring that it had been fitted incorrectly. | LTA matching of assembly components | N | Potential Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA Hazard identification | COMMENTS & RECOMMENDATIONS:<br>All components were new and free from defect.<br>The lock ring had no markings of identification, size or fitting instruction.<br>The tyre fitter had recently received instruction in tyre assembly from an international tyre company.<br>Most lock rings fail safely as they cannot be retained in the lock ring groove 'the wrong way around' or they 'peel out' at very low pressures.<br>A new type of lock ring bearing the warning 'Do not inflate wrong way around' has been located.<br>Safety Alert Number 78 was issued in May 1995 and recounted a very similar story. If we do not learn from mistakes we are doomed to repeat them. |
| | | | | | | | LTA awareness, competence and behaviour. | LTA competence/experience/skill for the task | LTA work method | | |
| 4. | anon | Australia 2003, CAT 785, anecdotal - Pos 1 caught on fire causing truck to be gutted. | Continuous high speed and excessive payload – TKPH exceedance resulting in initial tyre fire then spreading to truck. | High Speed | Tyre Fire | Loss of vehicle | LTA Crisis & Emergency Mgt | Abnormal. Op. situation/condition | LTA Operating speed | LTA rescue | na |
| | | | | TKPH & payload exceedance | | | | | | | |
| | | | | TKPH & payload exceedance | | | | | | | |

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| 5. | [13] | Australia. Rear Hub Failure and subsequent fire. Cat 789 rear dump truck. The rear hub of a dual set of wheels on a rear dump truck cracked around the circumference and parted. The inner wheel ruptured the oil brake cooling line; the leaking oil pumped onto a hot surface and ignited, the resulting fire spread under the truck. After 48 hours the vehicle was approached and the smoldering tyres extinguished; the truck was completely gutted. | Metal fatigue causing fire – it appears the hubs failed under tensile load, initiated from a fatigue crack. | Material fatigue | Eq. Fire | Loss of vehicle | LTA design, construction, commissioning | LTA equipment integrity | N/A | LTA rescue | 1. Hastings Deering will be issuing an information bulletin for the use and maintenance of hubs in questions, the following may be included: |
| | | | LTA material testing/fatigue NDT | | | | LTA Crisis & Emergency Mgt | | | | 2. Replace rear hubs before reaching 60,000 hours |
| | | | Metal fatigue of hub rupture of oil brake cooling line triggering fire. | | | | LTA maintenance | Pressure | | | 3. Visually inspect hubs each time a wheel is replaced<br>4. Periodically inspect the early series hubs for signs of cracking, possibly 12 monthly or more frequently if the vehicle is used in arduous conditions.<br>5. Continue with good management practices.<br>6. Review the mine fire management procedure for rubber-tyred vehicles, specifically isolation of burning tyres and removal of all persons from a possible blast zone. |
| 6. | [14] | 'Firefighter's inquest urges safety upgrade', Brisbane Australia. A fire-fighter was killed after he was hit by a tyre and retaining | There was evidence of a workshop mechanic, who said there was a significant problem with the forklift brakes seizing, which he had not been able to properly repair | Seized or overheated brake, overheated electric motor | Pyrolysis | Fatality | LTA maintenance | LTA equipment integrity | LTA Hazard recognition/perception | LTA Hazard identification | 1. "Tyres fitted under high pressure should have added safety features, and that automatic fire suppression systems or insulation be considered for hydraulic machines" (comments by coroner). |

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| | | | | | | | LTA Crisis & Emergency Mgt | | | LTA Rescue | 2. Encouraging authorities to reinforce warnings and develop a state-wide hazard alert about the dangers of incidents involving split-rim wheel assemblies. |
| | | | | | | | | Temperature | | | 3. Also recommended that shipping containers be marked to identify their containers in the event of a fire. |
| | | | | | | | | Pressure | | | |
| 7. | [15] | USA, Vehicle Fire Caterpillar 637 Scraper, Jan 2003 one unit parked amongst 35 others found on fire , professional fire fighters where called in to fight combat fire. Pos 2 exploded, airblast leveling fire fighting crew injuring 4 personnel, tyre propelled ~30' (~10 m). Then Pos 1 or 3 (drive wheel) exploded propelled 75' (~22m). A fender was found 150' (~ 45m) away from blast site. | Possibly electrical or mechanical equipment fault, no incendiary substance involved, fuel tank found intact. | Electrical /mechanical equipment fault. | Eq. Fire | Injury | LTA maintenance | LTA equipment integrity | LTA Hazard recognition/perception | LTA Hazard identification | |
| | | Significant fire damage to unit. Injury to fire crew. | | | | Potential Fatality | LTA Crisis & Emergency Mgt | | | LTA rescue | |
| | | Potential fatality | | | | | | Temperature | | | |
| | | | | | | | | Pressure | | | |

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| 8. | [16] | Skid Steer Loader, fatality, welder attempting to weld repair leaks in loader rim. Prior to welding the person had unsuccessfully used multiple 12 ounce cans of flammable tire sealant/inflator. | Application of external heat to tyre and rim assembly. Considerable quantity of Presence of flammable tyre sealant | Use of chemical tyre sealant/propellant/hot work. | Pyrolysis | Fatality | LTA maintenance | Chemical | LTA work method | LTA Hazard identification | Never perform any hot work activities on rim/wheel assembly. |
| | | While welding, the pressurized tyre was blown off the wheel propelling the victim 15' (~4.5m) into the air and 24' (7.2m) away from the loader. | | Heating of wheel assembly or wheel studs | | | | Temperature | LTA Hazard recognition/perception | | Only use of non-flammable tire sealant/inflator for field repair or leaking rim wheels. |
| | | | | | | | | Pressure | | | |
| 9. | [17] | Australia, Contact with power line: On road haulage truck tray was raised and made positive contact with 11kV overhead power lines, Nov 1999. Tray was lowered. Burn marks in power lines, tray, covering tarpaulin and tyres. | Accidental contact with overhead power line | Contact with Powerline | Pyrolysis | Potential Fatality | LTA design, construction, commissioning | Congestion/restriction/access | LTA equipment / materials handling | LTA Hazard identification | 1. Exclusion of any loading/unloading or maintenance operations under power lines |

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| | | Protection device in power system tripped power. The report does not provide any information on actual consequences. It is assumed that the tires were replaced. Highlights danger of exploding tyres after contact has been made, either immediate or delayed. | | | | | LTA Crisis & Emergency Mgt | | LTA Hazard recognition/perception | | 2. Safe clearance distances recommended in accordance with Australian Standards |
| | | In this instant, no injury or damage was reported. | | | | | LTA operations | Temperature | | | 3. Traffic rules and travel routes. |
| | | Potential fatality. | | | | | | | | | 4. Training of operators and drivers, and management of contractors |
| | | | | | | | | Pressure | | | 5. Adequate Signage of sites and reminder signage in vehicle cabins. |
| | | | | | | | | | | | 6. Isolation of equipment for up to 24 hrs after event. |

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| 10. | [18] | 1. USA, anecdotal, CAT??7 truck – striking 138kV overhead powerline. Driver heard the electrical arcing and stopped a short distance away and alighted from truck. Operator checked the trucks tyres and as he was walking some 15 m away from the vehicle one tyre exploded All other tyres exploded at 20 second intervals. Explosions caused front spindle of truck being torn out. | Pyrolysis of Tyres after contact with high voltage line | Contact with Powerline | Pyrolysis | Potential Fatality | LTA design, construction, commissioning | Congestion/restriction/access | LTA equipment / materials handling | LTA Hazard identification | |
| | | Potential fatality | | | | | LTA Crisis & Emergency Mgt | | LTA Hazard recognition/perception | | |
| | | | | | | | LTA operations | Temperature | | | |
| | | | | | | | | Pressure | | | |
| 11. | [19] | Australia, Fatal injuries to tyre service person – split rim tyre assembly 'exploded' while fitting tyre assembly to mobile crane. | Possible overinflation of tyre/rim a assembly | Overpressurisation of tyre or rim | N | Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA Hazard identification | 1. Careful inspection of all rim components prior to assembly, particularly to wear in the rim assembly studs and nuts. |

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| | | The tyre had been inflated to 150 kPa (22psi), water ballast was to be added at this point but was not. It is likely that the tyre was inflated above its previous pressure. | | | | | | | | | 2. Rim assembly nuts should be tightened to the correct torque specification. |
| | | The outer section of the cast iron split rim ruptured allowing a sudden release of stored energy | | | | | | | | | 3. Prior to inflating a tyre, a restraining device should be fitted. |
| | | Wheel components were projected some 13 meters in the blast. | | | | | | | | | 4. Persons inflating the tyre should mot sand in front of the tyre, but in a safe position. |
| | | | | | | | | | | | 5. Inflation devices to incorporate hand piece with a pressure gauge, flow control mechanism and sufficient hose to distance operator from inflation chuck. |
| | | | | | | | | | | | 6. Assembly/disassembly of split rim components should be carried out with care and 'shock loading' of vulnerable parts of the assembly should be avoided (e.g. due to striking with heavy hammers) |
| | | | | | | | | | | | 7. Periodically components should be checked for cracks. |
| | | | | | | | | | | | |
| 12. | [20] | Australia, Tyre Blowout Oct 1997, rear tyre of 200 ton dump truck blew out when traveling over sharp rock on put floor propelling a 20kg rock approx 160m horizontally. Rock struck parked light vehicle causing minor damage. | LTA pit floor maintenance | Tyre environment - severe conditions causing tyre failure | N | Potential Fatality | LTA operations | LTA surface gradients/conditions | LTA equipment use | LTA Hazard identification | 1. Sheeting of pit floors with suitable materials |
| | | | | | | | | | | | 2. Reinforce dangers to employees re compressed air (workshop, pneumatic tires) |
| | | | | | | | | | | | 3. Keep areas pedestrian free where rubber tired vehicles travel over sharp protruding rocks. |

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| 13. | [18] | 2. Australia, anecdotal, mechanic loosening frozen wheel nuts with heat gun. Heat conducted through wheels rim base into adjacent area of bead. Pyrolysis is stated to commence at 250º C. Continued heating raises internal temperature of air chamber to auto ignition temperature of Pyrolysis gases of approx. 430ºC. Report claims that internal temperature of at least 700ºC are needed before heat expansion of the internal air would cause the upper pressure tolerance of the tyre to be exceeded. | Application of external heat to rim components causing Pyrolysis and subsequent explosion. | Heating of wheel assembly or wheel studs | Pyrolysis | Potential Fatality | LTA maintenance | Temperature | LTA work method | LTA Hazard identification | |
| | | Potential fatality. | | | | | | Pressure | LTA Hazard recognition/perception | | |

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| 14. | [18] | USA, Road truck, anecdotal, – overheated brake causing tyre/rim explosion of one tyre. | Overheating of brake | Seized or overheated brake, overheated electric motor | Pyrolysis | Potential Fatality | LTA maintenance | Temperature | LTA work method | LTA Hazard identification | |
| | | Adjacent tyre caught fire also, but did not explode (liner found partially pyrolyzed). | | | | | | | LTA Hazard recognition/perception | | |
| | | Witnesses reported a fire ball of flammable gases, flange was blown off rim and scattered. | | | | | | Pressure | | | |

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| 15. | [13] | This document describes several incidents and accidents and provides a good overall reference to the subject. | 1. Welding cracks on wheel rims, heating of wheel studs with a allied flame, heating of brakes to free up linkage (applied flame) heat build up due to faulty (binding) brakes or failed bearings, Fires in wheel motors, discharge of electrical energy through the tyre and rim (contact with overhead powerlines), burning tyres off rims, external fires from agencies such as ruptured hydraulic lines or other ob vehicle fires. | | N | N/A | | | | | **1. Operating Practice** |
| | | | 2. Tyre fatigue, cuts and casing separations causing localized heating of tyre casing in operation | | | | | | | | Correct matching of tyre specification to duty |

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| | | | 3. LTA operating conditions causing heating and tyre fatigue incl. under inflation/overloading, high speed and continuous operation, at high ambient temperatures. | | | | | | | | Correct inflation |
| | | | 4. Absorbed fuels and solvents increase risk if source of ignition present. | | | | | | | | Control of vehicle speed and load, particularly at high ambient temperatures. Correct matching of dual tyres. |
| | | | | | | | | | | | Immediate replacement of punctured tyres |
| | | | | | | | | | | | Attention to maintenance of brakes and wheel motor systems. |
| | | | | | | | | | | | Scrupulous care in tyre changing and maintenance, clean out carefully when fitting (foreign materials left inside tyre cavity) |
| | | | | | | | | | | | **2. Engineering Approach** |
| | | | | | | | | | | | Use of fire resistant hydraulic fluids |
| | | | | | | | | | | | On board temperature sensors |
| | | | | | | | | | | | On board extinguishing systems |
| | | | | | | | | | | | Overhead Powerlines |
| | | | | | | | | | | | Keep O/H powerlines away from truck tip and operating areas. |
| | | | | | | | | | | | Provide clear warning of overhead powerlines |
| | | | | | | | | | | | Examine the interlocking of truck tray position with vehicle travel function. |

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| | | | | | | | | | | | Consider **Nitrogen inflation** |
| | | | | | | | | | | | **3. Awareness of the risks** |
| | | | | | | | | | | | **Emergency procedures** – quarantine periods 24 hours – particularly where contact with powerlines had been made. Controlled Radius of exclusion > 400m. |
| 16. | [21] | Australia, Haul truck tyre explosion. A raised truck tray severed a 33kV overhead power line, the driver then proceeded to park next to the mine crib room. | Accidental contact with high voltage line | Contact with Powerline | Pyrolysis | Equipment Damage | LTA design, construction, commissioning | Congestion/restriction/access | LTA Hazard recognition/perception | LTA Hazard identification | Remain clear of all fallen power lines. Isolate supply and alert fire crew. |
| | | | | | | | LTA Crisis & Emergency Mgt | | | | The driver of any vehicle in contact with a power line should remain in the vehicle and summon assistance. If assistance is unavailable, driver should attempt to free vehicle by driving away. |
| | | Minutes later a tyre exploded causing damage. | | | | Potential Fatality | LTA operations | Temperature | | | Vehicle should be driven into a clear area where it can be left and driver evacuated. |
| | | Potential fatality. | | | | | | | | | Driver rescue may be effected using a similar vehicle which should approach from the front to allow the driver to step across. |
| | | | | | | | | Pressure | | | Vehicle should not be approached within 300 m and 24 hrs Deflation of tyres should not be attempted. |
| | | | | | | | | | | | Following 24 hours stand down period, all tyres require internal inspection. |
| | | | | | | | | | | | Avoid erection of powerlines in mobile equipment operating areas. |
| | | | | | | | | | | | Ensure clearance and height indicators requirements as required by AS3000.7.5. |

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| | | | | | | | | | | | Install tray raised alarms and or interlocks which restrict vehicle movement if a tray is not fully lowered |
| | | | | | | | | | | | Tyres correctly filled with Nitrogen will minimize risk of explosion. Strict controls and standards are essential for this to be effective. |
| | | | | | | | | | | | Mobile equipment personnel need to be aware of the hazards associated with powerline contacts and their duties and responsibilities should such occur. |
| 17. | [22] | Australia, Tyre explosion 26.5R25 steel cord radial tyre - Jan 1981 – 'frozen' wheel nuts on a 'Wigtruck', fitter applied oxy torch to heat and loosen the 12 nuts to enable removal of wheel. Two wheel nuts were removed without heat, the tyre burst when heat was applied to the fourth nut. It is believed that this occurred approx 10 minutes after heat was first applied to the rim. | Pyrolysis of the tyre due to application of heat to rim base, subsequent ignition by continued application of heat. Manufacturer advised that 'simple heating' would require internal temperature to reach 700º C to reach burst pressure. Auto ignition temperature of bead lubricant used was discounted (~1000ºC) | Heating of wheel assembly or wheel studs | Pyrolysis | Potential Fatality | LTA maintenance | Temperature | LTA work method | LTA Hazard identification | Check Auto ignition temperature of any bead lubricants used. |
| | | Potential fatality. | | | | | | | | | Proceed with caution when heat is applied to any rim/tyre assembly (the author believes this is a dangerous recommendation and one tat should not be followed!) |
| | | | | | | | | Pressure | LTA Hazard recognition/perception | | Un-inflated tyres are believed to behave similarly to fully inflated tyres. |
| | | | | | | | | | | | It is not believed that filling the tyre with water will prevent the explosion hazard. |

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| 18. | [23] | Australia, 37.25R35 Steel radial on CAT633 Scraper – Jan 1987. Scraper was being refueled. Fuel tank positioned above engine. Defective cutout on the fuel gun caused fuel to spill over the engine/turbo causing fire. Initial attempts to extinguish the fire failed, fire brigade (~10 mins later) was able to extinguish fire emanating from engine bay/fuel tank.\ however failed to extinguish the inner walls of the front tyres. Despite ongoing effort, front RHS tyre then ruptured injuring a fireman. Left hand tyre ruptured next injuring a second bystander. Rubber fragments found up to 30 m from the scraper. | 1. Faulty fuel gun cut out mechanism | Spillage of fuel onto hot engine. | Tyre Fire | Injury | LTA design, construction, commissioning | Temperature | N/A | LTA rescue | Investigation suggested that tyre ruptures were caused not by Pyrolysis but by the tyre casings merely rupturing after being weakened by the fire burning on the lower part of the inner sidewalls. Thus although not chemical explosions, the force of the blasts was still sufficient to injure personnel. |
| | | | 2. LTA adequate design – location of tank/filling point above engine area. | | | Potential Fatality | LTA maintenance | | | | |
| | | | 3. On vehicle fire fighting equipment found to be faulty. | | | | LTA Crisis & Emergency Mgt | | | | |

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| 19. | [24] | Australia, 33.00R51 steel radial, Komatsu HD1200M rear dump truck – Nov 1986, truck tipping load under a 33kV powerline and contact was made. Truck earthed via left front tyre. Operator was unaware of the incident and continued to travel ~2 km back to loading area. On application of the truck brakes, the tyre exploded tearing off access ladder and air cleaner assembly, throwing these items 175 to 200 meters. Considerable damage to truck cabin, but no injuries to operator. The only other radial tyre was removed and inspected and later fitted to a back position of the truck. | Tipping in the vicinity of powerlines | Contact with Powerline | Pyrolysis | Potential Fatality | LTA design, construction, commissioning | Congestion/restriction/access<br>Temperature<br>Pressure | LTA Hazard recognition/perception | LTA Hazard identification | Tyre was observed to have ruptured circumferentially just below both shoulders at a point diametrically opposite an area in the crown of the tyres liner where combustion of some type had clearly taken place (liner tacky). Inspection revealed a clear zone of charring (in the crown of the tyre) with 2 rupture areas diametrically opposite. Apart from ruptured areas, tyre was found undamaged externally. |

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| 20. | [25] | Australia, Mt. Newman, Wabco 3200 190 t diesel electric truck – tyre size not provided. | 1. Diesel electric truck wheel fires (overspeed, armature bearing collapse, flashover, break associated problems – see below) causing tyre fires | Seized or overheated brake, overheated electric motor | Tyre Fire | Potential Fatality | LTA Crisis & Emergency Mgt | N/A | N/A | N/A | 1. In a mixed fleet, ensure pedal positions and actions are uniform across all vehicles. |
| | | | 2. LTA design of brake pedal position and education causing excessive service brake application resulting n overheating of brake assembly. | | | | | | | | 2. Operator training in correct braking procedures, particularly for big trucks. |
| | | June 1987 wheel fire culminating in tyre explosion – no information is provided on fire type or escalation in any detail | 3. Plastic wheel motor covers melting onto brake disc. | | | | | | | | 3. Flammable cowlings/covers/guards to be replaced with non-flammable materials. |
| | | | 4. Ruptured brake oil line | | | | | | | | 4. Design, selection and positioning of pressurized fluid lines to minimize rupture.<br>5. Where possible, substitute flammable with non-flammable or fire resistant service liquids.<br>6. Recommended minimum safe distance – at least 300 m.<br>7. Tyre explosions may occur even where no fire is visible – smoking tyres or brakes must be treated as potential tyre fire requiring isolation of vehicle.<br>8. Releasing air from a tyre does not eliminate the risk of a tyre explosion as explosion pressure exceeds the tyre burst pressure.<br>9. Tyre explosions can occur well after the source of heat has been removed. |

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| 21. | [26] | Australia/New Guinea, Diesel Electric trucks 46 Euclid R170, 36.00*51 tyres. | Unbalanced tyre loading generating heat buildup. | | Tyre Fire | N/A | N/A | N/A | N/A | N/A | 1. Yates believes that development of radial tires resulted in a lower incidence of tyre fires. |
| | | | Wheel motor fire | | | | | | | | 2. He also mentions the mine dispatch system which allows monitoring/adjustment of TKPH performance. |
| | | Yates reports that there have been a 'significant number of violent rupture of tyre assemblies … but it appears that only one was considered to be the result of a gaseous explosion'. | | | | | | | | | 3. Replace fiberglass motor guard with aluminum guards – it is believed these metal guards also aid n the dissipation of heat. |
| | | | Flammable fiberglass motor guard | | | | | | | | 4. Fitment of temperature sensors adjacent to rear disc and connected to cab brake warning system (this simple system is believed to be responsible for a decrease in brake related fires as well as mechanical faults. |
| | | | | | | | | | | | 5. Yates also cautions against the belief that Nitrogen inflation will eliminate the danger inherent in damaged, overheated tyres, but adds that $N_2$ inflation would substantially reduce the likelihood of a chemical explosion. |

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| | | | Burning/welding on rim components. | | | | | | | | 6. Yates stresses the fact that fighting tyre fires is difficult, particularly in combination with an onboard fuel fire. He recommends both onboard extinguishing systems (to reduce the time that the fire is allowed to grow) as well as large volume water trucks with remotely adjustable cannons He also recommends connections points around the water truck to allow safe recharge of the water tank. away from the hazard zone. |
| 22. | [27] | Australia, Tyre explosion and subsequent fire - 36.00*51 bias ply , Terex 33-15B rear dump truck, | Tyre fatigue – small cuts and casing separations are thought to have been present – considered to have caused localized heating of the casing in operation, with elevated temperatures from this thought to have persisted after vehicle stopped causing the explosion. | Tyre fatigue | Tyre Fire | Potential Fatality | LTA operations | Abnormal. Op. situation/condition | LTA Operating speed | N/A | 1. Combustible materials: Mass of tyre lubricant required to cause an explosive mixture within the tyre was discounted as possible cause. |
| | | Truck had been parked up for 3.25 hours after working for part of the shift when left rear inner tyre exploded without warning (Pos 4?). Rubber fragments found 200 m from truck position. | | | | | | | | | 2. Incorrect lubricant – discounted. Accidental inflation with LPG – discounted. |
| | | Initial inspection revealed that there was no visible fire, but within 10 minutes it was well ablaze. Efforts to extinguish the tyre proved impossible leading to the loss of the truck. | | Elevated operating temperatures | | | LTA Inspection | Temperature | | | 3. Pyrolysis of liner evolving explosive gases. Tests on running tyres showed that some gas is produced but well short of required volume. |
| | | Tyre had achieved 10,000hrs, tyre TKPH on that shift was only 40% of the tyres rating, ambient temperature was 39ºC. | | | | | | | | | 4. Tools/tramp materials left inside tyre – discounted. |
| | | | | | | | | | | | 5. Carbon Dust given off from Pyrolysis of tyre inner – auto ignition temperature 200ºC. |

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| | | | | | | | | | | | 6. Ignition Sources: Truck reported to be consistently slow traveling uphill – but dragging brakes or collapsed bearings were discounted. |
| | | | | | | | | | | | 7. Sabotage – discounted. |
| | | | | | | | | | | | 8. High voltage contact (powerline/electrical storm) – discounted as no evidence was found. |
| | | | | | | | | | | | 9. Tyre fatigue – small cuts and casing separations are thought to have been present – considered to have caused localized heating of the casing in operation, with elevated temperatures from this thought to have persisted after vehicle stopped causing the explosion. |
| 23. | [28] | 190 t truck diesel electrical truck, Mt Newman, wheel fire causing tyre explosion and subsequent fire. Adjacent tyre caught fire (without exploding) – inner liner was found partially pyrolyzed | Wheel fire causing Pyrolysis of at least one tyre. | Seized or overheated brake, overheated electric motor | Pyrolysis | Potential Fatality | LTA operations | Temperature | LTA Hazard recognition/perception | LTA rescue | |
| | | Potential fatality | | | | | LTA maintenance | Pressure | | | |

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| 24. | anon | Blocks of wood (?) left inside tyre during fitment of tyre. This combustible material eventually reached auto ignition temperature causing explosion of wheel assembly | Combustible material left inside tyre during fitment. | Tramp material left in tyre cavity. | Pyrolysis | Potential Fatality | LTA maintenance | Temperature | LTA Hazard recognition/perception | LTA Hazard identification | Clean and inspect tyre cavity prior to assembly. |
| | | | | | | | | Pressure | | | |
| 25. | [5] | 39 year old technician killed while using a **truck mounted tyre handling crane** to place 2 tyres in an upright position against front of a 50 ton haul truck. Whilst handling the 2nd tyre it slipped from the gripping pads pinning him against the vehicle. | Tyre slipped from gripping pads. | Uncontrolled handling of tyre (LTA grip). | N | Fatality | LTA design, construction, commissioning | LTA task planning/preparation | LTA equipment / materials handling | LTA hazard identification | Discuss work procedures and identify hazards associated with task being performed, |
| | | | | | | | | | LTA equipment use | | Implement measures to ensure people are properly protected. |
| | | | Hydraulic controls may have been reversed. | Incorrect installation of cranage controls. | | | LTA maintenance | | | | Never work under or near suspended loads. |
| | | | | | | | | | | | Fasten the load securely to the hoisting attachment. |
| | | | Cranage equipment was tested to be in good working order other than the reversed controls. | Confined working environment. | | | | | | | Do not lower the clamping force to reorientate a tyre held in the gripping pads when a tyre is suspended. |
| | | | | | | | | | | | Carry out prejob hazard analysis. |

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| | | | | | | | | | | | Provide training in the safe installation of tyres |
| 26. | [29] | While attempting to plug a tyre, three men were seriously injured when the tyre exploded. Reportedly, the left rear tyre had been partially inflated with a can of 'fix a flat' and topped off with oxygen from the cutting torch tanks mounted on the truck. When it was noticed that the tyre was still leaking, one man reamed hole in preparation for inserting a plug. When the tool was removed the tyre exploded. The men were thrown approx 3 meters from the vehicle, resulting in serious injury to all of them. | 'Fix a Flat' product may have contained flammable propellants. | Use of chemical tyre sealant/propellant/hot work. | Apparent Explosion of flammable propellant inside tyre | Injury | LTA maintenance | Chemical | LTA work method | LTA hazard identification | Never use Oxygen to fill tyres |
| | | | | Inflation using oxygen. | | Potential Fatality | | Pressure | LTA Hazard recognition/perception | | Never use tyre sealing products containing flammable compounds. |
| 27. | [30] | Tyre repairman was fatally crushed when attempting to install a 45/65/45 tyre on a CAT FEL. | Insufficient grip on tyre clamping pads, positioning of body under the suspended tyre. | LTA positioning of crane operator. | N | Fatality | LTA maintenance | LTA lighting | LTA work method | LTA hazard identification | No recommendations provided. |

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| | | He was using a **truck mounted crane.** | | | | | | | | | |
| | | Cranage equipment was tested to be in good working order (truck, crane, hydraulic system, tyre gripping pads). | | | | | | Complacency/ motivation/attitude | | | |
| | | Ground level and mostly dry. | | | | | | | | | |
| | | Work may have been conducted after sunset or conditions of low light. | | | | | | | | | |
| 28. | [31] | During the underground installation of a previously assembled wheel and tyre of a Joy 10SC shuttle car, the lock ring and flange separated from the wheel and struck the victim who died some days later from his injuries. | Cumulative effect of deficiencies: | LTA matching of assembly components. | N | Fatality | LTA awareness, competence and behaviour. | LTA condition of equipment | N/A | LTA hazard identification | Use of solid fill (foam filled tyres) to eliminate the pressure hazard. |
| | | | Rim components (flange) not properly matched - incorrect flange was installed, insufficient training of tyre servicing personnel. | LTA matching of assembly components. | | | | | | | Check all rim components for compatibility prior to assembly. |
| | | | Lock ring possibly installed backwards. | LTA material testing/fatigue NDT | | | LTA maintenance | | | | Do not interchange rim components unless safe to do so as per applicable rim manuals. |
| | | | Lock ring may have been distorted prior to installation. | LTA training /competency | | | | | | | Inspect rim components for dirt, surface rust, corrosion and pitting before mounting. |
| | | | Corrosion and dirt buildup in rim base gutter. | LTA procedure | | | | | | | The tyre side of the lock ring should be marked by some distinctive means so that immediate identification of proper location of the lock ring is achieved. |

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| | | | Third party not following tyre fitment procedures. | Fitted assemblies received but not checked for integrity. | | | | | | | Clean all rust and dirt from mating surfaces before assembly.<br>Do not mix components from different manufacturers or models.<br>Never beat on a pressurized multi piece wheel/tyre assembly.<br>Provide comprehensive tyre and rim safety training to maintenance personnel who service tyres and rims.<br>Never attempt to use broken, work or unserviceable parts. |
| 29. | [32] | A tyre serviceman was fatally injured when he was struck by a 1650 pound tyre which fell from a hydraulic lift arm while being loaded onto the back of his service truck. He was using a truck mounted crane. Cranage equipment was tested to be in good working order. No issues with remote control identified. | Failure to adequately grip the tyre, one gripping pad had only 30 to 40 % contact with the tyre tread. | Uncontrolled handling of tyre (LTA grip). | N | Fatality | LTA maintenance | Complacency/ motivation/attitude | LTA work method | LTA hazard identification | No recommendations provided |
| | | | Positioning of the body under a suspended load. | LTA positioning of crane operator. | | | | | LTA hazard recognition/perception | | |
| 30. | [33] | Tyre serviceman was struck by a tyre he was fitting to a FEL. | The tyre serviceman was using a shop fabricated (non engineered or certified) bead hook. | Uncontrolled handling of tyre (LTA grip). | N | Fatality | LTA design, construction, commissioning | LTA tools/ equipment / materials (condition/availability/ suitability) | LTA equipment / materials handling | LTA hazard identification | Eliminate people working under suspended loads, or standing near suspended loads. |

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| | | He was using a **truck mounted crane** and was lifting the tyre using a bead hook. Weight of the tyre was 2660 pounds. | | | | | | | | | Have in place safe work procedures that deal with working near suspended loads. |
| | | Cranage equipment was tested to be in good working order. No issues with remote control identified. Working space between crane truck an vehicle was cramped. | Area of hook/bead contact may have been lubricated. | LTA positioning of crane operator. | | | LTA maintenance | LTA equipment integrity | LTA work method | | Do not use shop made implements e.g. hook to lift tyres. |
| | | | | | | | | | | | Any lifting devices (hooks) to be fitted with a safety latch to prevent the lifted item from slipping off the hook. |
| | | | Standing under a suspended load. | Uncertified lifting equipment | | | | Congestion/restriction/access | LTA hazard recognition/perception | | Correct PPE i.e. hardhat to be work while carrying out lifting operations. |
| | | | | | | | | Complacency/ motivation/attitude | | | |
| 31. | [4] | A person was fatally injured when he was struck by pieces of a tyre which exploded after heat was applied to the wheel/hub/brake assembly of a Cat311 scraper. No training had been provided. | Tyre was not removed from rim prior to wheel maintenance commencing | Heating of wheel assembly or wheel studs | Pyrolysis | Fatality | LTA maintenance | Temperature | LTA supervision | LTA hazard identification | Implement SWPs that include dismounting of all tyres prior to wheel/brake maintenance. |
| | | Tyre did not appear to be deflated or removed prior to wheel maintenance taking place. | | | | | | | | | Never apply a heat source to a tyre/rim until the tyre is removed from the rim/hub assembly. |
| | | Gross negligence by | | | | | LTA | Pressure | LTA Hazard | | |

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| | | | Application of heat to a rim/tyre assembly causing pyrolysis. | | | | | | | | The manufacturer's guidelines for tyre and brake drum removal should be consulted and followed. |
| | | | SWP not in place. | | | | | | LTA work method | | Tyre and rim safety training should be provided to maintenance personnel who are required to service tyres and rims. |
| 32. | [34, 35] | On August 28, 1998, a 64-year old maintenance man with 30 years mining experience was fatally injured while inflating a tire on a fuel truck. The tire's two-piece steel wheel had deteriorated and exploded while being inflated. | Inflation of a deteriorated (structurally unsound) two piece rim assembly, possible over inflation. | LTA rim integrity | N | Fatality | LTA awareness, competence and behaviour. | Pressure | LTA Hazard recognition/perception | LTA hazard identification | A wheel cage or stand-off inflation device should be used to protect persons while inflating tires. |
| | | The truck had not been used for several years and the tire had been flat for an extended period of time. The victim was not using a pressure gauge or a stand-off inflation device. | | | | | | | | | Persons should not service wheel rims unless they have been trained in the manufacturers recommended procedures. |
| | | He had not received any training in this task. | | No NDT schedule | | | LTA maintenance | LTA equipment integrity | LTA work method | | Tires should not be inflated to a higher pressure than is recommended by the manufacturer. |
| | | | | LTA material testing/fatigue NDT | | | | | | | Always be cautions when inflating tyres with a compressor that delivers greater pressure than permitted by the manufacturer of the tyre. |

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| | | | | | | | | | | | Always inspect tyres and rims before inflating them. Tyre and rim assemblies should not remain unchecked for any length of time (i.e. years) as invisible corrosion can commence internally weakening the integrity of the assembly. |
| 33. | [36] | A tyre serviceman was critically injured when a tyre exploded after heat had been applied to the tyre/rim assembly (5 piece rim). The person died 2 weeks later. | Application of heat to a tyre/rim assembly causing pyrolysis and explosion of the resultant combustible gases inside the tyre assembly. | Heating of wheel assembly or wheel studs | Pyrolysis | Fatality | LTA maintenance | Temperature | LTA Hazard recognition/perception | LTA hazard identification | Issue safety alerts that spell out the dangers of applying heat to tyre and rim assemblies. |
| | | | | | | | | | | | Provide training to all company operations in safe work practices for removing wheels, including the prohibited use of heat of any heat source. |
| | | | The tyre remained on the rim and had been deflated. | | | | LTA awareness, competence and behaviour. | Pressure | LTA work method | | Follow the manufacturers' guidelines for wheel removal. |
| 34. | [37] | A worker was removing an inflated tyre from a log stacker. The tyre was mounted on a multi piece rim. The inner and outer rims were held together by 16 smaller bolts and the entire rim assembly was attached to the hub with 48 larger bolts. When the worker had removed most of the larger bolts, the smaller bolts could not withstand the internal air pressure. The outer | Not deflating the assembly prior to loosening wheel nuts. | LTA deflation practice. | N | Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA hazard identification | Always deflate the tyre before losing any nuts or bolts on a wheel. |
| | | | | | | | | | LTA work method | | With multipiece rims, use the correct grade of fasteners and apply the factory specified torque. |
| | | | Smaller rim to rim bolts had been weakened by improper torqueing and or unequal loading | LTA training /competency | | | LTA awareness, competence and behaviour. | LTA equipment integrity | | | Inspect the wheel fasteners as part of preventative maintenance inspections. |

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| | | | | | | | | | | | Obtain current manufactures instructions on heavy equipment. If the equipment was not purchased new, the manual may not contain important safety updates and service bulletins. |
| 35. | [38] | A loaded truck ascended the access ramp of an open cut, and was proceeding along the main haulroad when one of the vehicles rear outside wheels literally fell off. Simultaneously the valve stem was torn from the associated inside tyre causing it to deflate, and the final drive planetary mechanism fell off the drive hub. | Accumulated dirt on the rim/hub mating surfaces that was not cleaned off during fitment process causing wheel to come lose. | LTA fitment – insufficient cleaning of mating surfaces. | N | Potential Fatality | LTA maintenance | LTA equipment integrity | LTA work method | LTA hazard identification | Wheel rim components and drive hubs must be properly cleaned and free of any material which may come between mating surfaces during assembly. |
| | | Wheel falling off causing damage to hub and planetary gears. Potential fatality if loose wheel had struck anyone, or truck had lost control. | | | | | | | | | Wheel fasteners tensions are checked soon after vehicle returns to service. |
| 36. | [39] | On two separate occasions split rim tyre assemblies exploded when trucks where operating under normal conditions. | Reuse of damaged rim components. | LTA rim integrity | N | Potential Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA hazard identification | Manufacturers of multi-piece rims list a number of important procedures. |

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| | | The explosions resulted in components of the multiple rim assemblies being projected a considerable distance with the potential to cause serious or fatal injuries to mine personnel. | | | | | LTA maintenance | | | | Do not use a hammer or any other object to force rim components in place. |
| | | | Use of incompatible components. | LTA matching of assembly components. | | | | LTA equipment integrity | LTA work method | | Do not attempt to take rim components apart on inflated tyres. |
| | | | | | | | | | | | Always use a clip on chuck that permits a person to stand clear of the potential path of rim components when inflating tyres on these rims. |
| | | | Tyre low pressures (under inflation) causing the rim integrity to be compromised. | Tyre low pressures (under inflation) causing the rim integrity to be compromised. | | | | | | | Always deflate the tyre before removing a wheel from an axle and before removing the tyre from the rim, by removing the valve core. |
| | | | | | | | | | | | Do not rework or reuse damaged rim components. |
| | | | Incorrect tyre to rim assembly. | | | | | | | | A rubber type lubricant must be applied to the tyre bead and the contact surfaces of the rim during assembly of wheel and inflation of the tyre. |
| | | | | | | | | | | | Wherever possible tyres must be inside a cage during inflation. If this is not possible all personnel must stand well clear of the tyre and rim components during the inflation. |
| | | | | Abnormal operating conditions. | | | | | | | Do not rest or lean any part of your body or any equipment against the cage during the inflation process. |
| | | | | LTA material testing/fatigue NDT | | | | | | | Do not inflate a tyre above 35 kpa whilst it is outside of a cage, unless the area can be isolated. |
| | | | | | | | | | | | Always inspect the tyre after it has been inflated whilst it is still in the cage to ensure all components are correctly fitted. |

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| | | | | | | | | | | | In addition to these recommended procedures it was recognized that "Sur-Loc" bands which are welded to bead seat bands on some of the multi-piece rim assemblies can cause obstruction to proper visual inspection of the fitment of lock-rings. If the "Sur-Loc" bands have been hammered, the resultant burring and/or deformation can interfere with the fitting of the lock-ring and can move the lock-ring out of the correct position during tyre inflation. |
| | | | | | | | | | | | Recommendations are also made about the use of special tools to check the profile of lock-ring grooves and lock rings to avoid incidents of this type. |
| 37. | [40] | A front-end loader was repositioning a truck tyre that was used as a road edge marker on a pit ramp; the operator accidentally put the tyre on its end. The tyre then started rolling down than ramp narrowly missing a person before crashing into a tank. | Tyre accidentally being stood up to become mobile. | Uncontrolled handling of tyre (LTA grip). | N | Potential Fatality | LTA maintenance | LTA task planning/preparation | LTA equipment / materials handling | LTA hazard identification | Assess current work practices and procedures and ensure that safe systems of work that include appropriate precautions are in place to prevent the risk o injury to any persons using the ramp. |
| | | JHA not completed. | | | | | | | LTA hazard recognition/perception | | Place a physical barrier and signeage across the ramp to prevent vehicles from using the ramp when tyres are being moved or installed. The ramp may be fixed or portable depending on access requirements. |
| | | Traffic had not been informed about the work being conducted on the ramp. | | Use of unsuitable equipment to handle tyre. | | | | LTA surface gradients/conditions | | | Review tyre lifting and handling equipment for adequacy across the site and across the full range of applications. |
| | | The lifting equipment used not appropriate for the task. | | | | | | Non-routine task | | | |

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| | | Hazard condition (large tyre rolling down a ramp) was not previously recognized). Operating on a downhill gradient. | | | | | | | | | |
| 38. | [41] | As a dump truck was being driven away from an excavator after it had been loaded in an open pit gold mine, the rear position 6 of the truck exploded. | The tyre ruptured was excessively worn and was due to be changed the next shift. | Tyre environment - severe conditions causing tyre failure | N | Potential Fatality | LTA maintenance | LTA housekeeping | LTA hazard recognition/perception | LTA hazard identification | Discard criteria should be developed for dump truck tyres in accordance with manufacturers recommendations. |
| | | The force of the rupture caused a rock to be propelled from the pit floor through the windscreen of a second truck waiting to be loaded. The second truck was approx 10 to 15 m away and at 90 degrees to the axis of the first truck and the tyre that ruptured.. The operator was fortunate not to have been injured by the flying rock. | Spillage containing sharp rocks was present on the pit floor. | | | | | | | | Tyre inspections should be carried out by a competent person at least daily to identify defects and monitor wear. |
| | | | The work condition of the tyre was such that rocks on the floor of the pit were able to puncture it. | | | | LTA operations | LTA surface gradients/conditions | | | Prestart checks systems should require operators to check tyres for new damage and remove any rocks from treads. Any trucks should be stood down if new tyre damage warrants this. |
| | | | There was a lack pf appreciation by site personnel that the tyre could explode with a sudden and massive release of energy. | | | | | | | | So far as is practicable, the pit floor, haul roads and dump areas should be maintained clear of rock spillage and operators should be given instruction in the procedures for dealing with such spillage. |
| 39. | [42] | General advice to tyre users – worldwide tyre shortage – use of second hand tyres, repaired tyres, retreaded tyres, non traditional brands of tyres, untried brands | | | N | Potential Fatality | N/A | N/A | N/A | N/A | Consider the following when changing procedures with respect to tyre purchase and use: |
| | | | | | | | | | | | Does the rubber compound and TKPH (Yon kilometer per hour) rating o the tyre match the haul profile of the machine? |
| | | | | | | | | | | | Will the steering be affected? |

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| | | | | | | | | | | | Will braking performance be affected? |
| | | | | | | | | | | | Will any changes affect the propulsion system controller configuration files of electric drive trucks? |
| | | | | | | | | | | | Will changes in overall tyre dimensions cause interference with other components of the machine? |
| | | | | | | | | | | | Are the rims designed for the interchange of tyres being considered? |
| | | | | | | | | | | | What codes are the tyres and rims manufacture to (TRA, JATMA, Tyre and rim association of Australia, European tyre and rim technical organization? |
| | | | | | | | | | | | Carry out proper risk review and appropriate workplace consultation and training. |
| 40. | [43] | A truck driver escaped with minor injuries in a park up area at shift change. | The tyre was weakened by a previous rock cut. | Tyre environment - severe conditions causing tyre failure | N | Potential Fatality | LTA awareness, competence and behaviour. | LTA equipment integrity | LTA hazard recognition/perception | LTA hazard identification | Tyre inspections should be carried out on a daily basis by competent personnel to identify and monitor defects and wear. |
| | | A loaded truck, approx 15 m away, reversed when one of its tyres burst, showering the person with rocks and grit of the ground. | The rock cut was not formally inspected on a regular basis. | LTA operational prestart inspection - tyre & rims. | | | | | | | Good loading/trucking practices and haul road design and maintenance practice should be implemented to ensure the load is evenly distributed and spillage is minimized. |
| | | The injuries could have been worse had the truck driver been closer, or not wearing correct PPE. | The location of the previous rock cut was virtually impossible to observe during prestart inspections. | | | | LTA operations | LTA competence/experience/skill for the task | | | Equipment capable of removing spillage from pit floors, ramps, haul roads, ROM pads and dumps should be available. |
| | | | There was a lack of adequate knowledge by site personnel of the potential risks associated with being close proximity to loaded trucks and the potential for a sudden massive release of energy. | | | | | | | | Procedures should be developed that effectively deal with spillage. |
| | | | | | | | | | | | Tyre rotations and discard criteria should be developed in accordance with manufacturer's recommendations. |

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| | | | | | | | | | | | Purpose designed loaded truck park up areas should be available and specific procedures for pedestrian traffic adjacent to loaded trucks should be developed. |
| | | | | | | | | | | | Employee awareness of the potential for rupture due to wear, spillage, overheating and poor operating techniques should be addressed in operator training. |
| | | | | | | | | | | | Employees need to wear appropriate PPE at all times, especially at the end of shift when the equipment is operational in their vicinity. |
| 41. | [44] | A mine worker was fatally injured when struck by a wheel assembly he had fitted and was in the process of inflating (assembly consisted of a 7.5*16 tyre and 7.5*16 inner tube being fitted onto a 6.75*16.6 rim). | Tyre was not compatible for the rim. | LTA matching of assembly components. | N | Fatality | LTA maintenance | LTA competence/experience/skill for the task | LTA hazard recognition/perception | LTA hazard identification | Employees undertaking tyre fitting work must be given adequate instruction and training as per relevant mining acts and regulations. |
| | | It is believed that the inner tube burst and the tyre bead failed on the underside causing sudden uncontrolled release of compressed air. | | | | | | | | | Persons engaged in tyre fitting work must ensure the tyre being fitted is the correct size and compatible with the rim. |
| | | This propelled the wheel upward from the ground striking the deceased. Evidence suggests that the tyre was not compatible with the rim. | | | | | | Pressure | | | All light vehicle or industrial tyres that have just been mounted onto a rim must be inflated inside a tyre cage. Personnel should stand to one side of the wheel during inflation. |
| | | | | | | | | | | | During inflation process, the tyre pressure should be regularly monitored using a suitable pressure gauge. |

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| | | | | | | | | | | | Tyres must never be inflated beyond manufacturers' recommendations. |
| | | | | | | | | | | | Damaged tyres that are no longer serviceable should be discarded and not reused. |
| 42. | [45] | Failure of bead seat band – Dakar – anecdotal | Failure of lip on bead seat band | LTA rim integrity | N | Fatality | LTA maintenance | LTA equipment integrity | N/A | LTA hazard identification | It is unsure what exact root causes caused the failure of the bead seat band, however as a precaution the following steps are recommended: |
| | | A person was hit by part of a 5 piece rim bead seat band | | LTA material testing/fatigue NDT | | | | | | | 1. Closely inspect all rim components prior to assembly for suitability, cracks, damage, deformation and corrosion. If in doubt consult with a supervisor or the original equipment manufacturer to check safety and serviceability of the componentry. |
| | | While exact details are not available it appears that the "lip" of the bead seat band peeled off while the tyre had sufficient pressure during inflation. It is said that the person was standing in the trajectory zone and was killed instantly. | | | | | | | | | 2. Always ensure that all rim components are fitted correctly and rim assembly integrity is assured. |
| | | The machine was 5000 hours old and was still fitted with original tyres and rims. | | | | | | | | | 3. Never stand in the trajectory zone (i.e. in front of a tyre and rim assembly) while it is being inflated. Either use a certified inflation cage, or use a 3 m long inflation line as per SWP and stand well away from the tyre. |

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| | | | | | | | | | | | 4. While the assembly is being inflated check seating of all componentry for proper seating, and stop/dump all the air if a problem is identified. |
| | | | | | | | | | | | 5. Ensure all your rim bases and components are tracked and nondestructively tested as per industry Standards. |
| 43. | | Failure of patch on tube tyre caused LV rollover killing one of the passengers. | Substandard workmanship of tube repair. Age of tube was estimated at 12 years, tyre 2 years. | Failure of tyre or tube repair. | N | Fatality | LTA maintenance | LTA equipment integrity | LTA hazard recognition/perception | LTA hazard identification | Tube should not be older than tyres fitted to vehicle. |
| 44. | [46] | A pressurized tyre on a special tractor for UG work exploded during oxy-acetylene cutting of loose wheel studs in the workshop at Matla No 3 Mine fatally injuring a boiler maker. The tyre was a 14.00*24 (12 ply) Firestone grader tyre fitted with a tube without a flap on a 24*8.00TG three piece semi drop centre rim. | The explosion occurred soon after the complete fusion (not cutting) of the third wheel stud by the deceased. | Heating of wheel assembly or wheel studs | Pyrolysis | Fatality | LTA maintenance | Temperature | LTA Hazard recognition/perception | LTA hazard identification | Never apply any form of heat (direct or indirect application of heat with welding or gouging arc, gas flame or grinder) on the wheel studs or wheel of a wheel assembly fitted: |
| | | Chemical explosion, not a violent blowout due to too high tyre pressure. | The molten slag produced during the fusion of the studs accumulated on the rim base and heated the rim base to cause extensive thermal decomposition (partial combustion and pyrolysis) of the tube portion in direct contact with the rim base. | | | | | | | | With either an inflated tyre (with air or nitrogen) or deflated tyre, and |

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| | | | A unique combination of factors on 21 April 2004 caused the extensive thermal decomposition of the tube producing an explosive gaseous mixture and the resultant explosion inside the tyre. | | | | LTA awareness, competence and behaviour. | Pressure | LTA work method | | Fitted with a tube or without a tube (tubeless). |
| | | | Primary cause of the accident: A method based on the application of heat (oxy acetylene cutting/fusion) was used to remove loose wheel studs on a wheel assembly fitted with a tyre. | | | | | | | | Use hydraulic nut splitters to remove loose studs.<br>The nuts on some wheel assemblies are not accessible for nut splitters. Improve the design of the stud head to axle hub interface to secure the stud head ensuring nut removal with standard tooling even without the interference fit between the serrated stud shank and axle hub.<br>Install flaps on all three piece semi drop centre rims.<br>Install the wheel assembly with the lok ring facing the tractor.<br>Conduct an investigation to determine the main cause of the loosening of wheel studs on special tractors for underground work at the mine.<br>Conduct an audit on the inspection and repair of wheels the tyre service provider. |

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| 45. | [47] | The sidewall of rear inner tyre on a Caterpillar 777 dump truck ruptured violently while parked outside the workshop. | Initial indications are that a previous repair of a sidewall tear (approximately 125 mm x 100 mm) by a tyre repairing company had failed during service. | Failure of tyre or tube repair. | N | Potential Fatality | LTA maintenance | LTA Equipment integrity | N/A | LTA hazard identification | Energy released by tyre explosion or rupture is enormous. The consequences therefore, are often massive equipment damage and fatal injuries. Explosions usually occur due to impact or chemical pyrolysis (chemical heating causing build up of flammable gas and pressure within the tyre). Pyrolysis related explosions have been known to occur up to 24 hours after the initiation of pyrolysis. Whilst this incident appears to be related to defective repair rather than an explosion due chemical effects, it is an opportunity to reiterate possible initiators of pyrolysis such as contact with high voltage power lines, application of heat to wheel rims and lightning strikes. |
| | | The operator who was greasing the front suspension struts was hurled out from under the truck but escaped injury. | However, other possible contributory factors could be operation with under-inflated tyre, poor tyre handling and poor storage practice, improper mounting or a combination of these factors. | | | | | | | | There are also high safety risks associated with multi-piece rims. Many serious and fatal accidents over the years have been attributed to poor maintenance, inadequate inspection, poor fitting practice and use of incompatible components in multi-piece rims. |
| | | Fortunately, he was not in line with the air blast. Most of the energy from the blast appears to have dissipated when the air ricocheted from across the opposite set of wheels to hurl the operator out. | | | | | | | | | The risk of damaging pressure energy release associated with tyres warrants a risk management exercise encompassing the whole life cycle from selection to discard. |
| | | | | | | | | | | | **RECOMMENDATIONS:** |
| | | | | | | | | | | | • Develop standards for tyre management through a risk management exercise. Guidance could be sought from tyre manufacturers and Australian Standard AS 4457-1997: Earth-moving machinery off-highway rims and wheels, maintenance and repair. |
| | | | | | | | | | | | • Ensure that training and competency requirements for persons involved in tyre repairs are adequately addressed. |

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| | | | | | | | | | | | • Ensure that designers, manufacturers, importers, suppliers, tyre repairers and other service providers are aware of and understand their obligations under the Mining and Quarrying Safety and Health Act 1999 and the Coal Mining Safety and Health Act 1999. |
| 46. | [7] | While removing a tyre and rim assembly (Multi piece rim assembly (five piece)) from a drive axle bogey of an off-highway coal transport prime mover the operator suffered fatal injuries when the inner rim assembly failed and blew the outer wheel and mounting jewellery of the inner assembly off the drive axle. | Failed rim of a pressurized assembly. | LTA deflation practice. | N | Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA hazard identification | The potential energy stored in tyres and rims is enormous and has resulted in numerous fatalities both in Australia and overseas in the past 12 months. |
| | | | Failure of a pressurized rim assembly can cause the ejection of components at great force and velocity. | No NDT schedule | | | | LTA competence/experience/skill for the task | | | Multi piece rims are high-risk assemblies and need to be treated with the respect they deserve. Many serious and fatal accidents can be attributed to poor removal and fitting practices, inadequate inspection regimes and a lack of training for personnel involved in tyre and rim maintenance tasks. |
| | | | Any person hit by one of these flying objects may suffer a fatal or serious injury. | LTA material testing/fatigue NDT | | | LTA awareness, competence and behaviour. | | LTA work method | | **RECOMMENDATIONS:**<br>Defuse the bomb' - Prior to ***any*** task that requires the removal of a pressurised tyre and multi piece rim, it is imperative that all tyres be deflated, including the adjacent tyre on dual wheel axles as well as the tyre on the wheel being removed.<br>Implementation of an adequate NDT (non-destructive testing) regime is essential and the monitoring and testing periods must be established appropriate to the component failure history and work environment. |

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| | | | | | | | | | | | Recommendations contained within Australian Standard AS 4457 pertaining to crack detection, mount and demount of rims and wheels and all other facets of tyre and rim handling should be adopted as a guide to site practices. |
| | | | | | | | | | | | Ensure that training and competency requirements for persons involved in tyre and rim handling are adequately addressed. |
| | | | | | | | | | | | Safety Alert No.29 July 2000 recounts a similar event. If we do not learn from our mistakes we are doomed to repeat them. |
| 47. | [48] | **Welding on assembled wheel results in explosion**<br>A stacker wheel with less than 4,500 hours of use developed a slow air leak in a weld along the circumference of the rim. The factory weld had been weld-repaired three times before in the previous two months. | Welding of rim cracks | Heating of wheel assembly or wheel studs | Pyrolysis | Fatality | LTA maintenance | Temperature | LTA Hazard recognition/perception | LTA hazard identification | Do not weld on an assembled wheel. Remove the tire first. Then weld only if allowed by the manufacturer or under the direction of an engineer.<br>Consider inflating the tire with nitrogen instead of air. Use a source regulated to the maximum pressure permitted for the tire being filled. |

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| | | As with previous repairs, the worker removed the valve core and removed most of the air from the tire before welding. This time the weld was approximately 1 x 6 inches on the rim. The tire was still mounted. After completing the weld, the worker attached an air line and was adding air when the tire exploded. The worker died instantly. | | | | | LTA awareness, competence and behaviour. | Pressure | LTA work method | | Work on assembled wheels must be conducted in compliance with the Occupational Health and Safety Regulation. |
| | | After the explosion, investigators found there had been a fire inside the tire. It is believed welding heated the nearby rubber, which then started to smoulder and released flammable gas. When air was added to inflate the tire, it fanned the smouldering area into a fire. When the ratio of flammable gas and oxygen reached the explosive limit, the tire exploded. | | | | | | | | | **Relevant sections of the Occupational Health and Safety Regulation* 16.48 Equipment and procedures ...7) Welding or heating on assembled rim or wheel parts is not permitted, except that limited heating to facilitate removal of a wheel from a hub is acceptable after the tire has been deflated by removing the valve core.** |

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| 48. | [49] | A fitter received severe bruises to the chest and left collar bone area when an earthmover tyre pinned him against a truck. | The tyrehand controls were operated close to the lifting operation, exposing the operator to Potential hazards. | Uncontrolled handling of tyre (LTA grip). | N | Potential Fatality | LTA maintenance | LTA surface gradients/conditions | LTA equipment / materials handling | LTA hazard identification | Tyre fitters must be adequately trained and assessed in the system of work before operating tyrehands. |
| | | | The tyrehand was parked close to the earthmover, restricting maneuverability. | | | | | | | | Suspended loads must be carefully secured. |
| | | The fitter used a "tyrehand" -- a **truck-mounted self-loading crane modified with rotating arms for holding tyres** -- to replace the tyre on the earthmover (scraper) in an open area of a peat farm in Stirling in October 1995. He picked up the 950 kg new tyre with the tyrehand and maneuvered the tyre into an upright position. The tyre swung inwards and pinned him against the truck. | The tyre was held off centre by the tyrehand arms, which possibly caused it to swing towards the fitter when lifted. | | | | LTA awareness, competence and behaviour. | LTA tools/ equipment / materials (condition/availability/ suitability) | LTA work method | | Wherever possible workers should stay well clear of suspended loads, and operate controls on the opposite side of the truck from the load being lifted or unloaded. |
| | | | The tyrehand was not stabilized in a level position. Much of the site was sandy and unsuitable for this task. | LTA positioning of crane operator. | | | | | | | Employers and owners must ensure a safe system of work for replacing earthmover tyres using a tyrehand . The minimum operating distance between grab truck and machinery should be specified and complied with. |
| | | | | Crane not stabilized. | | | | LTA equipment integrity | | | |
| | | | | Confined working environment. | | | | Congestion/restriction/access | LTA Hazard recognition/perception | | |

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| 49. | [3] | **Tire explodes when truck contacts overhead power line** A load of gravel was being delivered to a farm. After dumping the load as directed by the farmer, the driver moved the truck forward with its box still raised. As the truck was moving forward, the box contacted an overhead high-voltage power line. The driver saw sparks, stopped the truck, and jumped from the truck. Fortunately, the truck had broken contact by then and he was not injured. | Tipping in the vicinity of powerlines | Contact with Powerline | Pyrolysis | Potential Fatality | LTA operations | Congestion/restriction/access | LTA Hazard recognition/perception | LTA Hazard identification | Check for overhead hazards before raising the box. |
| | | All 10 of the tires on the truck had burn marks on them where the power went to ground. One front tire, a balloon-type tire, exploded, resulting in the aluminium wheel, bearings, and brake shoes being blown up to 12 meters (40 feet) away, along with parts of the grill. | | | | | LTA Crisis & Emergency Mgt | | | | Keep your vehicle a safe distance from overhead power lines. The distance varies with the voltage, refer to individual design codes and Standards :<br><br>Contact the owner of the power utility if you cannot maintain the required minimum distance from the power line. The power lines may need to be rerouted, de-energized, or identified and guarded. |
| | | | | | | | | Temperature | | | |
| | | | | | | | | Pressure | | | |

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| 50. | [50] | A mechanic was removing two inflated right rear dual tires off a logging truck low bed. He was removing the lug nuts of both tires and was banging on the wheel lugs to loosen the tires when a loud explosion occurred. The inside tire had a hidden crack in the lock rim groove, which was held in place by the outside tire. When the outside tire was loosened there was an explosive separation of the inside tire from the rim that propelled the outside tire off the axle hub, striking the mechanic and throwing him backwards. He suffered severe injuries to his ribs and right shoulder. | Failed rim of a pressurized assembly. | LTA deflation practice. | N | Potential Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA hazard identification | Provide written safe work procedures for demounting of multi-piece tire rims. |
| | | | | LTA material testing/fatigue NDT | | | LTA awareness, competence and behaviour. | | | | Deflate tires before removing wheel nuts of any multi-piece tires that are to be removed from their hubs. |
| | | | Failure of a pressurized rim assembly can cause the ejection of components at great force and velocity. | No NDT schedule | | | | LTA competence/experience/skill for the task | LTA work method | | Inspect multi-rim wheel assemblies on a regular basis to detect cracks or other damage. |
| | | | Any person hit by one of these flying objects may suffer a fatal or serious injury. | | | | | | | | |
| 51. | [51] | A split ring tyre assembly exploded whilst being fitted to the rear axle of a drilling rig. The tyre was inflated to 675 kPa (98 psi) at the time of fitting. The force of the explosion propelled the tyre and rim striking the person fitting the tyre and | The split ring tyre was not assembled correctly. Either the tyre bead was not in full contact with the split ring or the split ring was incorrectly fitted on the rim. | LTA matching of assembly components. | N | Potential Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA hazard identification | **COMMENTS AND PREVENTATIVE ACTION** |
| | | | | | | | | | | | Care must be exercised when assembling rims and tyres provided with a split lock ring. Particular |
| | | | | | | | LTA awareness, competence and behaviour. | LTA equipment integrity | | | attention must be given to: |
| | | | | | | | | | LTA work method | | i) The removal of rust and other foreign matter from the rim and the split lock ring before assembly. |

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| | | | | | | | | | | | ii) The application of recommended lubricant on the rim or tyre bead to reduce friction between tyre and rim. |
| | | | | | | | | | | | iii) Partial inflation of tyre and inspection of the degree of fit between tyre and locking ring. |
| | | | | | | | | | | | iv) Full inflation of tyre to manufacturer's specification, in a tyre cage, and further inspection of degree of fit between tyre and split locking ring before removal from cage. |
| 52. | [52] | At approximately 06:25 hours on 14 November 1996, a fitter employed by an earthmoving contractor sustained fatal multiple head and internal injuries when a tyre explosion took place at the contractors' workshop at an open pit gold operation. | Split ring fractured striking employee. | No NDT schedule | N | Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA hazard identification | Before tyres are repaired, written procedures for the type of tyre in question should be checked instead of guessing what may be required. |
| | | The deceased was engaged in fitting a wheel to a crane at the workshop. A tyre had been fitted to the wheel rim and inflated on the previous night shift. During the operation to fit the wheel to the machine, an explosion took place which involved the cast metal outer split rim being fractured and striking the deceased throwing | Failure of rim component | LTA material testing/fatigue NDT | | | LTA awareness, competence and behaviour. | | LTA work method | | Care must be exercised when assembling multi-piece rims with special attention to the following points:<br>(i) The rim components should be carefully inspected prior to assembly, with particular attention given to wear in the rim.<br>(ii) The rim assembly nuts should be tightened to the correct torque specifications using a "T" bar and socket or tension wrench.<br>(iii) Prior to inflating the tyre, an appropriate restraining device should be fitted.<br>(iv) The person inflating the tyre should not stand in front of the tyre, but in a safe position. |

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| | | | | | | | | | | | (v) The inflation device should incorporate a hand piece with a pressure gauge, flow control mechanism and sufficient hose to distance the operator from the inflation chuck. |
| | | | | | | | | | | | (vi) Assembly and dismantling of multi-piece rim components should be carried out with care and "shock loading" of vulnerable parts of the assembly (e.g due to striking with heavy hammers) should be avoided. |
| | | | | | | | | | | | (vii) Periodically, components should be checked for cracks. |
| | | | | | | | | | | | Training in tyre repair procedures must be provided to all maintenance personnel required to carry out repairs, to ensure that they are competent to do so. This competence must be verifiable by the production of a certificate of competency or ticket provided by recognized tyre repair trainer. |
| 53. | [53] | A tyre fitter sustained serious arm injuries while removing a wheel from a 40 tonne container lifter. The container lifter, which looks like a large forklift, was fitted with dual load-bearing wheels, and single steering wheels. | The axle on the container lifter was chocked up and the tyre fitter had removed the retaining bolts and clamps. He had not deflated the tyre. Another worker was waiting on a 4 tonne forklift ready to lift the wheel off the axle hub. In order to break any rust cohesion between the rim and the spade and the hub, the tyre fitter delivered a blow to the assembly with a small hammer. The wheel assembly shattered under the pressure of the compressed air, striking the fitter's arm before striking the mast on the 4 tonne forklift. The force of the assembly snapped the forklift mast and caused other damage. Wheels under pressure are always | LTA deflation practice. | N | Potential Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA hazard identification | Tyres must be deflated to no more than 35 kPa before wheels are removed from vehicles, or disassembled. |
| | | The wheels had steel 1300 x 25 rims, marked 'Made in India, batch 9809 WIL'. 18.00 x 25 industrial, smooth-treaded tyres were fitted to the rims, and the tyres were inflated to 138 psi (cold). | | LTA material testing/fatigue NDT | | | | | | | Australian Standard 4457: *Earth moving machinery - Off highway rims and wheels - Maintenance and repair*, provides useful guidance. |

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| | | The wheels are centered onto the axle hubs by a 'spade' or wedge. The wheels have a split rim with a locking ring that sits into a groove in the outer flange of the rim (see Figure 3). The whole assembly is attached to the wheel hub with a series of clamps and locking nuts. Tyres are regularly rotated so that they wear evenly. | | No NDT schedule | | | LTA awareness, competence and behaviour. | LTA equipment integrity | | | Titan Wheels Australia Pty Ltd, who supplied the 'Wheels of India' rims, provide standard operating procedures for tyre and rim safety. |
| | | | | | | | | | LTA work method | | Manufacturers and suppliers of equipment must supply |
| | | | | LTA rim integrity | | | | | | | All large rims should be registered in a scheduled maintenance programme. |
| | | | | | | | | | | | All wheel components should be subject to visual inspections for cracks, wear and corrosion. |
| | | | | | | | | | | | It is recommended that large rims be crack tested at 2 years of age and re-tested each time a tyre is replaced. |
| | | | | | | | | | | | All wheels must have external access to valves so that tyres can be deflated prior to any work. |
| | | | | | | | | | | | All tyre workers must be fully trained in safe working procedures with comprehensive, documented training procedures. |

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| 54. | [54] | A sixteen year old tyre fitter received facial lacerations and whiplash when a split rimmed wheel he was removing from an old tractor/backhoe exploded. The tractor backhoe was driven into the tyre fitter's yard without the driver announcing his arrival to the manager. The tractor/backhoe driver advised the tyre fitter that the rear wheel had a slow air leak. They decided they would remove the wheel and leave the tyre inflated, to make it easier to roll the wheel into the workshop once it was removed. The tractor/backhoe driver indicated they should remove the outer ring of securing nuts, and | Failure to notify management that the tractor had arrived on site, to allow management to identify any risks associated with the work. | LTA deflation practice. | N | Potential Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA hazard identification | Employees should not be allowed to work on split rimmed wheels until they have been trained and instructed in the repair of all types of split rimmed wheels they might encounter. |
| | | | Lack of training and instruction. The owner of the premises had not provided relevant training, as the company had not repaired that type of bolted split rimmed wheel during the time the sixteen-year-old had been working for the company. | | | | | | | | The outer nuts which secure the two sections of a split rimmed wheel together should be painted red to highlight a hazard, and a decal (as illustrated below) should be attached to the wheel advising that the tyre must be deflated before the outer (red) nuts are removed. |
| | | | Lack of information regarding the danger of repairing bolted split rimmed wheels. The only information available related to the use of a split rim safety cage for the repair of collar-type split rims. | LTA dismantling of 2 piece industrial rim. | | | | LTA competence/experience/skill for the task | LTA work method | | Information relating to the dangers of working on all types of split rimmed wheels should be displayed in a prominent position in all tyre repair shops. |

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| | | | There was no warning on the wheel to alert a person to the danger of removing the outer nuts without first deflating the tyre. Originally, the manufacturers of bolted split rimmed wheels provided split pins through the studs which had to be removed before the nuts could be removed. Alternatively, they painted the outer nuts red to highlight the danger. The nuts originally securing the split rim had been painted red, however the paint had worn away with the passage of time. | | | | | | | | |
| | | | Youthful enthusiasm and initiative, although commendable, contributed to a hazardous situation with the potential for serious injury. | | | | LTA awareness, competence and behaviour. | | LTA supervision<br>LTA operating authority | | |

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| 55. | [55] | An 18-year-old labourer was killed in April at Toodyay when the split ring from a wheel which he was fitting to a low loader came free and hit him in the chest and head. | The exact cause of the split ring coming loose is not known, however it is alleged that: | LTA matching of assembly components. | N | Fatality | LTA maintenance | LTA work procedures | LTA Hazard recognition/perception | LTA hazard identification | **Recommendations**<br><br>Two areas of concern identified were the fitting of the tyre and installation of the wheel onto the axle. Attention must be given to: |
| | | Prior to the incident the deceased had fitted the rim with a new tyre and tube, inflated the tyre to 760kpa (110 psi) and arranged for the wheel to be carried to where the low loader was parked on the other side of the factory. | the split ring assembly had not been seated correctly; | | | | | | | | |
| | | The deceased had fitted a tyre of incorrect size to the rim, and the rim showed signs of wear and scale. The rim assembly was manufactured in 1942 and was of a three-piece type. The ring and split ring had been riveted together. | the tyre was an incorrect size for the rim; | | | | LTA maintenance | LTA equipment integrity | LTA work method | | 1. The provision of suitable equipment and a safe system of work to remove and fit the tyre to the rim. Suitable equipment should include a tyre cage, tyre pressure gauge in the airline, soft headed hammer (not steel), suitable rim cleaning equipment and a chart that provides details of tyre–rim compatibility. |
| | | | the training of the deceased was inadequate, and therefore the supervision was also inadequate; | | | | | | | | 2. Whenever a tyre is replaced, rims must be inspected for defects such as rust, distortions, cracks and imperfections before a new tyre is fitted. |

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| | | | the procedure for fitting the tyre was poor; and the equipment provided for the fitting of the tyre did not allow a safe system of work to be used. | LTA training /competency | | | | | | | 3. Wheels must be placed into a restraining device (safety cage) before inflation. |
| | | | | | | | | | | | 4. The person inflating the tyre must stand to the side of the wheel in a safe position, and not in the trajectory line of the split ring. Note the diagrams below. |
| | | | | LTA procedure | | | | | | | 5. The airline should incorporate a hand piece with gauge and be a sufficient distance from the valve stem attachment so the fitter is in a safe position while inflating the tyre, should the split ring part with the wheel. |
| | | | | | | | | | | | 6. Inflation should be undertaken in stages, not more than 70kpa (10psi) at a time. (While AS 4457-1997 does not apply to these rims it is recommended initial inflation should be nominally 35kpa.) The ring should then be checked for correct seating. |
| | | | | | | | | | | | 7. When fitting the wheel to the axle hub, the fitter should not sit or crouch in the unprotected trajectory line of the split ring. |
| | | | | | | | | | | | 8. Always consider the trajectory line of the split ring components and rim during any stage of dismantling, re-assembling and fitting of wheels to a vehicle. DON'T be unprotected and in the path at any stage. |
| | | | | | | | | | | | NEVER allow an untrained unsupervised person to undertake the fitting of tyres to a split ring rim. |
| 56. | [56] | A man received fatal injuries when struck in the chest by a wheel rim that separated violently while being inflated with an airline at a service station. | The tyre was inflated beyond the manufacturer's recommended maximum pressure. | Overpressurisation of tyre or rim | N | Fatality | LTA maintenance | Pressure | LTA Hazard recognition/perception | LTA hazard identification | **Recommendations**<br>1. Information or warning signs should be displayed at service stations advising of the risks associated with the inflation of tyres, and particularly split rims. |

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| | | The wheel, which had been removed from a wheelbarrow, was a split design that had been bolted together. | The wheel rim was thinned and rusted. | | | | | | | | |
| | | Investigations revealed that the rim was thinned in the area of the bolts and rusted. It was also revealed that the pressure to the airline was not regulated from the compressor. | The pressure available at the service station forecourt was unregulated. | | | | LTA awareness, competence and behaviour. | | | | 2. Tyre pressures should not exceed the manufacturers' recommendations. |
| | | | The wheel had been removed from the barrow thereby losing some of the protection provided by the barrow frame. | | | | | LTA competence/experience/skill for the task | LTA work method | | 3. Wheels should not be inflated if damage or corrosion is evident. |
| | | | | | | | | | | | 4. Small tyres that require only a few seconds to inflate with high pressure equipment should only be inflated with automatic equipment that cuts out at a pre set pressure, or be inflated with a manually operated-pump. |
| | | | | LTA rim integrity | | | | LTA equipment integrity | | | 5. Where practicable wheelbarrow tyres should be inflated on the barrow as the frame may afford some degree of protection in the event of tyre/rim failure. |
| | | | | | | | | | | | 6. Wherever practicable a tyre cage or protective barrier should be used when wheels with any type of split rim construction are inflated. |
| | | | | | | | | | | | Whilst this incident occurred in another state the details are presented here in an attempt to prevent a similar accident in West Australia. |

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| 57. | [57] | This report contains a number of case descriptions of 'fatalities whilst using jacks in Australia, 1989 to 1992. It covers both domestic as well as industrial usage of jacks but appears not to include heavy earthmoving accidents (it could not be ascertained f no fatalities occurred during the jacking of heavy earthmoving equipment). | Causes attributed to this type of accident include: | Incorrect jacking | N | Fatality | LTA legal requirements, commitments and document control | LTA task planning/preparation | LTA Hazard recognition/perception | LTA hazard identification | Selection of suitable tooling , jacks and stands in light of equipment weights and measures, and Codes of practice. |
| | | 27 cases are described. | Unsuitable jack being used. | | | | LTA maintenance | LTA hazard analysis | LTA work method | | |
| | | 20 were carrying out car repairs at home. | | | | | | | | | |
| | | 7 were regarded as being at work. | Vehicle not adequately secured after being jacked up making it vulnerable to movements, bumps and vibrations. | | | | LTA maintenance | LTA tools/ equipment / materials (condition/availability/ suitability) | | | |
| | | 14 of the 27 fatalities resulted from a car falling onto the person. | 6 of the 27 fatalities were caused by vehicles rolling off ramps onto the person. Causes attributed to this type of accident include: | LTA jack design | | | | LTA routine/ non routine task | | | |
| | | | Vehicle not chocked or chocked improperly (incorrect chock or method) allowing the vehicle to roll. | LTA / No support equipment other than jacks | | | | LTA competence/experience/skill for the task | | | |
| | | | 4 of the 27 were caused by the vehicle falling off various supports used, eg blocks, bricks, car stands, coil springs etc. | LTA chocking of vehicle | | | | LTA surface gradients/conditions | | | |
| | | | 2 others are described | | | | | | | | |

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| | | | | | | | | LTA competence/experience/skill for the task | | | |
| 58. | [58] | A wheel was being fitted to the right hand inner side (position 5) of a coal hauler prime mover when the shift cylinder **(of the tyrehandler attachment)** failed, allowing the tyre clamping forks to open, dropping the wheel to the ground. At the time of the incident the tyre fitter was between the forks and the wheel being fitted and fortunately was not injured due to the wheel being held in the upright position by its top edge. | In order to align the wheel in the correct position when it is being fitted to the hub, the tyre fitter must stand between the clamps to give direction to the tyre handler operator. This places the tyre fitter between the forks and the wheel, which is a potentially dangerous situation. | LTA integrity tyrehandler | N | Potential Fatality | LTA maintenance | LTA tools/ equipment / materials (condition/availability/ suitability) | N/A | N/A | Careful inspection of equipment in service and instigation of a check system to be undertaken by the tyre fitter on each occasion prior to using the equipment. |
| | | | The shift cylinder failed, allowing the tyre clamping forks to open and thus dropping the wheel to the ground | | | | LTA monitoring, audit and review | LTA equipment integrity | | | Investigate the possibility of fitting a secondary locking mechanism or updating the design. |
| | | | | | | | | | | | Review the possibility of removing the person from between the wheel and the tyre handler, by such means as cameras or laser technology. |

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| 59. | [59] | A mechanic was killed while removing the left rear wheel from a Toro 35 D underground haul truck. The wheel is a detachable rim type, with the tire held in place by a collar and split ring, the collar and split ring. As the mechanic removed the last nut holding the wheel assembly onto the axle, the rim failed and the outer bolting flange was projected away by air pressure. The outer bolting flange flew out from the wheel assembly and struck the mechanic in the chest. The force of the impact threw him back several meters against some shelving. He died shortly after the accident | The rim had been previously welded in a number of locations. These repairs were of poor quality. The wheels from the entire fleet were checked. A total of three defective wheels were found, in addition to the wheel assembly that exploded. These wheels were immediately removed from service. The investigators found that the tires for heavy vehicles from the mine were normally changed offsite by another company. The mine site itself did not change tires of this size, but changed the entire wheel assembly with the tire already mounted on it. Since there was no identification or record keeping for each wheel assembly brought onto the site, the investigators were unable to determine where the defective wheel had come from. The wheel assembly that failed had originally been designed for use with tubeless tires, but had been altered to accommodate tubes. This contributed to the accident in that a tubeless tire would have lost air through the fatigue cracks in the rim and would, therefore, not have presented a danger to the worker. | LTA rim integrity | N | Fatality | LTA legal requirements, commitments and document control | Pressure | LTA work method | LTA hazard identification | 1. Tires on heavy vehicles should be fully deflated before wheels are removed. |
| | | | The wheel assembly that caused the death of the worker failed as a result of fatigue cracking at weld | No NDT schedule | | | LTA suppliers, contractors and partners. | | | | 2. Non destructive testing should be part of the inspection procedure on all rims of this design when changing tires. |

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| | | The wheel assembly was found to have extensive fatigue cracks, both in the rim and in the outer bolting flange where it was bolted to the hub. | | | | | | LTA tools/ equipment / materials (condition/availability/ suitability) | | | 3. Any repairs of wheel/rim assemblies should be by authorized and trained personnel only. Repairs should meet or exceed the manufacturers original specifications. |
| | | | | | | | LTA maintenance | LTA equipment integrity | | | 4. A serial number should be stamped on all tire/rim assemblies and the numbers recorded in the equipment logbook as tire/rim changes are made. |
| | | | | LTA rim integrity | | | | | | | |
| | | | | LTA material testing/fatigue NDT | | | LTA monitoring, audit and review | | | | 5. Owners of heavy haul trucks should periodically inspect the wheels of their vehicles. Where the rims are failing, steps should be taken to ensure that there is appropriate preventative maintenance. |
| | | | | LTA deflation practice. | | | | | | | |
| 60. | [60] | Newspaper report: Preliminary reports say the worker, Jermey Heckler, 30, was killed by an exploding truck tire as he was welding and grinding on a steel tire rim. | Application of heat to a tyre/rim assembly causing pyrolysis and explosion of the resultant combustible gases inside the tyre assembly. | Heating of wheel assembly or wheel studs | Pyrolysis | Fatality | LTA maintenance | Temperature | LTA Hazard recognition/perception | LTA hazard identification | |
| | | | | | | | LTA awareness, competence and behaviour. | Pressure | LTA work method | | |

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| 61. | [61] | A set of 16 inch light truck tyres were inappropriately mounted to the steering axle of a rough terrain forklift, instead of the correct industrial tires (11R16) required for that application. *(There was no property damage or personal injury in this instance as the incorrect fitment was discovered by an alert visiting manufacturer technical representative1 who quickly advised management of the dangers involved. The light truck tyres were immediately removed and replaced with the correct industrial tyres).* | Incorrect bead seating angle can cause the tyre to blow off the rim which like any uncontrolled deflation can have fatal consequences. | LTA matching of assembly components. | N | Potential Fatality | LTA awareness, competence and behaviour. | LTA competence/experience/skill for the task | LTA Hazard recognition/perception | LTA hazard identification | 1. **Do NOT install a light truck tire on an industrial wheel** - if in doubt, stop and consult with the tyre manufacturer. |
| | | Comparison of the load carrying and speed capacity suggested a correct selection; However necessary OEM information in particular rim geometry and bead angle and resultant tyre/bead seating issues were not consulted nor considered. | | | | | LTA maintenance | | LTA work method | | 2. Always check vehicle OEM specifications on correct tyre size and type recommended for mounting to a vehicle rim/wheel. |
| | | | | | | | LTA monitoring, audit and review | | | | 3. Ensure bead angle of the tyre will be compatible with the bead angle of the rim/wheel. |

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| 62. | [62] | A Pos.3 tyre assembly had been replaced on a CAT truck and the tyre | Not following established procedures, and using low/wrong torque setting on assembly. | Inadequate torque | N | Equipment Damage | LTA change management | Complacency/ motivation/attitude | LTA procedural compliance | LTA hazard identification | 1. Only trained and competent personnel are permitted to carry out re-torques. |
| | | serviceman carried out the initial wheel torque to the wheel fastening system (wheel studs) | | | | Potential Fatality | | | | | 2. Safe and correct wheel stud/nut torque can only be achieved using purpose designed torque tools, manual or hydraulic. |
| | | using a hydraulic torque multiplier tool. The SWP was not fully followed and instead of | | | | | | | | | 3. Rattle guns must only be used to tighten the wheel studs/nuts and must not solely be relied on to torque up wheel suds/nuts. |
| | | checking to establish the correct air regulator setting, the tyre serviceman used a setting he thought was correct which resulted in the wheel not being torqued sufficiently. | | | | | | | | | 4. Ensure that torque tools are able to deliver the required OEM specified torque, are inspected, fit for purpose and fully serviceable before the job commences. |
| | | This caused the wheel assembly to come loose and detach from the truck before the truck was returned to the tyrebay for its first inspection and wheel stud torque check. | | | | | | | | | 5. The torque tool, manual or hydraulic, must be 'in calibration' and the calibration certificate must be readily available. Note: The work must not proceed if the torque gun is 'out of calibration' - this can be verified by checking its last calibration date, this must be less than 12 months old. |
| | | Considerable property damaged occurred as did a minor oil spill, no personal injury occurred, however it | | | | | | | | | 6. All wheel / rim / hub mating surfaces must be thoroughly cleaned and inspected before fitment as per SWP. |
| | | | | | | | | | | | 7. All wheel studs, Nuts, Cleats etc. are to be inspected individually for damage, corrosion and damage, and be cleaned as per SWP. |

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| | | | | | | | | | | | 8. Damaged/stretched or corroded wheel studs/nuts are to be replaced. Stud holes are to inspected also for ovality or other damage. |
| | | | | | | | | | | | 9. For hydraulic torque multiplier tools, the air regulator chart must be current, and available at the tyre bay so that the serviceman can correctly set the tool to deliver the OEM required torque, failure to consult with the chart will result in the wheel not being torqued to the correct setting and cause the wheel to become loose in service. Note: Do not proceed unless the chart had been checked and the correct setting has been established. Charts are not interchangeable, and each tool must have its unique chart (refer to serial number of gun) available in the tyrebay. |
| | | | | | | | | | | | 10. Where required by the OEM, ensure the correct lubricant type and amount is applied to the stud/nut, and never over tighten a wheel stud/nut beyond its OEM specified torque. |
| | | | | | | | | | | | 11. Failure to abide by these simple steps will not only cause a hazardous condition, putting people and equipment at risk, but may also result in disciplinary action including dismissal. |
| 63. | [63] | A tyre serviceman received minor abrasions to his hand when he was attempting to change out the damaged valve core housing from a fully inflated tyre assembly. | The root cause was attributed to the tyre not being deflated with a super large bore inflator tool before removal/replacement of the valve component. | LTA deflation practice. | N | Injury | LTA maintenance | Pressure | LTA work method | LTA hazard identification | This task may only be carried out by trained and competent personnel in accordance with the sites Safe Work Procedure (SWP). |
| | | | | | | | | | | | 2. PPE including safety glasses/goggles, gloves, hearing and head protection are mandatory during this task. |
| | | While the actual injury was minor, there was the real potential of air/particle injection into his hand, or | | | | | | LTA task planning/preparation | LTA Hazard recognition/perception | | 3. Set up the vehicle as if performing a normal tyre change as per site/vehicle SWP including placement of wheel chocks, isolation, hosing down and full assembly inspection before proceeding. |

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| | | | | | | | | | | | 4. Where valve assemblies are to be changed out on front or single tyre positions, the vehicle is to be jacked and supported as per site and vehicle SWP. |
| | | | | | | | | | | | 5. This is to be followed by full deflation of the assembly using a super large bore inflator (where possible) as per site/vehicle SWP. |
| | | | | | | | | | | | 6. Where valve assemblies are to be changed out on rear (dual) positions which require removal of one/both tyre/rim assemblies, the vehicle is to be jacked and supported as per site and vehicle SWP, and both assemblies are to be deflated as per site/vehicle SWP. |
| | | | | | | | | | | | 7. Once fully deflated the valve assembly may be removed and replaced. Check for the cause of the damaged valve assembly. |
| | | | | | | | | | | | ***Note: All required PPE including gloves must be worn to minimize potential hand injuries. Throughout the process, never stand directly in front of the valve or tool to avoid being hit by high pressure air, grit or the tooling itself should the tool or valve assembly fail.*** |
| | | | | | | | | | | | 8. Re-inflation of the assembly can then be carried out as per site/vehicle SWP. |
| | | | | | | | | | | | 9. During re-inflation, all necessary integrity checks must be completed to ensure that the tyre and rim components are mating/seating as required as per site/vehicle SWP. |
| 64. | [64] | A tyre serviceman was manipulating a loose **63" scrap tyre** onto a stack of same sized tyres when the tyre he was manipulating dropped clear from the tyrehandler hands. (Tyrehandler attachment/forklift combination) | The root cause was attributed to the tyre not being gripped firmly enough to prevent it from slipping from the handler. | Uncontrolled handling of tyre (LTA grip). | N | Potential Fatality | LTA maintenance | Wet/ damp tyre | LTA work method | LTA hazard identification | 1. Only competent operators are permitted to operate the tyrehandler. |
| | | | Tyre was worn. | | | | | | | | 2. Carry out a prestart inspection of the tyrehandler in line with established proformas and Klinge SWPs. Particular attention needs to be given to ensure the tyre hands and grip buttons of the tyre hand pads are clean. |
| | | The tyre ricocheted off the stack, landed | | | | | | | LTA Hazard recognition/perc | | 3. Ensure no personnel is in the direct vicinity of machine and tyre being manipulated. |

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| | | | | | | | | | | | a. Positive Communication: the operator of the tyrehandler is to clearly communicate what and how he is going to manipulate the tyres, or other items being handled. |
| | | The tyre was damp/wet. | | | | | | | | | b. Stand Well Clear: Any persons on the ground must ensure they stand well clear of the machine and be in clear view of the operator at all times while tyres are being manipulated. |
| | | While there were no personnel on the ground, the incident had the potential to cause serious injuries. | | | | | | | | | 4. Tyres must be firmly gripped, and before being moved, the operator should lift the tyre a short distance off the ground and firmly rock it using the hydraulic controls of the machine. The tyre should be held horizontally, and vertically while being rocked to check firmness of the tyrehandler grip. |
| | | | | | | | | | | | 5. If deemed safe, when carrying the tyre, it should be held horizontally and as low as possible to |
| | | | | | | | | | | | the ground. |
| | | | | | | | | | | | 6. Only if necessary rotate the tyre into a vertical position. |
| | | | | | | | | | | | 7. Wet or muddy tyres are to be treated with extra caution, if unsure scrap stacks should be limited to '2 high', with the third tyre being added once the tyre tread has dried off. |
| | | | | | | | | | | | 8. Never allow anyone to stand between the tyrehandler hands while loose tyres are being handled. |
| | | | | | | | | | | | 9. The same precautions need to be adopted when manipulating fitted tyres/wheel assemblies, |
| | | | | | | | | | | | a. Note: Tyre service personnel may enter the space between the tyrehandler arms if, and only if the assembly has been pushed onto the rim/hub and is held in position securely by the tyrehandler, and the machine operator and tyre serviceman have positively communicated the next task steps with each other. |

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| 65. | [65] | A tyre serviceman was adjusting the inflation pressure of an OTR truck tyre using a large bore inflation tool. As he was trying to check the pressure using a handheld gauge, the large bore inflation tool dislodged from the valve stem and caused the tyre serviceman to be hit in his face by the high pressure air escaping from the valve assembly. | Large bore inflation tool may not have been properly attached to the valve stem or threads on tool/valve stem may have been worn. | LTA tooling | N | Injury | LTA maintenance | LTA tools/ equipment / materials (condition/availability/ suitability) | LTA work method | LTA hazard identification | Pressure adjustment - inflation or deflation must only be carried out by trained |
| | | The person involved was wearing safety glasses, hearing protection and a safety hat. | | | | | | | | | and competent personnel in accordance with the sites Safe Work Procedure (SWP). |
| | | While the hearing protection and safety hat were blown off the persons head by the air blast, the safety glasses appeared to remain on his face saving him from serious eye injury. | | | | | | | LTA Hazard recognition/perception | | 2. PPE including safety glasses or goggles, hearing and head protection are mandatory during this task. |
| | | | | | | | | | | | 3. Any tooling used must be 'fit for purpose' and be checked prior to use for any defects such as worn threads or other damage. Worn or damaged tools must be replaced. |
| | | | | | | | | | | | 4. Before attaching the inflation tool to the valve stem, ensure that both the valve stem and the inside of the tool is free of dirt and the thread is serviceable so that the tool can be fully screwed on and become secured to the valve stem. |
| | | | | | | | | | | | 5. Throughout the process, never stand directly in front of the valve or tool to avoid being hit by high pressure air, grit or the tooling itself should the tool or valve assembly fail. |

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| | | | | | | | | | | | 6. Before removing an inflation tool, ensure that the tyre is either completely deflated (check with pressure gauge) or the valve core housing has been fully inserted and seated. |
| | | | | | | | | | | | Always check to ensure each and every step of the SWP is followed as short cuts and or partial completion can result in unexpected loss of pressurized air which is highly hazardous. |
| 66. | [99] | A tyre had been fitted on a 'rim mounting jig', some times also referred to as a 'dummy rim'. | Incorrect tyre/rim match during assembly. | LTA matching of assembly components. | N | Potential Fatality | LTA design, construction, commissioning | LTA hazard analysis | LTA work method | LTA hazard identification | Use a separate and approved engineered support stand for all mounting of tyres to rims to avoid having a 'rim mounting jig' on site – this will eliminate to Potentialfor accidental fitment of a 'rim mounting jig' instead of the correct rim. |
| | | | | | | | | | | | 2. Where such a 'rim mounting jig' is in use it must be engineered and certified, and be permanently attached to a base so it becomes visually and physically differentiated to other rims, and cannot be fitted to a vehicle. |
| | | For reasons unknown, this assembly - tyre and 'rim mounting jig', was then mounted to a truck instead of a 'fit for purpose' tyre and rim assembly. During service, the tyre lost air, came free and slipped off the 'rim mounting jig'. | | | | | LTA maintenance | | LTA Hazard recognition/perception | | 3. Where a disc type 'rim mounting jig' is used, any nave plate mounting holes are to be blanked off to prevent accidental mounting to any vehicle. |
| | | | | | | | | | | | 4. Where a rim type 'rim mounting jig' is used, accidental fitment must be made impossible by suitable and approved engineering modifications so accidental fitment over a vehicle hub is not possible. |
| | | While there was no injury or damage, this incident had the potential to cause serious injury to the operator and the equipment. | | | | | | | | | 5. Where such jigs are used, update relevant Safe Work procedures (SWPs) procedures to prevent accidental fitment of a 'rim mounting jig'. |
| | | | | | | | | | | | 6. Where such jigs are used, do not store the jig with other wheels/rims but keep separate with tyrebay tooling to avoid accidental use, and ensure that the jig is clearly identified against accidental misuse. |

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| | | | | | | | | | | | 7. Use this incident as a training case study, and or as a discussion tool in preshift meetings. |
| | | | | | | | | | | | 8. If there are any doubts, **STOP**, and seek assistance from your supervisor. |
| 67. | [67] | A tyre serviceman was using a forklift to transport a tyre. | Tyre was not positioned flat on tynes nor was it tied down while it was being transported. | Uncontrolled handling of tyre (LTA grip). | N | Potential Fatality | LTA maintenance | LTA task planning/preparation | LTA equipment / materials handling | LTA hazard identification | 1. Ensure there is a SWP for the vehicle which includes all/any likely use. |
| | | The tyre was not carried flat on the forklift tynes but was leaning against the mast. | | | | | | | | | 2. Ensure the load can be safely carried by the forklift. |
| | | The tyre was not secured. During transport, the tyre slipped forward and came to rest on the forklift tynes. | | | | | | Complacency/ motivation/attitude | LTA work method | | 3. If not fully supported by the forklift tynes, the load needs to be restrained securely using appropriate tie-downs so it cannot move. |
| | | While there was no injury or damage, this incident had the potential to cause serious injury to the serviceman, bystanders and the equipment. | | | | | | | | | 4. Drive according to conditions, if the load obstructs the drivers view, then operate the forklift in reverse. |
| | | | | | | | | | LTA Hazard recognition/perception | | 5. If there are any doubts, **STOP**, and seek assistance from your supervisor. |

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| 68. | [68] | Loose Wheel on a Rear Dump Truck: After routine tyre changes were carried out on the rear axle of a haul-truck an information tag was attached to the dashboard for the vehicle to be returned after 2 hours of service so the wheels could be retorqued.<br><br>The vehicle was not returned for its scheduled retorque adjustment resulting in the wheel coming loose some time later causing damage to both rim and hub. | Vehicle was not returned for retorque (as per procedure which caused wheel to become loose and come off during service. | LTA procedure | N | Potential Fatality | LTA awareness, competence and behaviour. | Complacency/ motivation/attitude | LTA procedural compliance<br><br>LTA work method<br><br>LTA Hazard recognition/perception | LTA hazard identification | After any wheel assembly has been refitted which requires the attachment system to be retorqued, an information, retorque or mine site specific tag is to be attached by the tyre serviceman in a visible location to the inside of the vehicle cabin (eg. retarder lever).<br><br>2. As the vehicle is handed back to production, or the vehicle remains down for further mechanical maintenance, Dispatch and or Operations Supervision is to be notified to raise a retorque alert on the mines dispatch system and or to remind the operator about the vehicles retorque requirements. These actions will alert both the operator and dispatch that a retorque is due should the tag accidentally be overlooked.<br><br>3. Tyre service personnel are to maintain up-to-date records of outstanding retorques each shift, and action any outstanding retentions.<br><br>4. After a vehicle has been retorqued, the tag is to be signed by the tyre serviceman, stapled to the tyre change documentation and be securely filed.<br><br>5. Communication with Operations personnel: all personnel are to be made aware of the importance of wheel retentions and potential risks if retentions are not carried out. |
| 69. | [69] | An assembled tyre and rim (14.00R20) had just been inflated (100 psi) by a Tyre Serviceman when the tyre | Zipper failure during inflation | Zipper failure | N | Potential Fatality | N/A | Pressure | N/A | N/A | Before fitting a tyre, visually inspect the tyre for any damage or signs of deterioration – especially marks of having been 'run flat' or under inflation. |

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| | | | | | | | | | | | 2. Size permitting, inflate all tyres in a tyre inflation cage. |
| | | The assembly was still contained in a Safety Inflation Cage but the Tyre Serviceman suffered minor bruising to the knee when the air hose flew off. He was wearing correct PPE. | | | | | | LTA equipment integrity | | | 3. As a minimum, Eye and Hearing Protection must be worn during inflation.<br>4. Use a remote inflation hose (minimum 3 m in length) with a quick dump valve during inflation.<br>5. Do not stand in front of the cage, during inflation.<br>6. Listen for popping/cracking noises while inflation is in progress – stop the inflation immediately and deflate if such noises are heard from the tyre.<br>7. After inflation has been completed, leave the tyre in the cage for a few more minutes before removal.<br>There is almost no way to determine whether a tyre will be subject to zipper failure, however strict adherence to the above steps will minimise the risk should such a failure occur. |

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| 70. | [70] | Caterpillar truck position 3 and 6 wheel assemblies were removed by tyre servicemen to allow for subsequent work by the maintenance team. After removal, none of the wheel studs holding position 3 and 6 were replaced. It then became necessary to relocate the vehicle with only position 4 & 5 tyres in place. As the planetary drive cover was not secured by the outside position wheel studs, it came loose causing the loss of planetary gear oil and resultant environmental contamination. | Movement of vehicle le partly disassembled. | LTA procedure | N | Equipment Damage | LTA communication, consultation and participation | LTA task planning/preparation | LTA change management | LTA hazard identification | **1.** When a number of work teams work on the same vehicle, ensure there is clear communication and a common understanding of the job and its impacts before a job is commenced , i.e. a task carried out by one party must not create an adverse situation for the other party. |
| | | This incident not only resulted in environmental contamination but also had the potential to cause considerable damage to the planetary drives of the equipment. | | | | | | | | | **2.** Before a truck can be relocated with Pos 3 and 6 assemblies removed, ensure that at least 20 wheel studs are fitted evenly around the hub to the outside positions – this action is to be adopted for all CAT 785, 789,793 & 797 trucks. |
| | | | | LTA communication between work teams. | | | LTA maintenance | | LTA Hazard recognition/perception | | **3.** Check relevant SWPs and OEM documentation if this precaution also applies to other trucks and type of equipment. |

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| 71. | [71] | A modified CAT 773 fuel truck was being jacked on an incorrect jacking point resulting in some damage to the vehicle. While no injury occurred to the tyre service personnel, this incident had the Potential to cause a fatality/serious injury as well as considerable damage to both the truck and the jacking equipment. | Incorrect jacking of machine using non approved jacking point. | Incorrect jacking | N | Potential Fatality | LTA maintenance | LTA competence/experience/skill for the task | LTA hazard recognition/perception | LTA hazard identification | Mandatory actions and controls to prevent this accident from recurring are:<br><br>1. All personnel must be familiar with the task at hand – refer to the correct safe work procedure (SWP) for the specific vehicle, and carry out a JSA covering all task steps before commencing the work. If in doubt – STOP, and get assistance.<br><br>2. Ensure only OEM recommended jacking and vehicle support points are used - Do not use<br>any alternative jacking/stand points unless approved by the OEM. |
| 72. | [72] | An articulated truck slipped off its jacks during tyre maintenance after the vehicle was bumped by the tyrehandler.<br>While no injury or damage occurred to the tyre service personnel and the equipment,<br>this incident had the potential to cause a fatality/serious injury as well as considerable damage to both the truck and the jacking equipment. | Support stands were not installed after the vehicle had been jacked nor was the articulation pin fitted to prevent the machine from jack-knifing. | LTA / No support equipment other than jacks | N | Potential Fatality | LTA maintenance | LTA competence/experience/skill for the task | LTA hazard recognition/perception | LTA hazard identification | Mandatory actions and controls to prevent this accident from recurring are:<br><br>1. All personnel must be familiar with the task at hand – refer to the correct safe work procedure and carry out a JSA covering all task steps before commencing the work. If in doubt – STOP, and get assistance.<br><br>2. Ensure wheel assemblies and jacking/support points have been cleaned.<br><br>3. Ensure correct vehicle jacking and support points are used to support the machines weight, this will ensure the machine is both stable and does not cause any damage to the chassis.<br><br>4. All vehicles, after jacking, must be supported by approved vehicle stands of sufficient capacity, unless a suitable 'lift and lock' jack is used.<br><br>5. If tyre maintenance is being performed on an articulated vehicle, the articulation pin must be fitted, this will ensure that the vehicle will not accidentally jack-knife off the jacks/stands should it be pumped during maintenance. |

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| 73. | [73] | A tyre service person was knocked to the ground after the driver of the light vehicle he had just finished servicing reversed out of the service bay without paying due care to his surrounds. | Contributing factors were the haste of the driver and less than adequate communication between both parties involved. (the driver had just received a mobile phone call) | Driving without due care<br>LTA communication between work teams. | N | Potential Fatality | LTA awareness, competence and behaviour. | Complacency/ motivation/attitude<br>Distraction/preoccupation | LTA Hazard recognition/perception | LTA hazard identification | Any vehicle entering the tyrebay must be guided in and positioned in the service area.<br><br>All vehicles are to be positively isolated and chocked. If a light vehicle cannot be isolated, the ignition keys are to be removed to a safe place.<br>The vehicle driver is not permitted to remain in the work area.<br><br>Upon completion of the work the isolation and wheel chocks are to be removed, and the vehicle is to be handed over to the owner/custodian.<br><br>All vehicles leaving the service area are to be guided out. |
| 74. | [74] | A tyre serviceman lost part of his thumb as he was removing the O-ring from a rim. | Not using a small lever to remove O-ring from groove | LTA tooling | N | Injury | LTA maintenance | Complacency/ motivation/attitude | LTA equipment / materials handling<br>LTA work method | LTA hazard identification | Ensure you have been trained in this task and are fully aware of the potential pinch hazards.<br>Never use your hands/fingers to insert and or remove an O-ring.<br>For both installation and removal, always use the appropriate tools such as tyre levers or long screwdriver to guide the O-ring into its groove, or pry the O-ring out of its groove and pull it off the rim.<br>Use a lever to ensure your hands and fingers are **NEVER** directly in the pinch (danger) zone should the tyre or bead seat band move unexpectedly. |

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| 75. | [75] | A tyre serviceman was fitting a wheel to a truck using a tyre handler machine. After positioning the wheel vertically on the hub, he alighted from the tyre handler to check the fitment. As he was standing between the arms of the manipulator, the tyre handler slowly crept forwards despite the handbrake having been applied. This near miss could have resulted in injury /fatality of the serviceman. | Tyrehandler was not chocked | LTA chocking of vehicle | N | Potential Fatality | LTA maintenance | LTA equipment integrity | N/A | LTA hazard identification | To access the work area in front of tyre hand while gripping/manipulating a tyre/wheel, the following controls will be adopted at all Klinge sites.<br><br>1. Before entering the direct work area in front of the tyre handler, ensure that the tyre is adequately and securely clamped in the jaws of the tyre handler.<br><br>2. Ensure that the work is performed on flat even ground – ensure the tyre handler does not sit in any type of drain while the work is being performed.<br><br>3. Ensure the park brake is applied. Park brakes must be tested regularly to ensure they hold firm.<br><br>4. In addition, Wheel Chocks are to be placed in front of and behind one front tyre to eliminate any movement of the machine.<br><br>5. Ensure area free of trip hazards eg tools.<br><br>6. Ensure that tyre handler arms are free of oil/grease or mud.<br><br>7. Ensure good lighting of immediate work area. |

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| 76. | [76] | A wheel loader requiring wheel change on all positions was fully raised using the loader bucket hydraulics and then supported by 2 stands positioned near the articulation point, and the loader bucket itself. All wheels were off the ground during the wheel change. On removal of the safety stands (by raising the machine with the loader bucket), one of the stands toppled causing damage to the machines transfer case.<br><br>This incident not only required repairs, but also had the potential to cause serious injury to the tyre service personnel as the loader was not properly secured against movement.<br><br>Caution: Whilst this alert relates to a wheel loader the following solution also applies to all vehicles/equipment with self lifting/jacking capabilities. | Uncontrolled raising of loader using bucket controls as supports were withdrawn. | Incorrect jacking | N | Potential Fatality | LTA maintenance | LTA task planning/preparation | LTA supervision | LTA hazard identification | ▪ Check and Follow Safe Work Procedures at all times – do not improvise or rely on procedures that may apply only to other equipment. If in doubt, stop and ask your supervisor and carry out a risk assessment!<br><br>▪ Where fitted, insert the anti-slew bar or locking pin to prevent articulation of the vehicle.<br><br>▪ Change wheels 'axle by axle', i.e. support'one axle at a time' and carry out the wheel change, then support the other axle and carry out the wheel change.<br><br>▪ All equipment must be chocked against accidental movement – never raise all wheels off the ground unless approved as per manufacturer procedure using manufacturer approved stands/support. |
| | | | | | | | | LTA hazard analysis | LTA work method | | |
| | | | Vehicle was not secured to prevent movement as all wheel positions were off the ground. | | | | | | LTA hazard recognition/perception | | |

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| 77. | [77] | The rear window of a service utility sustained some damage after it was hit by a heavy object carried in the tray of the vehicle without being secured – while the vehicle was travelling, the unsecured load shifted and impacted the back of the cab damaging the rear window.<br><br>This incident had the potential to cause serious injury to the occupants of the vehicle, bystanders and property, particularly at increased vehicle speed. | Equipment carried in LV tray not secured | Equipment in transport not secured | N | Equipment Damage | LTA operations | LTA task planning/preparation<br><br>LTA hazard analysis | LTA equipment / materials handling | LTA hazard identification | To avoid incidents like this from recurring, ensure you always adhere to the following points:<br><br>All loads must be placed into the tray of the vehicle and properly secured using the supplied tie-down straps – check the straps each time you use them and ensure they stay with the vehicle. Only use proper tray tie-down points to secure the load.<br><br>Ensure that the load can safely be carried by the vehicle – never overload the vehicle!<br><br>Tools incl. stands, jacks, tyres, rims etc must not be carried inside the passenger compartment.<br><br>Loose items in the passenger compartment must be restrained or placed on to the floor of the vehicle.<br><br>Loads must not protrude from the side of the vehicle and must not interfere with the forward or rearward vision of the driver.<br><br>If a load protrudes from the front or back of the vehicle, you must abide by site/relevant government traffic rules and attach a suitable warning flag to the item.<br><br>When loaded, drive at reduced speed, particularly in corners, and allow for increased braking distance. |
| | [78] | A high potential incident occurred to | LTA mechanical integrity of tyrehandler arm causing | LTA integrity tyrehandler | N | Potential Fatality | LTA legal requirements, | LTA equipment integrity | N/A | N/A | The exact root cause of the failure has not been established, however this incident is a |

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| | | | | LTA material testing/fatigue NDT | | | | | | | |

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| 79. | [79] | A tyre serviceman received serious injuries to his hand while using a hydraulic Portapower tool. Despite wearing PPE (gloves), high-pressure oil was injected into his hand from the equipment when the hose ruptured where he was holding it. He required emergency hospitalization and surgery. | Failure of high pressure oil line and oil injection into skin | Failure of high pressure oil line | N | Injury | N/A | Pressure<br><br>LTA equipment integrity | LTA Hazard recognition/perception | LTA hazard identification | To avoid such accidents at your workplace, follow site safe work procedures and<br><br>o Check the Portapower tool for any defects each time prior to using it; pay particular attention to examining the hose and all fittings closely for cracks, kinks or other signs of damage.<br><br>o Do not lift the hydraulic pump or ram head by the connecting hydraulic hose – this will weaken the connections.<br><br>o Ensure the hydraulic ram is properly secured before you start pressurizing the system.<br><br>o **Stop and check for any leaks**, particularly on the ram and the hose while pressurizing the system – stop and repair any leaks before proceeding.<br>o Do not hold the hose with your hands or support it with other parts of your body while pressurizing the system.<br><br>o After your work is completed, carefully store the Portapower tool in an appropriate area. |
| | [80] | An incident occurred where a tyre handler | Operation of a large machine in an area too | Confined working | N | Equipment Damage | LTA maintenance | Congestion/restriction/access | LTA work method | LTA hazard identification | In situations where a machine requiring tyre maintenance is parked in locations such as |

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| | | | | | | | | | LTA hazard recognition/perception | | |
| 81. | [81] | A tyre service man observed a lock ring, mounted on a rim in a hazardous state - the lockring had started to creep out of the lockring gutter section of the rim base after the tyre had been inflated. The tyre was safely | Inflation of an assembly fitted with corroded and pitted lockring. | LTA matching of assembly components. | N | Potential Fatality | LTA maintenance | LTA tools/ equipment / materials (condition/availability/ suitability) | LTA hazard recognition/perception | LTA hazard identification | If the tyre assembly is to be used for Underground Service, then replace the Lock Ring at each Tyre Change to ensure safety.<br><br>For Surface Service, replace Lock Rings in accordance with Site Specific Safe Operating Procedures (SOP) or when wear, rust, pitting and or damage is evident.<br><br>All Rim Bases must be NDT tested (non destructive testing) in accordance with site |

| | Source or Reference | Brief Description (escalation of incident), & description of consequences/outcomes | Identified Root Causes – Long Description | Root & Contributing Cause(s) – short description | Actual/ Potential Fire or Pyrolysis Event | Stated or Potential Consequence | Org. Factors | Task or Environmental Conditions | Individual or Team Actions | Absent failed Defences | Preventative /Recommended /Accepted Steps of Risk Mitigation, Points of Interest |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | LTA competence/experience/skill for the task | | | |
| | | | | LTA rim integrity | | | | | | | |
| 82. | [82] | A tyre serviceman sustained a fracture to his lower leg while attempting to break the bead on a 2900 rim/tyre assembly.<br>At the time a crowbar was in use to lever the rim flange to allow spacer washers to be inserted to permit the introduction of a hydraulic bead breaker tool.<br><br>The serviceman applied downward pressure on the crowbar, it dislodged from the pry-pocket on the rim base and he lost his balance.<br>As he twisted to regain his balance, he sustained a fracture to his lower leg.. | LTA manual handling | LTA manual handling | N | Injury | LTA maintenance | N/A | LTA work method | LTA hazard identification | Tyre maintenance work involves lifting, pushing, pulling etc. and we need to be mindful of the risks through any manual handling activity: Specifically…<br><br>When exerting any manual force (lifting, pushing, pulling etc.) the person needs to position him or her self to maintain full balance should the tool or work piece slip or move away.<br><br>Also, PPE footwear must be in good condition and provide firm ankle support. Check the grip of your shoe soles for wear. |
| | | | | | | | | | LTA Hazard recognition/perception | | |

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