



# **SAFETY GUIDELINES: PREVENTION OF WHEEL DETACHMENT**

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## 1 Introduction

Road transportation is most widely used means of transporting bulk cryogenic gases and packaged compressed and/or liquefied gases from main facilities to branch facilities and from these facilities to our customers.

Trucks typically are equipped with 6 to 10 wheels and for the semi-trailer truck configuration, 18 to 22 wheels are common sight. A typical truck wheel consists of a metal rim with rubber compound tyre (in American English: tire) and can weigh up to 50kg or more each.

Wheel detachment can occur on any wheel axle of the truck, resulting in the loss of one or even both wheels. The immediate hazard of an uncontrolled high speed loose wheel is:

- Moving projectile
- Loss of steering control if the detached wheel is from the front steer axle
- Loss of stability of the semi-trailer or trailer chassis which may lead to rollover

The moving projectile (loose wheel) a speed of 60km/h can lead to serious injuries or even death of other road users, including the drivers themselves. Potential road safety events are:

- Fatality of the truck driver due to loss of control of truck
- Fatality of other vehicle driver due to serious damage of vehicle or loss of control of vehicle
- Fatality of a motorcyclist, cyclist or pedestrian when struck by the moving projectile
- Serious damage to third party vehicles on the road
- Serious damage to third party properties along the road

This document highlights the contributing causes and factors of wheel and associated components to wheel detachment road safety event. The common causes of wheel detachment will cover the roles of personnel in the transport team to detect potential wheel detachment events and to prevent them from happening when on the road. Procedural compliance by maintenance personnel on wheel removal and fitment of wheel at all times, namely during tyre change in authorised workshop and during roadside breakdown or emergency activation.

## 2 Scope

This document applies to heavy-duty product vehicles such as lorries (trucks), prime movers, semi-trailer trucks.

This document does not cover private or non-commercial vehicles.

## 3 Definitions

For the purpose of this publication, the following definitions apply.

### 3.1 Publication terminology

#### 3.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

#### 3.1.2 Should

Indicates that a procedure is recommended.

#### 3.1.3 May

Indicates that the procedure is optional.

#### 3.1.4 Will

Is used only to indicate the future, not a degree of requirement.

**3.1.5 Can**

Indicates a possibility or ability.

**3.2 Technical Definitions****3.2.1 Rim**

Metal (Steel or aluminium) structure frame in circular shape that can be fitted with a tyre (tire).

**3.2.2 Tyre**

Natural or synthetic rubber mixed with other filler and binder compounds with specially designed thread pattern. Normally fitted to a metal rim and inflated with compressed air or nitrogen gas.

**3.2.3 Wheel**

A metal rim fitted with an inflated tyre (tire).



### 3.2.4 Wheel Axle

Collection of components assembled together to attach wheel hub to the vehicle chassis



### 3.2.5 Wheel Hub

Component to hold the wheel studs



### 3.2.6 Wheel Stud (Wheel Bolt)

Mounting bolts to hold and attach the wheels to the axle



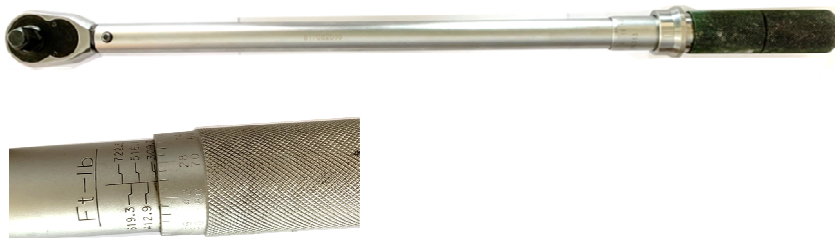
### 3.2.7 Wheel Lug Nut (Wheel Nut)

Securing nut to secure the wheels via the wheel studs



### 3.2.8 Torque and re-torque

Torque - Using a calibrated torque wrench with OEM set value to tighten and torque the lug nuts.  
Re-torque – To verify the initial torque value as above



### 3.2.9 Authorised workshop (insourced / outsourced )

A workshop / contractor that was audited and certified competent to perform the tyre change out as per user requirement.

### 3.3.0 Unauthorised workshop (outsourced )

A workshop / contractor that was not audited or certified to perform the tyre change out.

## 4 Causes of Wheel Detachment (Wheel Disengagement)

Generally, FTA (Federal Transit Administration) and IRTE (Institute of Road Transport Engineers), identify the various contributing factors and one common culprit is the misused of the air impact wrench to fasten the lug nuts.

Other contributing factors are

- Materials degradation, worn off thread, damage wheel nuts washers
- Improper maintenance procedure resulting in insufficient clamping force

- Fit up alignment, foreign objects, corrosion between rims surface
- Improper tighten of wheel lug nuts and allow the wheel to wear
- Failure to conduct regular inspection
- Incorrect lubrication of thread and interfaces
- Improper OEM preventive maintenance for axle and bearings
- Studs not pressed fully to into the hub
- Misuse of air impact tools
- Torque wrench not calibrated or exceeded the calibration validity date

#### **4.1 Failure of studs**

The general cause describe below could result in the studs failure

- Over-torque
- Under-torque
- Use of incorrect lug nut

#### **4.2 Loss of lug nuts**

- Did not tighten the lug nuts
- Over / under tighten of lug nuts
- Lug nuts loosened during vehicle movement
- Using of non-OEM lug nuts (different size, materials)
- Worn off threads or damage washers

#### **4.3 Improper fitment of rims**

- Poor cleaning of mating surfaces prior to assembly

### **5 How to Prevent Wheel Detachment?**

Driver role: Check for wheel and lug nuts condition.

- Pre trip and post trip inspection
  - Visual aid such as wheel nut indicators
  - Indication signs of missing or defects lug nuts, bolts

Mechanic role: Proper preventive of maintenance and inspection in accordance to OEM procedures and standards

- Inspection of wheels, lug nuts and studs thread condition
- Using torque wrench to tighten and torque the lug nuts as per specification
- Torque wrench should be validated and certified

#### **5.1 Work Done in Authorised Workshop (Insourced / Outsourced)**

Wheel re-torque can either be done after the vehicle has driven and completed the shift or recommended 200km maximum, using a calibrated torque wrench set to the manufacturer's specified torque value.

#### **5.2 Work Done by unauthorised workshop (Outsourced)**

In emergency cases, the tyre vendors being used may not be prequalified or OEM. In these cases, following the safe practise on tyre change out, the wheel assembly should be thoroughly inspected at an authorised workshop at the earliest opportunity, and preferably end of the shift.



At any stop opportunity, the driver should follow normal best practices to inspect the vehicles, including wheel assembly, before departure.

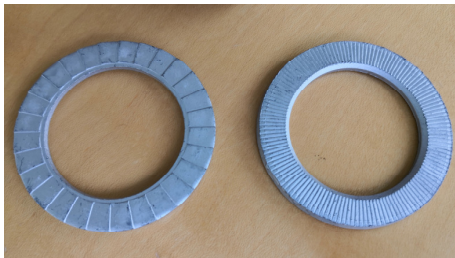
### 5.3 Use of Wheel Lug Nut Indicators

There are various types of wheel nut indicators available in the market. Although the shape and design are different, the main function is to alert the driver of a loosened wheel nut by the change in orientation of the indicators.



### 5.4. Use of wedge locking washer on wheel nut.

The use of wedge locking washer locks the nut in a secure position which is subject to higher vibration and prevents it from loosening.



## 6 References:

- [1] Michelin video clip on Wheel Safety
- [2] The Linde Group procedure VEH-01-04-GROUP Removal and Fitment of Commercial Vehicle Wheels
- [3] An FTA/IRTE best practice guide Edition 3, September 2015
- [4] Nord Lock wheel nut product information
- [5] ATE Wheel sentry – How to protect wheels and prevent wheel detachment, November 2015