TRUCK AND BUS TYRE | **TECHNICAL MANUAL**

MAINTENANCE AND CARE

About Tyre Inflation

ONE OF THE MOST IMPORTANT ASPECTS OF TYRE MAINTENANCE IS CORRECT INFLATION.

Correct inflation is needed to carry the load and avoid damage. Driving with improper inflation (particularly grossly under inflated or over inflated tyres) is dangerous and can cause critical damage or sudden failure of the tyre(s).

PROPER INFLATION SHOULD BE MAINTAINED AND CHECKED AT LEAST ONCE A WEEK AS WELL AS BEFORE A LONG DISTANCE DRIVE.

It is also advisable to take into account the axle load and driving conditions when setting inflation pressures. Compensation for heavier loads can be made by increasing inflation pressures. Make sure to not exceed the maximum inflation rates for the tyre or maximum load axle.

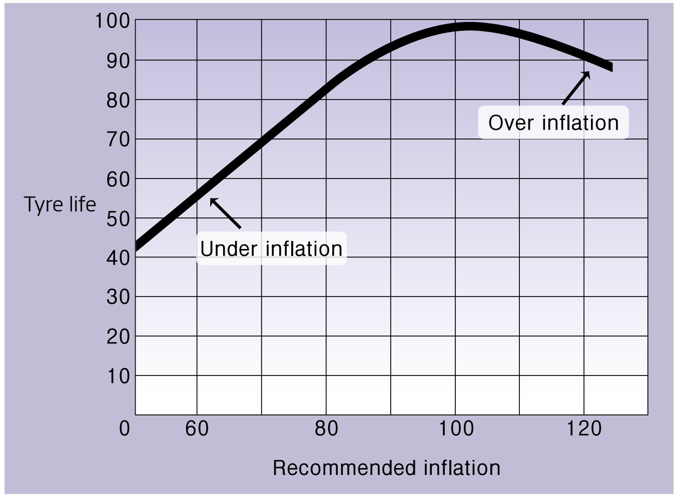
IN THE SPACE OF JUST ONE MONTH A TYRE CAN LOSE 10 POUNDS OF AIR PRESSURE.

It is important to check your air pressure regularly to make sure your tyres are neither under nor over inflated.

To keep running suitable inflation pressure:

· Check inflation pressure at frequent interval.
· Follow the recommended pressure guide in the vehicle, rather than setting the pressure at your discretion.
· Visually inspect tyres for any damages and consult a tyre specialist.
· Do not inflate with cold pressures beyond the recommended pressure.

INFLATION AND TYRE LIFE



UNDER INFLATION

The worst enemy your tyre can have. It causes increased treadwear on the outside edges (or shoulders) of the tyre and generates excessive heat, reducing tyre durability.
Soft tyres make your vehicle work harder, meaning that fuel efficiency is reduced as there is an increased rolling resistance.

OVER INFLATION

Is detrimental to the tyre as too much air pressure causes the centre of the tread to bear the majority of the truck's weight. This leads to faster deterioration and uneven wear. Any kind of uneven wear will also shorten the life span of your tyres.

LOADING

In terms of loading in your vehicle, overloading is very dangerous. It causes excessive tyre heat buildup and internal structural damage. This can lead to critical situation such as sudden separation of tyre, property damage and serious injury to persons.

Points to be aware of when loading into a vehicle:
· Check maximum load capacity at maximum inflation pressure marked on sidewall.
· Check inflation pressure which has a possibility to change by fatigue from continuous loading status during pre-trip vehicle inspections.
· Never exceed the Gross Vehicle Weight(GVW) of the vehicle.

Inspection

Tyre maintenance is very important for tyre performance, wear and safety. Inspecting tyres for punctures or other visible signs of damage before driving could prevent a serious accident. Check the tyres overall appearance and inflation pressure; including the spare tyre. Typical types of fatal external tyre damage include zipper rupture, penetration, crack and chip cuts (the tread surface is torn off) bulges and irregualr wear.

Zipper rupture

Penetration

Crack type 1

Crack type 2

Chip-cut type 1

Chip-cut type 2

Storage

Tyres should be stored inside and stacked vertically; never store tyres outside even with a protective covering. It is recommended for tyres to be kept cool, dry, moderately ventilated and out of the sun. Poorly stored tyres become distorted though excessive pressure and are subject to much greater damage from solvent, ozone or oxidative attacks compared to tyres well stored.

There are some recommendations you should know.

· Keep tyres away from direct sunlight.
· Keep tyres away from electric motors or generators producing ozone.
· Keep tyres away from moisture permeating inside and causing severe deterioration of the steel cords.
· Limit vertical stacking to a maximum of 5 feet (around 1.5m) in height.

Cleaning

Tyres are supposed to be black, however, there may be brown discolouration on the side wall. This is called Blooming.

Bloomimg

This is a general phenomenon triggered by the antioxidant added to rubber to protect tyres from premature deterioration, such as drying, peeling and cracking, through exposure to fluctuating environmental factors. Over time the antioxidant residue on the surface of the tyre shows as brown or white. This discolouration has no impact on the performance of the tyre.

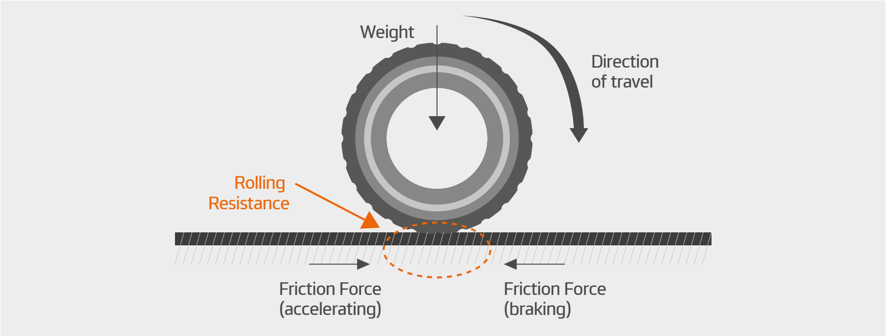
How to remove the blooming
Follow these five steps to clean the tyre

Step 1 Wet the discoloured area with clean water.
Step 2 Use a tyre soap and sponge pad to remove the blooming
Step 3 Rinse with clean water using a hose
Step 4 Wipe the tyre dry with a clean cloth.
Step 5 If the tyres are completely dry apply the tyre dressing

Fuel Economy

Fuel economy is a major focus for the automotive industry.
There are over 2 million vehicle components and tyres play a crucial role on vehicle fuel economy; incorrect use of tyres can a negative impact on fuel efficiency. There are many factors that can impact fuel economy ranging from Rolling Resistance (RR), vehicle load, speed, road conditions, vehicle design, axle alignment etc. Rolling Resistance (RR) is directly related to the tyre and explained in more detail below.

Tyre RR is the terminology used to describe the force resisting the rolling movement of the tyre on a surface - the greater the RR the poorer the fuel efficiency. Thereby the RR value of a tyre gives an indication of the fuel efficiency of the tyre.



What influences the Rolling Resistance (RR) of a tyre?

Technically there are several factors that can impact RR and fuel economy with two main factors being in the control of the vehicle user. Understanding what these are and what can be done will improve results in terms of fuel economy.

1. Tyre pressure

Low tyre pressure increases the tyre surface area in contact with the road which in turn increases the friction between the tyre and the road. Driving with under inflated tyres is an issue of safety as well as fuel efficiency. Properly inflated tyres in accordance with the vehicle manufacturer's recommendations will reduce RR and increase fuel economy.

2. Wheel alignment

For optimum fuel efficiency and to prevent accidents the tyres should be uniformly worn. Incorrect axle alignment causes irregular wear resulting in fuel economy losses due to increased wear volume and RR.

In both instances it is important to regularly check the tyre pressure and wheel alignment of a vehicle in order to achieve maximum fuel economy.

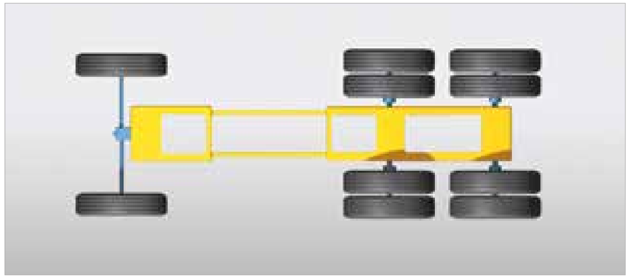
Truck Alignment and Tyre Wear

The two major things that affect tyre wear are :
- Inflation pressure
- Wheel alignment

COMPONENTS OF ALIGNMENT
- Toe
- Camber
- Caster
- Ackermann
- Axle parallelism
  - Thrust angle
  - Scrub angle

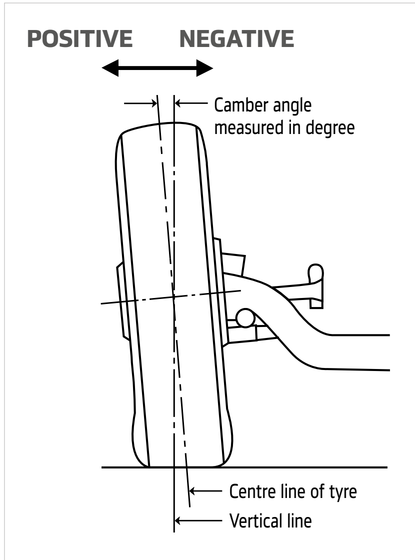
TOTAL WHEEL ALIGNMENT
Definition :
- The process whereby the vehicle and all the tyres are travelling in the same direction
- Steering axle alignment alone is not sufficient

ALIGNMENT AND WEAR



CAMBER
- Camber is the inward or outward tilt of the steering axle tyres when viewed from the front
- Positive camber is the top of the tyre tilted out
- Camber becomes more negative as the load increases

The angle that a centre line of the wheel is inclined from, the vertical centre line perpendicular to a flat road, is called camber angle. If the top of the wheel leans out from the perpendicular then it is positive camber. If the top of the wheel leans in from the perpendicular then it is negative camber.
Camber is meant to compensate for the downward forces of added loads. Correct camber settings help the tyre maintain a firm and even tread contact with the road while the vehicle is travelling under loaded conditions. Often wear at the outside or inside edge of the tyre may indicate incorrect camber setting.

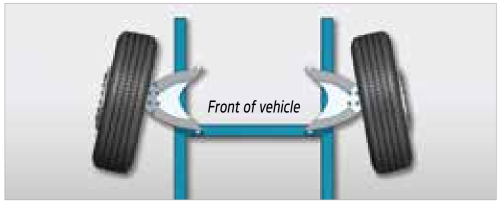


Positive camber

Negative camber

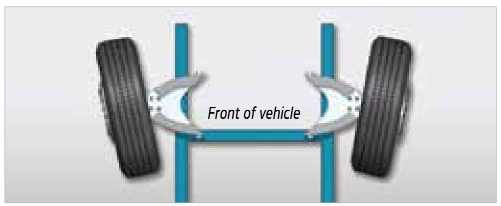
TOE

- Toe is the inward or outward pointing of the wheels when viewed from the top of the vehicle
- The goal is to have zero toe when the vehicle is loaded to its normal operating condition



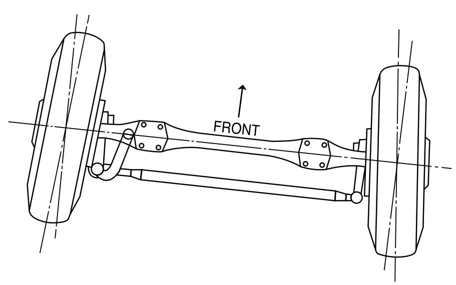
Toe-in refers to the inclination of the wheels of a vehicle so that the pair of front wheels (viewing from the front as per the illustration to the left), are closer together at the front than at the rear of the wheels.

The purpose of toe-in is to relieve or counteract some of the force which pulls wheels outwards as they roll along the road. Correct toe-in will ensure the rotation direction and direction of travel are as similar as possible at driving speed. Insufficient toe-in settings will result in steering instability.



The opposite is considered toe-out, see diagram as per the illustration to the left.

If toe-in or toe-out is insufficient or excessive the tyre wear will be effected and appear as feathering at the edges of the tread.



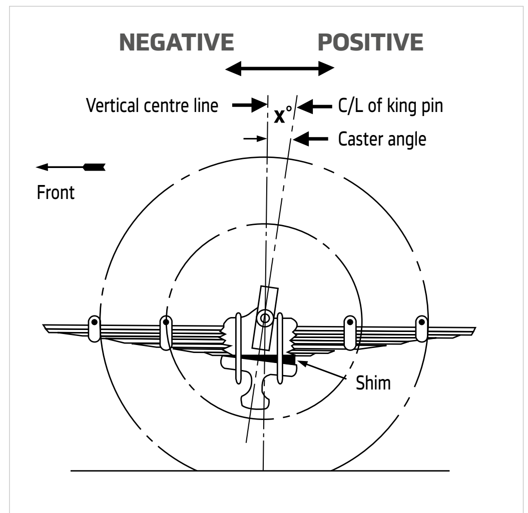
CASTER

- Caster is the forward or rearward tilt of the king pin of the steering axle when viewed from the side
- Caster is generally not considered to have a great effect on the tyre wear

Caster is the condition where the king pin is inclined with the top of the pin angled rearward similar to the front forks of a bicycle. Caster angle is meant to compensate for the resistance which the tyre(s) encounter(s) as a result of drag forces against the road. Caster angle should be the same for both wheels on a given axle or the result will be vibration and abnormal tyre wear.

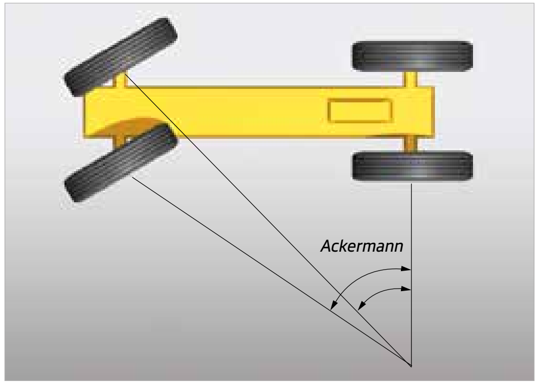
Too much caster will more than compensate for the amount of drag but it will also create additional difficulty in steering.

Too little caster makes steering become lighter but also unstable and can cause it to wonder. The caster angle should be checked as it can be distorted by impacts on the tyre or by driving in rough conditions.



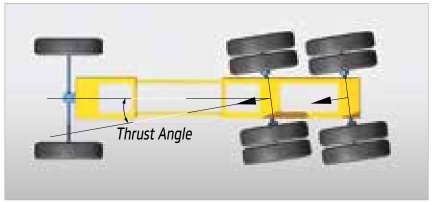
ACKERMANN

- The Ackermann Principle shows that in any turn the inside tyre needs a sharper turn angle than the outside tyre
- The difference in turn angles between the tyres is determined by the actual turn angle and the vehicle wheel base
- Improper Ackermann causes side force, excessive scuffing and fast or irregular wear



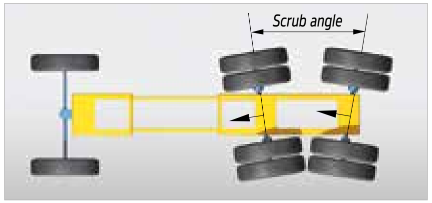
THRUST ANGLE

- Thrust angle is the difference between the line perpendicular to the axle and vehicle centre line
- Each drive axle has its own thrust angle
- The target is to have zero thrust angle



TANDEM SCRUB

- Tandem scrub is the difference in the thrust angles of the drive axles
- The target is zero
- Tandem scrub errors cause constant side force on the steer tyres. This leads to irregular wear



Abnormal Tread Wear

Under inflation and over inflation of the tyre is the prime cause of tread wear. However there are other conditions that influence tread wear and produce irregular wear patterns.

COMPONENTS OF ALIGNMENT

- Imbalance of the tyre or tyre and wheel assembly
- Improper wheel alignment
- Breaking system problems that may cause the wheel to lock up or flat spotting
- Bent or round rims
- Worn or damaged bearings
- Broken or worn shock absorbers, springs or steering components

ABNORMAL WEAR

DIAGONAL WEAR

SHOULDER WEAR CAUSED BY WRONG CAMBER OR MISALIGNMENT

Tyre Damage

Considerable loss of air can cause a rapid heat build up which can damage the tyre.
This may result in tyre failure or separations between the tread and carcass plies.

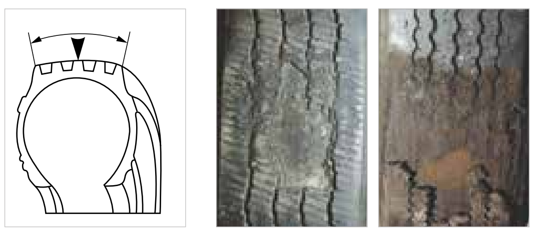
Care should be taken to avoid road debris, dirt or moisture penetrating any puncture or getting trapped inside the tyre, or between the wheel rim and tyre.
Damaged tyres should always be repaired or replaced at the earliest possible opportunity to avoid further tyre damage, possible tyre failure, vehicle or personal injury.

Check for and correct any of the following conditions:

DAMAGE DUE TO CONTACT WITH THE VEHICLE

- Improper tyre inflation
- Overloading
- Improper vehicle maintenance
- Brake system abnormalities
- Differences of tyres sizes or circumferences on the same axle
- Improper mounting of tyre or wheel
- Improper, worn or damaged valve
- Improper use of tube or flap

FLAT SPOTTING DUE TO LOCKED BRAKES



BEAD DAMAGE FROM CURBING

BURNT BEADS

RIPPED SIDEWALL

SIDEWALL DAMAGE DUE TO RUN FLAT OR SEVERE UNDER INFLATION

Tyre Damage due to Mounting Procedures

1. Bead hardening and multiple small cracks caused by incorrect tyre lubricant

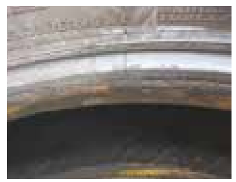
Appearance


Multiple small cracks on the bead

Main Cause

Application of incorrect tyre lubricant (waste/petroleum-based oil) during mounting.
▶ When it reacts with high heat, the bead rubber becomes hardened
→ It leads to bead crack and separation.

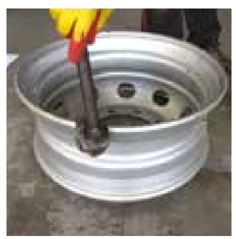

Application of incorrect tyre lubricant


Bead hardening

Prevention

Apply moderate amount of certified tyre lubricant to the tyre bead and wheel.


Apply certified tyre lubricant



2. Tyre dislocation on the wheel by rim flange wear/deformation

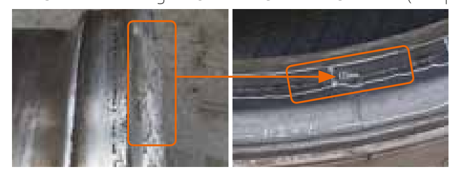
Appearance


Deformed rim


Tyre dislocation by deformed rim

Main Cause

As the inside rim diameter is reduced due to rim deformation the tyre is dislocated from the wheel.
→ Normal fitting result with normal wheel (right picture) compared to abnormal fitting result with deformed wheel (left picture).


Deformed wheel used


Normal wheel used

Prevention

Before mounting:
Check rim flange deformation by using “Rim Flange Gauge”.
Check rim flange step of inside/outside by using “Square Tool”.


Rim Flange Gauge

Square Tool

3. Tyre damages by rim flange wear/deformation

Appearance

Torn tyre bead

Main Cause

Aluminium wheel used for a long period or overloaded can become sharply worn/deformed due to abnormal friction. As a result the wheel diameter (inside/outside) is reduced.

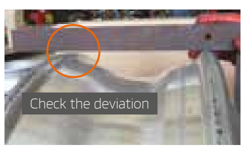
→ With a deformed wheel the tyre becomes displaced/unstable and if used like this the bead will crack or tear.

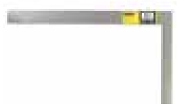
Sharply worn/deformed rim flange

Prevention

Check the strain of the wheel

▶ Check the deformation status on the entire rim flange by using the 'Rim Flange Gauge' tool and judge the suitability.

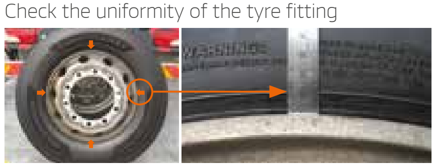




* Measuring Tool [Square Tool]

▶ Check the entire deviation of the upper and lower rim flange by using the 'Square Tool' and judge the suitability.

Check the uniformity of the tyre fitting



▶ Measure the distance of the rim flange / rim check line - 4 points (inside/outside)

4. Bead Separation by non-uniformed rim fitting

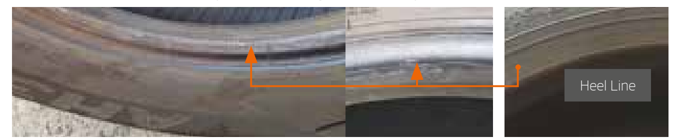
Appearance

Trace of non-uniformed rim fitting (white line)

Main Cause

The bead was not evenly positioned on the wheel as the tyre lubricant has not been correctly applied or due to the deformed wheel. Heel line (below right) is wavy. This means the mounting was not even.

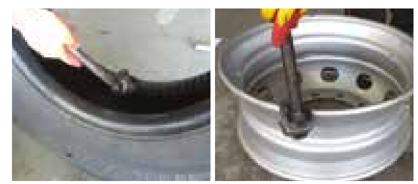
→ If used like this the unevenly fitted tyre can cause stress to be unevenly concentrated at certain points leading to bead seperation.



Deformed wheel used

Prevention

- Apply the tyre lubricant correctly. (Amount, applied position)
- Check the deformation status of the wheel and judge the suitability.



Correctly applied tyre lubricant

Deformed wheel

5. Tyre contamination by corrosion from steel wheel

Appearance

Contaminated bead by corrosion from the steel wheel

Main Cause

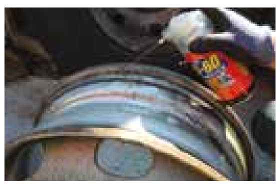
Corroded steel wheel was used without cleaning ▶ Bad contamination

Corroded steel wheel

Prevention

Before using the steel wheel, eliminate corrosion on the wheel using a brush and apply corrosion inhibitor on corroded area

Eliminate corrosion



Apply corrosion inhibitor

6. Tyre Separation by damages in mounting procedures

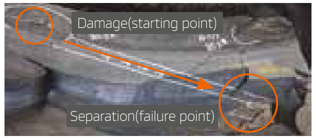
Appearance

Damage occurred in mounting procedures

Main Cause

Due to the misuse of mounting tools (or non certified tools) or incorrect mounting method, damage to the bead is caused such as tearing and cuts.

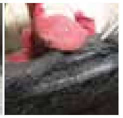
→ As a result of this damage the inside cord could be exposed or cut, so that moisture and air could penetrate around the steel cords and cause rust. It may also cause a crack which would lead to tyre seperation.



Bead Damages

Torn outside bead

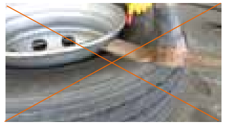
Cut bead



Torn inside bead

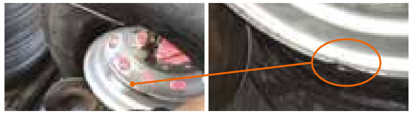
Prevention

1) Precautions for manual mounting:
- Do not use sharp tools, only use correct (certified) tools
- Do not hit the tyre/wheel with a hammer - this is the primary cause of damage



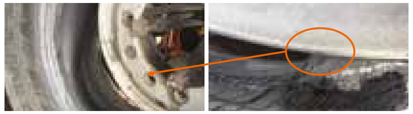
Rubber/Plastic hammer

2) Precautions for automatic mounting:
- Work with great care to minimise tyre bead damage



Common damages so spot when mounting

Cracks, tears etc can occur at the edge of the bead when the bead is crossing the rim flange.



Common damage to spot when demounting

Tearing can occur at the inside edge of the bead if the bead is unseated from the flange.

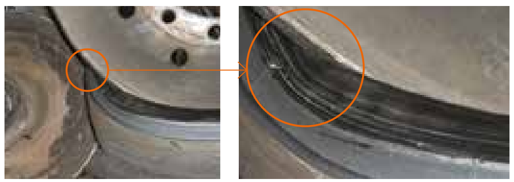
7. Bead deformation due to excessive pressure from the automatic machine

Appearance

Bead deformation by excessive pressure of automatic machine

Main Cause

Due to inexperience work or carelessness, the tyre bead can become deformed due to warping or buckling as a result of excessive pressure.



Prevention

- Correctly operate the machine and do not apply excessive pressure on the tyre
- Minimise the tyre deformation by using a lever as much as possible
  (The more the lever is used the less pressure there is on the tyre)

Lever work

8. Bead damages by balancing Lead Clip

Appearance

Tyre bead damages by balancing Lead Clip

Main Cause

Tyre bead is torn out due to issues with the Lead Clip such as
→ Lead Clip not attached properly, low inflation pressure, overloading etc.

Prevention

- Attach balancing Lead Clip carefully and correctly
- Do not overlap the Lead Clip on the tyre barcode

Tyre barcode attached on the bead

Tyre damage due to the vehicle

Incorrect wheel alignment settings can cause irregular/uneven tyre tread wear reducing tyre life (premature removal from service) and risking illegality of the tyre and even tyre failure which could lead to a fatal accident. The following images show examples of tyre damage from vehicle influences (misalignment, worn/damaged component, other mechanical issues), detailing the likely causes and the corrective action to take.

1. One-side Wear

Possible Cause	
Steer & Trailer axle	• Improper Toe, Camber • Drive or trailer axle misaligned • Steer or Suspension system is damaged • Excessive axial load • Frequent runout and pulling cases - High centre of gravity of vehicle/loadings - Spacing of trailer to tractor unit coupling - Loadings that are not secured or unevenly loaded - Bent or damaged trailer couplings or towing bar
Corrective Action	
Tyre	• Reposition tyres according to the pattern of wear
Vehicle	• Adjust the wheel alignment and align the axle • Inspect and repair the suspension system • Check the cause of runout, pulling and take action

2. One-side Shoulder Wear

Possible Cause	
Steer & Trailer axle	• Improper Toe, Camber • Drive or trailer axle misaligned • Steer or Suspension system is damaged • Excessive axial load • Frequent runout and pulling cases - High centre of gravity of vehicle/loadings - Spacing of trailer to tractor unit coupling - Loadings that are not secured or unevenly loaded - Bent or damaged trailer couplings or towing bar
Corrective Action	
Tyre	• Reposition tyres according to the pattern of wear
Vehicle	• Adjust the wheel alignment and align the axle • Inspect and repair the suspension system • Check the cause of runout, pulling and take action

3. Shoulder Wear

Possible Cause	
Steer & Trailer axle	• Under inflation, overloading • Frequent runout and pulling - High centre of gravity of vehicle/loadings - Spacing of trailer to tractor unit coupling - Loadings that are not secured or unevenly loaded - Bent or damaged trailer couplings or towing bar

Corrective Action	
Tyre	• Inflate tyres to correct air pressure for the axle loads imposed
Vehicle	• Check causes for tyre assemble run out and take corrective action

4. Heel and Toe Wear

Possible Cause	
Steer axle	• Slipping of tyre during rotation by improper toe out
Drive & Trailer axle	• Slipping of tyre during service from - High torque forces - Changes of load dynamics • For dual tyre fitments - Mismatching of tyres from differing rolling circumferences, tyre pattern or differing of tyre pressures

Corrective Action	
Tyre	• Repostion of tyres by running in opposed direction of travel of initial fitment • Correct matching of tyres in dual fitment in pattern, wear and correct air pressure match
Vehicle	• Adjust the wheel alignment • Check steer, suspension system and repair

5. Shoulder Edge Champer Wear

6. River Wear

Possible Cause

Steer & Trailer axle	• Type of wearing characteristics in steer tyres and trailer tyres that are free rolling • Vibration in low tread wearing service on continuous straight roads under light loaded conditions - Steering and suspension worn or broken components - Tyre and wheel assembly imbalance

Corrective Action

Tyre	• Reposition the tyres according to the pattern of wear • Adjust the inflation pressure considering the load status
Vehicle	• Check the steer, suspension system and repair • Check the rotation of hub and balance of the tyre and wheel assembly

7. Rib Depression / Punch Wear

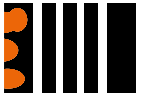
Possible Cause

Steer & Trailer axle	• Under inflation, overloading • Steer, suspension system worn or damaged • Unbalance of tyre and wheel assembly / Frequent straight line driving under light road conditions • For dual tyre fitments - Mismatching of tyres from differing rolling circumferences, tyre pattern or differing of tyre pressures - Two tyres have different inflation pressure (Smaller pressure tyre is slipped on)

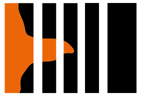
Corrective Action

Tyre	• Reposition the tyres according to the pattern of wear • Adjust the inflation pressure considering the load status
Vehicle	• Check the steer, suspension system and repair • Check the rotation of hub and balance of the tyre and wheel assembly

8. Cupping Wear



9. Shoulder Wavy Wear



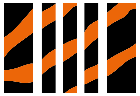
Possible Cause

Steer & Trailer & Drive axle	• Improper tyre pressures used and/or imbalance of the tyre and wheel assembly Steer and suspension worn or damaged • For dual tyre fitments - Mismatching of tyres from differing rolling circumferences, tyre pattern or differing of tyre pressures

Corrective Action

Tyre	• Reposition the tyres according to the pattern of wear • In dual tyre fitmen - Correct matching of tyres in fitment in tread depth - Correct and equal tyre pressures
Vehicle	• Check the balance of rotating equipment of tyre and wheel assembly • Adjust the wheel alignment • Check the steer, suspension system and repair

10. Diagonal Wear



Possible Cause

Steer & Trailer & Drive axle	• Forces applied to the tyre to cause diagonal type tread wear - Mechanical irregularities from damaged or worn steering and suspension components - Imbalance of tyre and wheel assembly • For tyres in dual fitment, - Tyres that are mismatched in tread wear - Tyres that have differing tyre pressures

Corrective Action

Tyre	• Replace tyres
Vehicle	• Check the steering and axle alignment • Check and repair the suspension components • Check and balance of the wheel assembly

11. Hot Spot Wear

Possible Cause

Steer & Trailer & Drive axle	• Rapid braking • Locked braking system • Unbalanced braking

Corrective Action

Tyre	• For dual fitment, reposition and match according to pattern of tread wear and depth • If wear is severe replace the tyre.
Vehicle	• Check braking system and repair

12.Shoulder Scrubbing / Scuffing Wear

Possible Cause

Trailer axle	• Scrubbing of shoulder area or tearing on the tread edge from severe lateral drag with possible contribution from improper tyre pressure used

Corrective Action

Tyre	• Reposition the tyres according to the pattern of wear • Set appropriate inflation pressure considering the load status
Vehicle	• Check vehicle wheel alignment

Tyre Damage due to External Impact

Bad driving habits and poor road conditions can result in tyre damage and lead to an accident. External risks on poor roads could be potholes, rocks, metal parts, shards, nails etc, all capable of causing tyre damage. It is important that a damaged tyre be replaced immediately to prevent an accident that could even be fatal.

The following show examples of damaged tyre patterns and the possible causes.

- Appearance: Damage by external impact
- Possible cause: Poor road conditions (Sharp debris, potholes etc.)


External damage type 1


External damage type 2


External damage type 3


External damage type 4


External damage type 5


External damage type 6

- Appearance: Penetration
- Possible cause: Penetration of a nail

- Appearance: Inner tyre material is rusty
- Possible cause: Inner material has become rusty due to penetration by a sharp object


Penetration


Inner tyre material is rusty

- Appearance: Chip-cut
- Possible cause: Wrong tyre application, poor road conditions.


Chip-cut type 1


Chip-cut type 2

- Appearance: Torn bead
- Possible cause: Bead damaged by rim flange or mounting tools

Torn Bead type 1

Torn Bead type 2

- Appearance: Cracks in grooves
- Possible cause: Small stone embedded in the groove caused the crack due to continuous force

Groove Crack type 1

Groove Crack type 2

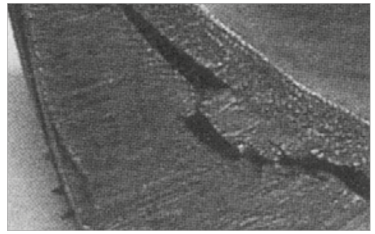
HEAT CAN DAMAGE TYRES

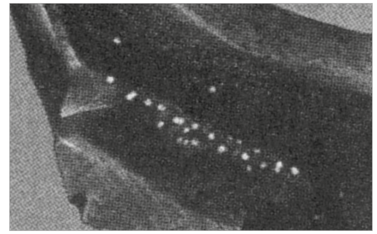
Under inflation, overloading or excessive speed can cause damage because of heat build up. Tyre parts such as cord, the bonding between carcasses, belts and treads can be easily damaged by excessive heat. Most tyre cords lose strength at temperatures above 120°C making the tyre more vulnerable to a failure.

Excessive heat can either weaken or damage cords and rubber compounds or even cause separation between the plies.

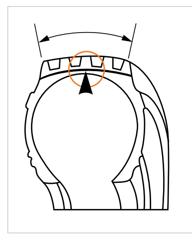
The following pictures show some of the possible damage conditions.

SHOULDER SECTION DAMAGE OR SEPARATION DUE TO HEAT

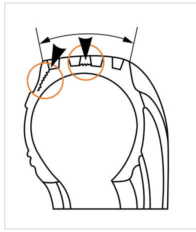




TREAD DAMAGE DUE TO EXCESSIVE HEAT



TREAD SEPARATION CAUSED BY EXCESSIVE HEAT



MOISTURE DAMAGE

Moisture inside the tyre or penetrating through to the steel belts of a radial tyre can cause rust damage to the steel cord or rim.

Therefore always:
➊ Store tyres indoors in a dry place.
➋ Ensure all wheels, flaps, tubes, valves and the inner tyre surface are clean and dry before and during mounting.
➌ Use the recommended mounting lubricant on the rim and tyre bead during the mounting process.
➍ Maintain inflation and keep the valve stem capped or protected so as not to allow moisture to enter the tyre.

Notes: