Truck, bus and coach tires
Basics to optimize your tire performance
Publisher's imprint

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Basics to optimize your tire performance

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Truck tires – technical basics
From the very beginning

We've been partners of the transportation industry ever since tires have been around. We've set technological milestones and furthered the development of our products. As a company, we've grown at an amazing pace. But one thing has always stayed the same: The needs of our customers set the standard for everything we do.

The Continental story is a success story in German engineering. From the very beginning our company has been interwoven with the transportation industry. The result is a broad range of innovations – such as the tubeless tire – and a full line of products tailored to meet the needs of various sectors within the transportation business.

But all that is possible only because we have always based the development of our products on a simple, yet demanding standard: The needs of our customers. And because these needs are as different as the various sectors of the transportation industry themselves, we still look at things first through the eyes of our customers…

As early as the 1950s, Continental was already offering specialized tires for various kinds of trucks and buses – and tailoring its communication of specific benefits to each segment.

In the 1960s, tailored product communication for different segments continued – trucks, buses and construction vehicles.
Today more than ever:
Tires optimized for specific uses

As partners of the global logistics and transportation industry, we are deeply familiar with the various sectors of this industry. That’s why we know: cost-efficiency makes all the difference. Our solution: Tires optimized for specific conditions – for every need.

Today, transporters are part of an ever more efficient global logistics network. As a close companion for our partners and customers in the global transport and logistics industry, we understand markets as well as we understand streets and roads all over the world. We also know: The bottom line is cost-efficiency.

But all streets are not made alike. Nor are various types of transport. That’s why we have always continued to develop our product lines for the customer segments Goods, People and Construction. The result? Tires that are tailor-made for the specific conditions faced by the various sectors of the transportation industry. This leads to an increase in the profitability of entire fleets considerably.
Global tire development

Tire engineering is driven primarily by global economic development. This overview shows the main aspects resulting from this trend.

<table>
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<th>Main customer needs</th>
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<th>China</th>
<th>South America/Turkey</th>
<th>Europe/NAFTA</th>
<th>Europe</th>
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<td>Cooperations</td>
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<td>Main tire type</td>
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<td>Radial tire</td>
<td>Radial tire</td>
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<tr>
<td>Main tube type</td>
<td>Tube type tire</td>
<td>Tube type tire/Tubeless tire</td>
<td>Tubeless tire</td>
<td>Tubeless tire</td>
<td>Tubeless tire</td>
</tr>
<tr>
<td>Main rim type</td>
<td>multi-part</td>
<td>multi-part</td>
<td>multi-part/one-part</td>
<td>one-part</td>
<td>one-part</td>
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<tr>
<td>Typical tire sizes</td>
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<td>11.00 – 20</td>
<td>11.00 R20</td>
<td>11 R22.5</td>
<td>315/80 R22.5</td>
</tr>
<tr>
<td></td>
<td>12.00 – 20</td>
<td>12.00 – 20</td>
<td>12.00 R20</td>
<td>12 R22.5</td>
<td>295/80 R22.5</td>
</tr>
<tr>
<td></td>
<td>11.00 R20</td>
<td>11 R22.5</td>
<td>315/80 R22.5</td>
<td>385/85 R22.5</td>
<td>315/70 R22.5</td>
</tr>
<tr>
<td></td>
<td>12.00 R20</td>
<td>12 R22.5</td>
<td>295/80 R22.5</td>
<td>315/80 R22.5</td>
<td>315/80 R22.5</td>
</tr>
</tbody>
</table>

Basics to optimize your tire performance

sealing ring
inner tube
flap
inner tube
leaking ring
multi-part
one-part
multi-part/one-part
one-part

Typical tire sizes

11.00 – 20
12.00 – 20
11.00 R20
12.00 R20
11.00 R22.5
12 R22.5
315/80 R22.5
295/80 R22.5
385/85 R22.5
315/70 R22.5
315/80 R22.5
Truck tire components and their functions

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tread strip</td>
<td>Rubber compound</td>
<td>The tread strip must provide high wear resistance and good grip under all road conditions. Sometimes the tread strip consists of two different materials (cap and base). In that case, the base minimizes tread temperature and rolling resistance.</td>
</tr>
<tr>
<td>Multi-ply steel belt</td>
<td>Steel cords embedded in rubber compound</td>
<td>Enhances driving stability, reduces rolling resistance and gives the tire its long service life. Restricts casing growth and increases the tire’s structural strength.</td>
</tr>
<tr>
<td>Steel casing</td>
<td>Steel cord</td>
<td>Gives the tire structural strength and deflection characteristics, substantially enhances driving comfort.</td>
</tr>
<tr>
<td>Inner liner</td>
<td>Rubber compound</td>
<td>Prevents diffusion of air and moisture in tubeless tires.</td>
</tr>
<tr>
<td>Sidewall</td>
<td>Rubber compound</td>
<td>Protects from lateral scrubbing and the effects of weather.</td>
</tr>
<tr>
<td>Bead reinforcement</td>
<td>Nylon, aramide, steel cord</td>
<td>Secures the end of the steel cord ply to the bead core. Reinforces the bead against high shear forces.</td>
</tr>
<tr>
<td>Bead core</td>
<td>Steel wire embedded in rubber compound</td>
<td>Ensures firm fit of the tire to the rim.</td>
</tr>
</tbody>
</table>

Materials that go into a truck tire

- **Structural components:**
  - core wire (6%)
  - nylon fabric (1%)
  - steel cord (17%)

- **Compound:**
  - natural rubber (30%)
  - synthetic rubber (5%)
  - halogen butyl rubber (4%)
  - other chemicals (37%)
Supplier industry
Various sectors supply the basic materials needed to manufacture tires.

The steel industry supplies high-strength steel cords and wires primarily for the manufacture of steel belts and the casing (steel cord) as well as materials used in the bead core (steel wire).

The chemical industry mostly supplies synthetic rubber and materials that improve the grip and durability of tires.

Natural rubber (latex) is extracted by tapping rubber trees grown in large plantations in the tropics.

The textile industry supplies fibers made of rayon, nylon, polyester etc. for the manufacture of textile cord, a reinforcing material, for example bead reinforcements.

Compound production
Natural and synthetic rubber are mixed with additives, following pre-defined formulas. Many different rubber compounds, each optimized for its specific function, are used in modern tires.

Steel cord
- Pre-treated steel cord is embedded into one or more layers of rubber on a roller and cut to the proper length for the tire size.
- Steel cord spools
- Steel cord calendering
- Cutting steel cord to size

Tread
- The kneadable mix of materials is formed into an endless strip by means of a screw-like extruder. The strip is cooled and then cut to size.
- Tread extruder
- Control of weight per meter
- Tread cooling
- Cutting the tread to size
- Control of unit weight

Textile cord
- Many individual textile threads are fed into the calender (large roller) via a special winding device and are embedded in a thin layer of rubber. This endless sheet is then cut to the desired width and rewound for further processing.
- Cord fabric on rollers
- Textile cord calendering
- Cutting textile cord to size

Steel bead
- The core of the tire bead consists of several individual rubber-coated steel wires formed into rings.
- Making up of production compound
- Coating of bead wire
- Rewinding of bead wire
- Spooling of bead wire
- Bead ring
- Applying the apex

Sidewall/Inner liner
- Sidewall sections cut to suit the particular tire size and in various contours are made with the extruder. A calender forms the inner liner into a wide, thin layer.
- Sidewall extrusion
- Calendering of the inner liner

Manufacture of semi-finished products

Building
- All these components come together onto the tire building machine. They are assembled in two stages – casing and tread/belt assembly – into what is known as a “green” tire.
- Building the casing
- Assembling the belt

Vulcanization
- Before vulcanizing the “green” tire, it is sprayed with a special fluid.
- Building the "green" tire
- Vulcanization

Quality control*
- After vulcanization the tire undergoes visual inspection and x-ray ing.

Uniformity checks are performed.
- Check for imbalances
- Force variation control

Basics to optimize your tire performance

* Each individual stage of production – from the inspection of the raw materials through to delivery – is subject to ongoing quality control.
Legal and standardized markings used on the tire sidewall

Legal and standardized markings

1. Manufacturer (brand name or logo)
2. Tread pattern reference
3. Size designation
   - 315 = tire width in mm
   - 80 = aspect ratio (section height to section width) = 80%
   - R = radial construction
   - 22.5 = rim diameter (code)
4. Service description consisting of
   - 156 = load index for single fitment
   - 150 = load index for dual fitment
   - L = code letter for speed rating
5. Country of manufacture
6. Data as per US safety standard on inner construction or number of plies, in this case
   - tread: under the tread there are five steel cord plies (including carcass)
   - sidewall: viewed from the side there is one steel cord ply (in this case the carcass ply)
7. Service description consisting of
   - L = code letter for speed rating
8. TWI (Tread Wear Indicator)
9. Recommended application
   - only Continental Truck Tires
10. Regroovable
    - the manufacturer has designed the tire for regrooving
11. Tubeless, tube type
12. DOT
    - U.S. Department of Transportation (responsible for tire safety standards)
13. M+S
    - Mud and Snow. The manufacturer has designed the tire for an improved grip/traction performance under mud and snow conditions.
14. Identification for Brazil
15. Manufacturer code
16. Date of manufacture (week/year)
17. Rotation
   - recommended direction of rotation
18. Single Point
   - Alternative load and speed

The most important markings

e.g. 315/80 R 22.5   156/150 L   tubeless

<table>
<thead>
<tr>
<th>Marking</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>315</td>
<td>tire width in mm</td>
</tr>
<tr>
<td>80</td>
<td>cross-sectional ratio H:W in %</td>
</tr>
<tr>
<td>R</td>
<td>radial design</td>
</tr>
<tr>
<td>22.5</td>
<td>nominal rim diameter of 15° tapered rim (code)</td>
</tr>
<tr>
<td>156</td>
<td>4000 kg tire load capacity B (single tire fitment)</td>
</tr>
<tr>
<td>150</td>
<td>3350 kg tire load capacity D (dual tire fitment)</td>
</tr>
<tr>
<td>L</td>
<td>speed 120 km/h (75 mph)</td>
</tr>
<tr>
<td>147</td>
<td>load capacity (kg/tire)</td>
</tr>
</tbody>
</table>

Speed index

- F: 80 km/h (50 mph)
- G: 90 km/h (56 mph)
- J: 100 km/h (62 mph)
- K: 110 km/h (68 mph)
- L: 120 km/h (75 mph)
- M: 130 km/h (81 mph)
- N: 140 km/h (87 mph)

Load index

- 147: 3075 kg (6700 lbs)
- 148: 3150 kg (6895 lbs)
- 149: 3250 kg (7135 lbs)
- 150: 3350 kg (7380 lbs)
- 151: 3450 kg (7575 lbs)
- 152: 3550 kg (7770 lbs)
- 153: 3650 kg (8000 lbs)
- 154: 3770 kg (8290 lbs)
- 155: 3875 kg (8560 lbs)
- 156: 4000 kg (8819 lbs)

Load capacity (kg/tire)

<table>
<thead>
<tr>
<th>Code</th>
<th>Load capacity (kg/tire)</th>
</tr>
</thead>
<tbody>
<tr>
<td>147</td>
<td>3075</td>
</tr>
<tr>
<td>148</td>
<td>3150</td>
</tr>
<tr>
<td>149</td>
<td>3250</td>
</tr>
<tr>
<td>150</td>
<td>3350</td>
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<td>151</td>
<td>3450</td>
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<td>152</td>
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<td>153</td>
<td>3650</td>
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<tr>
<td>154</td>
<td>3770</td>
</tr>
<tr>
<td>155</td>
<td>3875</td>
</tr>
<tr>
<td>156</td>
<td>4000</td>
</tr>
</tbody>
</table>
Units of measurement and definitions

As a matter of principle the technical data in the tables always complies with the international standards as specified by ISO and the ETRTO. Further details such as other tire sizes or designs, plus the static radius and the rolling circumference comply with DIN/WdK guidelines.

Lengths
Lengths are given in millimeters.

Rim width
The linear distance between the flanges of the rim.

Section height
Half the difference between the overall diameter and the nominal rim diameter.

Tire width
The section width of an inflated tire mounted on its theoretical rim and indicated in the tire size designation.

Overall diameter
The diameter of an inflated tire at the outermost surface of the tread.

Nominal diameter
It is a size code figure for reference purposes only, as indicated in the tire and rim size designation.

Tire pressure
Tire inflation pressure is given in Bar based on cold tire.

Outer diameter new*
Outer diameter is a nominal size which refers to the tread centre.

Max. outer diameter in service
Max. outer diameter in service is the maximum diameter permitted in the tread center as a result of permanent growth during tire use. Dynamic deformations are not included.

Cross-section width new*
Cross-section width is a nominal size referring to the smooth tire wall.

Max. operational width
Max. operational width is the maximum permitted width. This includes scuff ribs, decorative ribs, lettering and permanent growth during use. Dynamic deformations are not included.

Static radius
Static radius is the distance from the tire center to ground level. Measurements are checked on fitted tires inflated to the tire pressure specified in DIN 70020 Part 5.

Rolling circumference
Rolling circumference is the distance covered by one revolution of the tire.

Load capacities
Load capacities are given in kilograms (weight = mass).

Dual-tire spacing
Maintaining the minimum spacing distance ensures that the two tires in a dual fitment arrangement function without violating ETRTO standards, provided the tires are not fitted with chains. In the course of development, a variety of designations for tire dimensions have been introduced, some of which are used concurrently.

The following combination is most frequently used:
- Tire width in mm
- H : W (height : width) in %
- Codes for tire construction (e.g. “R” for radial and “–” for crossply and nominal rim diameter

When planning vehicle wheel space, automotive designers must proceed on the basis of the maximum values for tire width and outer diameter, taking into account the tire’s static and dynamic deformation. In this way they ensure that all standardly approved tires will fit in all cases. If this is not possible in exceptional cases, appropriate measures are to be taken to exclude any possible risk to safety.

PR
The ply rating, or PR for short, is an internationally used standard for the structural strength of the tire substructure. The term stems from the time when cotton was still used for the fabric substructure. In those days PR actually referred to the number of plies. When materials with greater strength were introduced, the same structural durability was achieved with fewer plies. PR now therefore refers to a load capacity category and is increasingly being replaced by the load index.
Unlock your truck tire’s potential – retreading and regrooving

Continental truck tires are designed to give you maximum economy throughout the entire life of the tire and long after that. The following options show how you can best maximize this potential.

Tire costs are a substantial factor in overall operating costs in the transportation industry. Purchasing a retreaded tire helps to reduce this factor considerably. The benefits of Continental truck tires are not just for one life. Thanks to professional retreading, they can be given a new lease of life and deliver the same quality as a new tire.

In order to further extend the service life, a truck tire with the word “regroovable” on its sidewall can also be regrooved. This option is suitable for fleets which run their own tire service and have a stock of replacement tires. If the company’s staff have been specially trained in regrooving tires, vehicle downtimes can be optimized.
Retreading

Like new. Allround. Continental truck tires are certainly well worth the investment. Their performance benefits last not only the entire life of the tire; they can also be used a second time round after the Continental retreading process – all that in the undiminished quality of a new tire, and under warranty. Our ContiRe retreading process gives your worn tires a new life, maximizing their economic efficiency.

Production of a ContiRe retread is carried out in the same way as production of our new tires. We use ultra-modern inspection techniques and latest manufacturing methods to guarantee a consistently high level of product quality. A standardized quality system with endurance and safety testing ensures that ContiLife retreads meet superior quality standards. Not only are our manufacturing methods, quality systems and inspection techniques comparable to those used in the production of new tires, we even use the same tread patterns and compounds. And of course, we only use carefully inspected, perfect casings with the C2 casing guarantee for our ContiRe retreads. Indeed, there is no question that the product characteristics of a ContiRe retread fully comply with those of our new tires.

Continental casings incorporate first-class quality and technological sophistication, making them an extremely valuable raw material – and indeed it is the casing that forms the basis for retreading. By purchasing a retread, you are not only easing your tire budget, but also making an active contribution towards protecting the environment. Reusing the casing helps save energy and raw materials. What’s more, maximum utilization of tire casings means you are helping to reduce the number of scrap tires and to keep pollution down.

Manufacturing processes

There are two methods that can be used for tire retreading: hot retreading and cold retreading. Only carefully selected and properly inspected casings are employed for both of these methods. The manufacturing process itself is also identical for both methods, up to the point of applying the tread material and performing the vulcanization.

During hot retreading, the process of applying the tread material is virtually identical to the production of a new tire. The tread material is taken directly from the extruder and applied to the buffed casing. Afterwards the tread/casing assembly is cured in a vulcanization mold with the required tread pattern. The pattern on the tread is formed during the vulcanization process, just as it is when a new tire is made. Hot retreaded truck tires from Continental are retreaded from bead to bead. The main advantage of this principle is that the sidewalls are renewed, ensuring that the quality of the hot retreaded tire is comparable with that of a new tire.

Using the cold retreading method, a patterned and pre-vulcanized tread is applied to the buffed casing. Under constant tension, this tread is placed along with an unvulcanized bonding ply onto the buffed casing. Even prior to vulcanization, pre-tensioning ensures that the tread adapts optimally to the contour of the tire and that the parts are optimally bonded together when the tire is in the autoclave. Then the prepared tire is “packed” into a curing envelope and vulcanized under pressure in an autoclave.

Regrooving

All Continental tires approved for regrooving have the word REGROOVABLE on both sidewalls, in accordance with ECE regulation 54.

As part of their design, all-steel truck tires have a so-called tread stock between the upper edge of the belt and the tread grooves. This tread stock is intended to prevent stones and the like from penetrating into the steel belt and the casing.

In order to further increase the service life, all-steel truck tires can be regrooved. A tread stock of 2 mm must remain underneath the additional tread depth gained by regrooving.

Although tires can be retreaded after reaching the legal wear limit, regrooving is not always advisable. The tread stock thickness is reduced and stones etc. can more easily penetrate and damage the steel belts, leading to rust formation. This has decidedly negative effect on the tire’s suitability for retreading.

The best time for regrooving is when the tread is worn down to about 3 mm. The tire must then be checked to make sure the wear is even all round. Attention should be paid to local or uneven wear patches. Regrooving should be carried out by an expert, in order to avoid premature failure as well as any reduction in the tire’s suitability for remolding.

Regrooved tires must not be used on drive axles of coaches or buses with an extended speed limit of 100 km/h.

The increased tread depth of up to 4 mm achieved through regrooving means substantially improved performance.
The correct choice of tire according to the recommendations of the tire manufacturer is the key to successful maintenance and care. The high-quality standard of tires assured by the recommendations in this chapter can be maintained only by regularly checking all the factors – for example by regularly checking tire pressure and conducting external inspection of the tires (including the inner and outer sidewalls and between dual tires). For that reason, pressure checking devices and small replacement parts such as valve inserts, caps and extensions should always be on hand.
The following requirements are law in the majority of European countries:

- Pneumatic tires on trucks and trailers have to feature tread grooves or sipes round their entire circumference and over the whole width of the tread area.

- The main grooves on truck tires have to have a tread depth of at least 1 mm, 1.6 mm or 2 mm, depending on the law in each country. The limit in the UK is 1 mm. The depth of the tread pattern is to be measured in the grooves or sipes; bridge-like protrusions or reinforcements in the tread base should be ignored in this context.

- On tires with wear indicators (TWI = Tread Wear Indicators), the tread depth should be measured in the grooves where the wear indicators are located. Wear indicators on commercial vehicle tires are bridge-like protrusions 1.6 mm high, which show whether the tire has reached the wear limit.

- Tires should be stored in cool, dry, dark and moderately ventilated rooms. Avoid contact with fuel, lubricants, solvents and chemicals. Tires age more quickly if exposed to direct sunlight or heat.

- Tire repairs

  Tire damage may initially be just a question of damage to the outer rubber. However, this apparently superficial damage can eventually extend down to, or into, the tire’s reinforcing materials (casing/belt). Therefore no time should be lost in taking the tire to a specialist for assessment as soon as any external damage is detected.

  Damage to the reinforcing materials, for instance due to a nail puncture or a deep cut, is particularly dangerous because dirt and moisture may penetrate during the time between when the damage occurred and when it was detected. This may even result in more serious damage to the reinforcing materials. Damage causing the reinforcing materials to leak will result in slow loss of inflation pressure.

- Tread depth

  The tread depth should therefore never be measured on the wear indicators, but next to them. N. B. Consult your local Continental office for legislation regarding specific countries.

- Tire inflation

  One of the most important causes of excessive tire wear and damage is incorrect tire pressure. Service manuals produced by the vehicle manufacturers and technical documentation from the tire manufacturers provide information about correct tire pressure. These values apply without exception to the cold tire, as the inner pressure of the tire increases during operation.

  Tire pressure should be checked every two weeks, at the latest every four, on the cold tire. Spare tires must also be checked.

  Underinflation leads to

  - Increased flexing, which makes the tire overheat and may cause tire failure
  - Increased wear, leading to shorter service life
  - Higher rolling resistance and subsequently increased fuel consumption
  - Irregular wear

  When checking tire pressure, be sure to conduct an visual inspection of the tire for external damage, e.g. by embedded nails or screws. Missing valve caps and leaking valves should be replaced immediately.

- Storing tires

  Tires should be stored in cool, dry, dark and moderately ventilated rooms. Tires which are not fitted on rims should be stored standing up. Avoid contact with fuel, lubricants, solvents and chemicals.

  Tires age more quickly if exposed to direct sunlight or heat.
Damage to truck, bus and coach tires caused by external factors

Damage to truck, bus and coach tires may be caused by a variety of external factors.

For example, improper axle alignment or incorrect storage can damage a tire, as can driving with insufficient tire pressure. The following chapter describes common damage to the tread area, the sidewall and the bead caused by external factors, and gives recommendations that will help you to prevent avoidable damage.
Tread

Abnormal one-sided wear

Cause
Abnormal one-sided tread wear arises as a result of tire constraint caused by wheels being inclined to the direction of motion. Scale-like or feather-edged wear is often seen at the shoulders. This wear pattern comes about by excessive toe-in/toe-out values or crooked axles. It also occurs if corners are regularly taken at excessive speeds.

Recommendation
Correct axle and wheel alignment

Abnormal one-sided wear in shoulder area

Cause
Occurs predominantly with trailer tires as a result of:
- high center of gravity of vehicle
- unsteady loads
- one-sided load distribution
- bent trailer tow-bar
- play in the trailer coupling ring

Recommendation
When wear patterns of this sort occur, the vehicle should be checked to see if any of these possible causes apply. In order to stabilize the tire cross-section, be sure to maintain maximum permitted tire pressure.

Abnormal one-sided wear on both sides in shoulder area

Cause
Wear patterns of this nature are caused by high lateral strain, for example by fast cornering and by underinflated tires. A high center of gravity on the vehicle further increases this tendency toward pronounced wear.

Recommendation
Ensure sufficient tire pressure to stabilize the tire cross-section for the load condition.

Abnormal center wear

Cause
Tire pressure too high or high proportion of journeys without load or only with partial load.

Recommendation
Adjust the tire pressure to the load situation.

Scale-like wear

Cause
Strain caused by slip is a result of high circumferential or lateral forces and is increased by excessive tire pressure or insufficient wheel load.

Recommendation
Adjust the tire pressure to the load situation.
**Tramline wear**

**Cause**
Unfavorable combination of various vehicle vibrations in low wear use, e.g. on motorways. Only occurs on tires on non-driven axles (front axle or trailer).

Free-wheeling grooves have no influence on the structural durability of the tire.

**Recommendation**
In the case of tractor tires: continued use on driven axle.

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**Circumferential damage**

**Cause**
Cuts caused for example by bent or protruding vehicle parts or by foreign objects trapped in the wheel house.

**Recommendation**
Regular inspection of the vehicle and its tires for such causes.

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**Exposed steel cords**

**Cause**
Regrooving too deep and going to the belt. Damage of this nature, combined with the effect of dirt and moisture, causes the steel cords to rust. This may render the tire unsuitable for retreading. In the final stages this can even lead to premature tire failure.

**Recommendation**
Remove the tire immediately and retread it if possible.

The tire manufacturer’s instructions regarding regrooving should be followed under all circumstances.

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**Spotty wear**

**Cause**
Difference in diameter on dual tires. Varying tire pressure on dual tires. The tire running on lower pressure is subject to excessive slip.

Irregularities on the vehicle, e.g. too much play in bearings or joints or defective suspension.

**Recommendation**
Only fit dual tires of approximately the same diameter. Keep both tires in dual arrangement inflated to specified pressure level.

Remove any play in bearings and/or joints or repair the suspension (springs, shock absorbers).

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**Flat spot**

**Cause**
Localized wear of the size of the ground contact patch, caused by:
- excessive sharp braking (emergency stop)
- brakes locking, for example as a result of incorrect adjustment of the trailer brakes or defective brakes

**Recommendation**
- Avoid unnecessary harsh braking.
- Check brakes and braking system and have adjusted where necessary.
- Install automatic anti-lock brake system.

**Stressed tread area, cuts caused by spinning, cuts**

**Cause**
Spinning of the drive wheels on stony ground – can be exacerbated by moisture and overinflation.

**Recommendation**
- Adjust the tire pressure to the load situation.
- Use special tires if necessary.

**Cuts**

**Cause**
Effect of sharp-edged objects (stones, glass, metal, etc.)

**Recommendation**
- If tires with deep localized cuts can be repaired or retreaded, this should be done by a tire expert.

**Break up of the tread due to impact break**

**Cause**
Break in the casing caused by sudden sharp deformation of the tire, e.g. when driving over an angular object at high speed. This is exacerbated by overinflation or overloading.

**Recommendation**
- If obstacles cannot be avoided, they should be passed slowly.
- Tire pressure should be adjusted to the load situation.
Sidewall

Cuts

Cause
Effect of sharp-edged objects (stones, glass, metal, etc.)

Recommendation
If tires with deep localized cuts can be repaired or retreaded, this should be done by a tire expert.

Casing rupture due to impact

Cause
Rupture in the casing caused by sudden, sharp deformation of the tire following forceful impact by an obstacle or object.
This is accentuated by excessively high tire pressure or overloading.

Recommendation
• If obstacles cannot be avoided, they should be passed slowly.
• Tire pressure should be adjusted to the load situation.

Casing rupture due to fatigue

Cause
Temporarily driving with insufficient tire pressure or on a flat tire, e.g. due to a nail puncture.

Recommendation
• Tires which must be removed prematurely due to damage should be checked with particular care for further usability. Often it is very difficult or impossible to establish initial damage to the casing, which may lead to premature tire failure.
• If a tire in a dual arrangement fails, stop the vehicle as soon as possible to prevent the second tire from being damaged as well.
• Adjust the tire pressure to the load situation.

Casing rupture due to foreign object trapped between twin tires

Cause
If stones etc. remain trapped between dual tires, this may lead to severe sidewall damage or to a break in the casing.

Recommendation
Regularly check for and remove any trapped foreign objects. To do this, tires must be deflated and in some cases the outer wheel removed.
Rupture damage

Cause
A sharp-edged foreign object penetrates in a localized area and causes the casing to rupture.

Recommendation
Tires damaged in this way cannot normally be repaired; they must be replaced.

Chafing

Cause
Frequent bumping into and scraping along curbs. Sometimes carcass damage may result.

Recommendation
- Check the sidewalls regularly.
- If the tire shows excessive wear, fit the wheel to a less endangered position or rotate the tire on its rim.
- Replace the tire when the damage goes as deep as the casing.
- Use a special tire if necessary, e.g. for buses.

Destruction of the casing

Cause
Driving with insufficient tire pressure. Excessive flexing and the heat then produced may cause complete or loss of tire pressure:
- penetrating nails or similar sharp objects
- leaking valves
- defective tubes and bead flaps
- hairline cracks in the rim (for tubeless tires)

Recommendation
- Check tire pressure regularly.
- Establish cause of loss in tire pressure and rectify.
- Use only new tubes and bead flaps.
Bead

Scorched bead

**Cause**
Excessive warmth on brakes and rims as a result of sustained braking or malfunctioning brakes.

**Recommendation**
- Regularly check the brakes and the braking system.
- Use retarder or constant throttle.

Bead damaged due to mounting

**Cause**
- Using incorrect or sharp-edge fitting tools.
- Fitting without the aid of lubricants.

**Note**
Excessive warming of the brake drums, leading to hardening of the beads, can set the stage for this type of damage.

**Recommendation**
Follow fitting instructions.

Bead damage due to rim

**Cause**
Locally deformed rim or corrosion of the rim flange.

**Recommendation**
- Check the rim for damage and replace if necessary.
- Remove any rust from the rim and renew protective coating before fitting.
- Use suitable fitting lubricants (e.g. CONTIFIX).