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Preface
Preface

This book is intended for tyre salespeople and installers. The purpose of the book is to give a deeper understanding of and general information on tyres.

Tyres are among the most important safety equipment for cars. Technical development is rapid in both cars and tyres. New materials and technical solutions for the manufacture of tyres are continuously improving their properties. However, this has increased the need for current information on the selection, installation and operation of tyres.

Special rims have become increasingly popular in recent years. They require special competence from the installers and set special requirements for the equipment.

The purpose of this new version of the technical manual is to provide resellers and installers basic information about tyres, rims and comprehensive installation instructions. Compared to the earlier version, this manual only concentrates on the technical issues. The up-to-date specific product information can be found in other sources such as websites, marketing toolbox, product toolbox etc.
Tyre manufacturing process

- Production of rubber compounds
- Component manufacture and assembly
- Curing of the tyre
- Visual and machine inspection
- Product information
- Storage
- To the customer
**Construction of a tyre**

Practically all passenger car tyres are steel belt tyres. The radial structure influences, for example, the tyre's driving properties. The belts are made of spirally woven, brass-coated, high-strength steel wire and lined with rubber on both sides. In addition, an edge strip is added to prevent the sharp ends from penetrating the tyre sidewall. On top of the steel belt, there is a spiral nylon bandage that ensures the roundness of the tyre and makes it more stable. The outermost layer is the tread.

One of the most important tyre components is the body ply. Its main task is to keep the tyre in shape and prevent the sidewalls from bulging out. The sidewall dictates the tyre’s profile. The rigidity of the sidewall, naturally, has a major impact on the tyre’s driving response. The side of a tyre consists of three elements: the ply, the flexible sidewall and the rigid bead. The bead section has a steel wire that ensures the precise fitting of the tyre on the rim. This wire must be dimensioned and shaped very accurately. The bead wire is woven of one thread of brass-coated steel wire. The brass coating is important because steel does not adhere to rubber as well as brass.

**Task of the tyre in a vehicle**

Tyre structures can be divided into two types: cross-ply and radial. The choice of type depends on the desired driving properties. The most important tasks of a tyre are:

- Carrying the vertical load and converting it into a distributed load
- Generating lateral and longitudinal force when needed
- Adjusting to the unevenness of the road surface and dampening its impact on the rim
Tyre marking

1. Manufacturer (brand)
2. Safety regulations (USA)
3. M+S symbol
4. Snowflake on a mountain symbol
5. Tyre type
6. Structure (radial/tubeless)
7. Manufacturing code
8. Time of manufacture (1209 = W12, year 2009)
9. E-approval number
10. Tyre size
11. E-approval (pass-by-noise)
12. Special marking for mounting
13. UTQG-grading (USA)
14. Load index (LI)
15. Speed index
16. Extra load
17. Structure details
18. Country of origin
Uniform Tire Quality Grading (UTQG)

Uniform Tire Quality Grading is a relative comparison system. Tyres are graded by manufacturers in three areas: treadwear, traction and temperature.

**The treadwear grade** is a comparative rating based on the wear of a tyre when tested carefully under controlled conditions. For example, a tyre graded 400 should have its useful tread last twice as long as a tyre graded 200. Treadwear grades are only valid for comparisons within a manufacturer's product line.

**Traction grades** represent the tyre's ability to stop on wet pavement as measured under controlled conditions on asphalt and concrete test surfaces. As of 1997, the traction grades from the highest to lowest are “AA”, “A”, “B” and “C”. The grades do not take into consideration the cornering or turning performance of a tyre.

**Temperature grades** represent a tyre's resistance to heat and its ability to dissipate heat when tested under controlled laboratory test conditions. The grades from the highest to lowest are “A”, “B” and “C”. The grade “C” corresponds to the minimum performance required by the federal safety standard.

195/65R15 95H XL

- The dimension 195 mm is the so-called cheek-to-cheek dimension – the norm allows tyres with sidewall protection to be wider at this point.
- The dimension 65 is the aspect ratio = cross-section height divided by cross-section width.
- Structural alternatives include R radial, D(-) bias-ply and B bias-belted, a tyre that has a bias-ply body with belts (steel or textile).
- 15” (inches) – the rim section of the norm specifies the exact dimensions. Correctness can be measured on the circumference of the rim using a so-called ball measure.
- LI (load index / for example, 95 = 690 kg) is specified in the norms.
- Speed category H = 210 km/h.
- Tyre can carry higher load and is marked with XL (Extra load)
Special “OE approval” markings

All factory installed Original Equipment tyres are put through a rigorous series of tests by the vehicle manufacturer before final approval is given prior to the start of supply. Some OEMs have developed special markings to identify that the tyres are approved for use on their vehicles.

Examples of these special markings include:

What is an N Marking?

» Tyres fitted by Porsche as Original Equipment are developed to suit the individual characteristics of specific models.

» It is an approval identification mark given by Porsche to identify a particular tyre, thereby differentiating it from other specifications of the same tyre size & pattern.

» All Porsche approved tyres fitted to vehicles manufactured from 1988 have been given a sidewall marking of either N0, N1, N2, N3, N4.

» Vehicles manufactured before 1988 had no Porsche approval marking.

» The same N marked tyre may be designed and compatible for a number of Porsche models/years.
# Load and speed designation

## Load index

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## Most common speed designations

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<tr>
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<td>R</td>
<td>170</td>
</tr>
<tr>
<td></td>
<td>S</td>
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</tr>
<tr>
<td></td>
<td>T</td>
<td>190</td>
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<tr>
<td></td>
<td>H</td>
<td>210</td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>240</td>
</tr>
<tr>
<td></td>
<td>W</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Z</td>
<td>&gt;240</td>
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## Percentage of load capacity (%) versus speed

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<th>H</th>
<th>V</th>
<th>W</th>
<th>Y</th>
</tr>
</thead>
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<tr>
<td>210</td>
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</tr>
<tr>
<td>300</td>
<td>85</td>
<td></td>
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</table>

For speed capabilities over 300 km/h the percentage of the load capacities and the relevant inflation pressures will be agreed between the vehicle and tyre manufacturers (or their national associations) taking into consideration the vehicle characteristics and the type of service.

Based on ETRTO standards manual 2012 recommendations
Flat run tyre

Technical safety items

Flat Run tyres are recommended to be used only on vehicles which have TPMS (tyre pressure monitoring system) and ESP-systems.

When driving with a flat tyre:
» Maximum speed is 80 km/h
» On slippery conditions (snow/ice) maximum speed is 50 km/h
» Guaranteed run flat distance is 50 km with full load and 150 km with driver only.

After driving in the run flat state always replace the tyre with a new one.

When mounting:
» Tyre sidewall is much stiffer than normal construction
» Difficulties can arise during the fitting of Run flat tyres due to the stiffer sidewall construction. Run flat tyres can be handled on the same machinery which is capable of mounting standard low aspect ratio tyres
» With Nokian Run Flat tyres you can use a normal standard rim
» Do not mount run flat tyres and normal tyres on the same car
» Special care is needed if a pressure sensor is mounted inside the wheel

The Flat Run/Run Flat structured tyres can be repaired in the tread area with appropriate tubeless patching. The repair can only be made if there is 100% certainty that the tyre has not been driven empty or while clearly under-pressure. The tyre needs to be inspected carefully from the inside and outside in order to detect driving whilst under pressure.

Generally, even driving a short distance with a deflated tyre may lead to the sidewall’s reinforcement component becoming detached from the body, and this defect cannot be seen.

Taking all the safety aspects into consideration, we do not recommend repairing a suspect tyre. In this case, we advise renewing the tyre.

This repair instruction only covers tyres up to the H speed symbol category. We do not recommend repairing tyres in the higher speed categories (V/W/Y).
EU Labelling
Main goal of EU labelling

Simplifying the tyre purchase decision for consumers based on three classification criteria: rolling resistance, wet grip, and external rolling noise.

In force
The new classification model and tyre labels will be introduced in the European Union on 1 November 2012.

Applies to
Passenger car, van, and lorry tyres manufactured after 1 July 2012.

Three classification criteria

1. Fuel Efficiency
   » Rolling resistance classes A to G for evaluating the fuel efficiency of the tyre

2. Safety
   » Wet Grip classes A to G to indicate braking distance on wet surfaces

3. Noise
   » External rolling noise and noise measurement value

NOTE! Regulation does not apply to studded tyres.
Nokian Tyres’ stand on the EU-label

Nokian Tyres supports the EU-labelling and will introduce it to all of its tyres as stated in the regulation. However, Nokian Tyres is concerned that the information provided on the label is too limiting and should not be the only decision base for the consumer. In addition, Nokian Tyres feels that the information provided in the label can even misguide consumers to purchase unsuitable winter tyres especially in Nordic countries. This endangers traffic safety. Therefore, Nokian Tyres wants to provide consumers with added safety information in an environmentally conscious way to guide the consumers in their decision making process.

Tyre rolling resistance

Resistance to movement is the set of resistive forces a vehicle has to overcome to be able to move. It requires energy to overcome these forces.

There are five forces that a vehicle has to overcome in order to move:
» Rolling resistance
» Aerodynamic forces
» Internal friction forces
» Gravitational forces when driving on a slope
» Inertial forces when accelerating

All these forces together resistance movement.

This rolling resistance value is measured indoors against a steel drum.
Wet grip

» A vehicle method for testing a set of tyres mounted on a passenger car equipped with measurement devices.

» A test method involving a trailer pulled by a vehicle or a test vehicle equipped with the test tyre(s).

» Water depth of 1.0 ± 0.5 mm; fluctuation of ± 10% is allowed during the test.

» Heavy braking at the test point until sufficient braking torque is reached in order to generate maximal braking force without locking the tyre at the test speed of 65 km/h.

Noise

This is the external noise made by the tyre and is measured in decibels and rated according to three classes. The more black bars shown on the label, the louder the tyres are.

The new label is designed to show information regarding three criteria. However, there are many other important performance factors to consider, including:

» Resistance to aquaplaning

» Driving stability on both dry and wet surfaces

» Handling and steering precision on wet and dry roads

» Durability

» Braking performance on dry roads

» Capabilities in winter conditions (M+S); ice grip, snow grip

» Slush planing

Factors that need to be taken into consideration in noise class limits:

1st consideration – tyre class: C1, C2 or C3?

2nd consideration – if C1:

» summer or winter?

» reinforced (XL) or standard?

» tyre width?

3rd consideration – if C2 and C3:

» summer or winter?

» driving axle or not?

» special use or not?

After checking these factors the noise class can be determined according to the limits set by the EU regulation. All in all, the measured value (in dB) does not simply correlate to the noise class.
Speed rating

These days, car manufacturers also use tyres of H or even V speed ratings as standard equipment in small cars. The selection of original equipment tyres is based on many tests that the car manufacturers conduct jointly with the tyre suppliers. It is clear that car manufacturers want their cars to function in the best possible way over the entire speed range of the car, so tyres with speed ratings well over the Nordic speed limits are installed as standard equipment on cars delivered to Scandinavia. However, it is a fact that the proportion of tyres with speed rating T has decreased significantly over the years – that is, speed rating H is gaining ground in small cars as well.

Air pressure

Another important issue in addition to the speed rating is tyre air pressure. Pressure maintenance of tyres is very significant in terms of the driver’s safety. A tyre is a pressure vessel. Air pressure is required for carrying the load. Tyre pressures have a significant effect on the driving characteristics of the car and the life of the tyres.

Underinflated tyres also increase fuel consumption. Stability and good driving characteristics can be achieved by correct tyre pressures. Rutted roads, surprising side winds, sudden evasive movements and rapidly changing conditions, among other things, are challenges for safe traffic. Driving safety can be improved by adjusting tyre pressures to the load and driving conditions. You should also note the effect of ambient temperature on tyre pressures (10°C @ approx. 10 kPa). When the pressures are correct, the rear of a loaded car returns to a stable state after sudden evasive movements and heavy cornering. This does not happen with underinflated tyres. Naturally, heavy loading emphasises the situation. The car manufacturers’ pressure recommendations generally emphasise comfort and are primarily intended for summer tyres. Quite often Nokian Tyres have observed the special requirements of winter tyres (M+S) in the pressure recommendations.
Winter tyres
Studded or non-studded tyres?

Should you go for studded or non-studded winter tyres? This is a choice worth some consideration. What is your driving style like? Do you drive a new or older car? How much experience do you have in winter driving? New car models are usually equipped with both ABS brakes and a driving stability management (ESP) system. If your car does not have these technical features, studded tyres are recommended.

Studded tyres are also the safest choice for inexperienced winter drivers. They provide the best grip in all winter conditions and especially on icy surfaces. Magazine tests have proven that high-quality studded tyres provide a significantly better grip than cheap imported tyres. A good example of high-quality studded tyres is the Nokian Hakkapeliitta 7 that has won nearly all comparison tests conducted by car magazines in Scandinavia over the past few years.

If you choose non-studded winter tyres, you should pay extra attention to your choice. There are two types of non-studded tyres available: tyres designed for the Central European winter, and tyres designed for northern conditions. The difference between these two types is that the Central European winter tyres have driving properties optimised for wet and dry surfaces; their grip on ice and snow is weaker than that of non-studded tyres tailored especially for northern conditions. Nordic non-studded winter tyres feature rubber compounds, structures and tread patterns specifically tailored for the varying, demanding winter conditions typical of the north.

Nokian Hakkapeliitta R is a non-studded winter tyre designed for northern roads. Hakkapeliitta R has won several tyre tests in which it has been praised for its safe grip in all conditions. In addition, it has the lowest rolling resistance among all tested winter tyres. A low rolling resistance reduces fuel consumption and CO₂ emissions.
Use of a new winter tyre

We recommend a “break-in” of 500 to 1,000 kilometres for both studded and non-studded tyres, avoiding hard braking and acceleration, and aggressive cornering. In order to ensure that the studs stay in the tyre, the rolling direction of studded tyres must never be changed. Tyre pressures play a major role in the driving characteristics of the car. They ensure stable handling in both summer and winter traffic. Follow the tyre or car manufacturer’s recommendations on tyre pressure. The pressure should always be checked when the tyres are cold.

A change of 10°C in temperature causes a change of 10 kPa in tyre pressure in a car tyre. When the tyres are pressurised at +20°C and the outdoor temperature is –20°C, the actual pressure once the tyres have cooled down is 40 kPa less than the set pressure. The minimum allowed groove depth on winter tyres is 3 mm. However, the recommended minimum in winter conditions is 5 mm. If studded tyres are used, all the tyres on a car must be studded. In Scandinavia winter tyres must be used in December, January and February. The sidewall of a winter tyre has one of these alternative designations: M+S, MS, M&S.
**Studded tyre**

**Nokian stud development**

New studded tyres should be driven in for the first 500-1000 kilometres (300 to 650 miles) by avoiding rapid acceleration, high cornering speeds and violent braking. The studs will then be able to properly settle into their holes and will function correctly for the lifetime of the tyre. New studs cannot be fitted to replace lost ones, as they will not stay in the holes formed in the tyre. The stud holes are formed during the vulcanisation process, by means of plugs in the tyre mould. The stud holes in tyres for heavy machinery are generally drilled after manufacture.

![Studded tyre components](image)

**Number of stud in a tyre**

| Rim (in inches) | Max no. of studs | 1. Option | Maximum of 50 studs per one metre of tyre rolling circumference.
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<thead>
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<th></th>
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<td>1. Option</td>
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<tr>
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<td>1. Option</td>
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<tr>
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<td>130</td>
<td>2. Option</td>
<td>Overrun test If the number of studs or the installation method are not in compliance with the regulations, Type Approval for the stud may be granted if the road surface wear has been tested in a reliable manner.</td>
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<td>Overrun test If the number of studs or the installation method are not in compliance with the regulations, Type Approval for the stud may be granted if the road surface wear has been tested in a reliable manner.</td>
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</tbody>
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* Other than PCR
Choosing the right winter tyre

**Studded winter tyres**
- Excellent ice grip properties
- Good snow properties
- Good slush planing properties
- Recommended to use with studs
- Not recommended to use in summer conditions

**Central European non-studded winter tyres**
- Moderate ice properties
- Moderate snow properties
- Good wet properties
- Good slush planing properties
- Very good handling properties

**Nordic non-studded winter tyres**
- Good ice properties
- Good snow properties
- Very low rolling resistance
- Not recommended to use in summer conditions

**All season tyres**
- Moderate wet grip properties
- Moderate handling properties
- Reduced slush planing properties
- Reduced winter properties
- Good handling properties on dry surfaces
- Good mileage
Performance comparison between studded and non-studded tyres

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Braking comparison

Braking distance from 50 km/h on slippery ice

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<td>Non-Studded Winter Tyre</td>
<td>59 m</td>
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<tr>
<td>All-Season Tyre</td>
<td>98 m</td>
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Winter symbols on a tyre

*M+S*

This marking does not require any testing or approving. Tyres are specifically designed for mud and snow (winter). MS, M6S, M.S and M-S are also permitted.

**Alpine logo**

This marking requires testing and approving. This is a so-called outdoor test performed in authentic conditions by braking on snow and comparing the acceptable tyre’s grip with a commonly agreed reference tyre. Once a tyre passes the snow grip test, it can have the so-called Alpine logo (a three-peak mountain with a snow flake) marked on its sidewall. The old winter tyre marking ‘M+S’ will still be used but this marking alone does not indicate that the tyre has been tested and type approved according to the latest requirements.

**DSI + snowflake**

On Nokian Tyres’ winter tyres there is a Driving Safety Indicator (DSI) and a snowflake symbol (Winter Safety Indicator) to improve driving comfort and safety. The numbers indicate the depth of the main grooves in millimetres. The numbers fade away as the tyre wears down. For safe winter driving, the required groove depth is between 4 and 5 millimetres. The snowflake symbol remains visible until the groove depth is four millimetres. Once the snowflake symbol wears off, the driver should buy new winter tyres to ensure adequate safety.
Rotation of the tyre under a car

It is wise to rotate the placement of tyres under the vehicle, even during one season. In modern steel belt tyres, wearing is usually manifested in such a form that the drive wheels' central tread section wears a bit more due to the traction, whereas the free-rolling tyres' shoulder areas wear first. Timely rotation of the tyres evens out the differences in wearing, which enables achieving the optimal output of the set of tyres. In studded tyres, the stud protrusion generally adjusts in such a manner that in the drive wheels, the stud protrusion increases slightly when driven, whereas in free-rolling tyres, the stud protrusion actually slightly decreases in use. This is another reason that supports rotating even studded tyres under the car. Approximately 8,000 km is a good interval for tyre rotating; even more frequent rotation is recommended for those who drive a lot. In four-wheel drive cars, the traction is very often concentrated in the front axle, which puts them in a rather similar situation with front- or rear-wheel drives. A general rule of thumb that applies to both summer and winter tyres is that you should always mount the tyres with better grip on the rear axle. This ensures control over the vehicle in extreme situations; in terms of control, losing grip at the rear axle is much more dangerous than losing grip at the front. The right tyre pressure significantly reduces tyre wear. In the north, most drivers use studded tyres in the winter. Such factors as rough asphalt and higher temperatures accelerate tyre wear. When worn more quickly than anticipated, an old non-studded tyre may start generating increased noise because the quick wearing can be manifested in an unusual wearing pattern. Finally, quickly worn tyres become unsafe – even dangerous.

Moreover, an old winter tyre does not provide a quick enough steering response; it is late in all corners and features poor stability even when driving straight. For example, the braking distance on a wet road with an old winter tyre can be as much as 60% longer than with a summer tyre. Hence, worn non-studded tyres are not a good choice for wet roads with deep grooves.

The idea of converting an old studded tyre into a summer tyre might tempt some drivers. The removal of studs, however, is not recommended. Once the studs are removed, the empty stud holes quickly fill up with small pebbles that may damage the tyre. When the tyre pressure is right, the tyre adjusts properly and generates heat in a controlled manner. Heat is the number one enemy of a tyre. Other factors influencing tyre wear include the driving style, mileage, load and surface.
Car track geometry

Caster

Caster is the tilting of the uppermost point of the steering axis either forward or backward (when viewed from the side of the vehicle). A backward tilt is positive (+) and a forward tilt is negative (-). Caster influences the directional control of the steering but does not affect the tyre wear and is not adjustable on this vehicle. Caster is affected by the vehicle height and, therefore, it is important to keep the body at its designed height. Overloading the vehicle or a weak or sagging rear spring will affect caster. When the rear of the vehicle is lower than its designated trim height the front suspension moves to a more positive caster. If the rear of the vehicle is higher than its designated trim height, the front suspension moves to a less positive caster. With too little positive caster, steering may be touchy at high speed and wheel returnability may be diminished when coming out of a turn. If one wheel has more positive caster than the other, that wheel will pull towards the centre of the vehicle. This condition will cause the vehicle to pull or lead to the side with the least amount of positive caster.
**Camber**

Camber is the tilting of the wheels from the vertical when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is positive (+). When the wheel tilts inward at the top, the camber is negative (−). The amount of tilt is measured in degrees from the vertical. Camber settings influence the directional control and the tyre wear. Too much positive camber will result in premature wear on the outside of the tyre and cause excessive wear on the suspension parts. Too much negative camber will result in premature wear on the inside of the tyre and cause excessive wear on the suspension parts. Unequal side-to-side camber of 1° or more will cause the vehicle to pull or lead to the side with the most positive camber.

**Toe in/Toe out**

Toe is a measurement of how much the front and/or rear wheels are turned in or out from a straight-ahead position. When the wheels are turned in, toe is positive (+). When the wheels are turned out, toe is negative (−). The actual amount of toe is normally only a fraction of a degree. The purpose of toe is to ensure that the wheels roll parallel. Toe also serves to offset the small deflections of the wheel support system that occur when the vehicle is rolling forward. In other words, with the vehicle standing still and the wheels set with toe-in, the wheels tend to roll parallel on the road when the vehicle is moving. Improper toe adjustment will cause premature tyre wear and cause steering instability.

**Setback**

Setback is the amount by which one front wheel is further back from the front of the vehicle than the other. It is also the angle formed by a line perpendicular to the axle centreline with respect to the vehicle’s centreline. If the left wheel is further back than the right, the setback is negative. If the right wheel is further back than the left, the setback is positive. Setback should usually be zero to less than half a degree, but some vehicles have asymmetrical suspensions by design. Setback is measured with both wheels straight ahead, and is used as a diagnostic angle along with caster to identify chassis misalignment or collision damage. The presence of setback can also cause differences in toe-out on turn angle readings side-to-side.
Tyre mounting
General installation instructions for passenger car tyres

A systematic approach should be adopted when installing tyres

1. Verify that the rim and tyre fit together. Check the right dimensions and regulations. Remember that car and van tyres have different norms.

2. Check the condition of the tyre
   » Externally: punctures and cuts.
   » Inside rubber coating: solid and clean.
   » Bead part: no breaks or cracks.

3. Check the condition of the rim
   » Cleanliness: dirt, rust.
   » Throw: radial, lateral.
   » Mechanical damage: wear on outer edge, warping.
   » Remove the old tubeless valve.
   » Remove any old balancing weights.
   » Check and clean the valve opening; dirt, rust.
4. **Install a new tubeless valve and remove the inner part of the valve**

5. **Lubricate the bead part of the tyre with mounting fluid**
   - Bead bottom and side.
   - Note! Excessive use of fluid may cause the tyre to rotate on the rim!

6. **Lubricate the outer edge and side of the rim and the hump part with mounting fluid**

Particular issues to be observed for aluminium rims. Ensure that the rim width is suitable for the tyre and that the ET dimension of the rim does not excessively alter the track of the car.

An excessive change in the ET dimension can alter the steering geometry. Verify with the rim supplier that the rim is suitable for the car and has sufficient load-bearing capacity. There are designated rims for vans and sports utility vehicles.

Particular care should be observed when mounting tyres on aluminium rims because extra-low-profile tyres are tight to mount.

- Lubricate the mating surfaces of both the tyre and rim carefully.
- Take care not to damage the lacquered surface of the rim; damage to the lacquer will result in corrosion starting immediately.
- After pressurising the tyre, verify the result of your work on a balancing machine by observing the distance between the tyre alignment rib and the outer edge of the rim.
- Ensure that the tyre is mounted tightly against the bead part of the rim in all positions.
7. Mount the tyre on the rim according to the instructions. If there are no special instructions for tyre mounting, install the tyre so that the date of manufacture identifier (DOT) is on the outside.

Asymmetric tyres and unidirectional tyres

ASYMMETRIC TYRES are usually summer tyres whose tread pattern is not symmetrical on both sides of its centre. The pattern on the outer edge is generally more uniform and includes longitudinal grooves. The inner edge has a block pattern that is more fragmented and includes lateral grooves. The tyres must be installed in accordance with the designations on the sidewall, such as “inside” and “outside”. Asymmetric patterns are generally used in tyres of H or higher performance rating. An asymmetric pattern is aimed at the best possible grip when cornering, braking and driving on a wet surface.

DIRECTIONAL TYRES are installed in the rolling direction indicated by the pattern. The rolling direction is indicated on the sidewall. In wide summer tyres, the pattern (usually an arrow pattern) is aimed at the best possible properties in wet weather. The pattern efficiently evacuates the film of water at high speeds. In winter tyres, a designated rolling direction aims to increase the grip of the blocks and siping and to improve the tyre’s ability to expel slush, snow, and water from the pattern.
8. **Inflate the tyre using double inflation**

» **Step 1.** Apply pressure to the tyre and verify that it goes over the hump at a pressure under 200 kPa.

» **Step 2.** Pressurise the tyre to 300 kPa.

» **Step 3.** Let the air flow out.

» **Step 4.** Install the inner part in the valve and pressurise to operating pressure.

» **Step 5.** Visually check that the tyre is correctly mounted on the tyre on both sides (alignment ribs).

9. **Balancing aluminium and steel rims**

Balancing is a phase that must always be completed with care. You should remember the following:

» Select the correct mounting hardware for the balancing machine so that the rim is centred similarly to how it would be on a hub on the car.

» Clean the mating surfaces of the rim, the balancing machine flange and the hub on the car.

» Verify the roundness of the tyre/rim combination (radial and lateral throw) before balancing.

» Follow the equipment manufacturer’s instructions regarding the course of the work, particularly the special instructions for various types of aluminium rims (combination weight).

» Use glued weights on aluminium rims.

» Do not accept any excessive weight requirements from the machine, because this indicates a defect or fault that cannot be corrected by balancing.
10. **Compensation for radial/lateral run-out**

» If the radial run-out of the combination is > 1 mm, the high point of the tyre and the low point of the rim must be aligned.

» **Step 1.** Measure the highest point on the surface of the combination and mark it on the sidewall using a crayon.

» **Step 2.** Measure the lowest point on the inner mating surface for the tyre bead on the rim and mark it on the outer edge of the rim using a crayon (item D in the figure).

» **Step 3.** Deflate the tyre and drop the bead part of the tyre from the rim using a bead removal tool. Lubricate the mating surfaces and turn the tyre on the rim so that the marks are aligned.

A similar procedure applies to excessive lateral run-out (max 1 mm).

Modern balancing machines include equipment for the quick measurement of combination run-out, and the machine provides advice on how to achieve optimum roundness. Once the radial and lateral run-out are within the allowed limits, balance the combination while taking the above into account.
11. Installation on the vehicle

» Verify that the rim is suitable for the car
» Clean the mating surfaces
» Verify that any adapter rings for aluminium rims are of the correct size and in good condition
» Verify that the rim mounts tightly on the hub
» Lubricate the threads on the nuts/bolts (only a drop of oil)
» Verify that the nuts/bolts are suitable for the rim
» Tighten the bolts/nuts to the appropriate torque; steel rims generally 90 to 100 Nm, while aluminium rims are generally tightened to 100 to 120 Nm. The values are directive! Use a torque indicator or a torque wrench.
» Remember to tighten in a cross pattern

Remind the customer:
› That aluminium rims must be re-torqued after driving 100 to 200 km.
› That the mounting fluid dries in 24 hours. Undried mounting fluid may cause the tyre to turn on the rim, resulting in wheel imbalance.
› If different nuts/bolts are used for aluminium rims, the original nuts/bolts must be kept in the car for the spare wheel.
12. Choose the right rim

Always choose the right kind of rim to mount the tyre. If you need further info about recommended rims, please check the data book or contact the tyre manufacturer. There’s always a measuring rim and also some alternative rim widths which are also suitable for mounting.

One example about recommended rims

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### Passenger car rims

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### Tyre mounting

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Based on ETRTO standards manual 2012 recommendations
Rim flanges and offsets

- Drop centre
- Hub plate
- Hub and plate joint
- Rim and plate joint
- Hub attachment area
- Bolt circle diameter
- Offset
- Hub opening diameter
- Bolt hole diameter

Rim flanges:

- Drop centre
- Hub plate
- Rim and plate joint
- Hub attachment area
- Bolt circle diameter
- Offset
- Hub opening diameter
- Bolt hole diameter

Offsets:

- Back spacing
- Width of wheel

Brake side:

Positive offset

Zero offset

Negative offset

B = 14
C = 15.9
J = 17.3
K = 18.0
L = 21.6
(F = 22.2)
Tyre repairing

Before having a tyre repaired, tell the dealer if you have used an aerosol fixer to inflate/seal the tyre. Aerosol fixers could contain a highly volatile gas. Always remove the valve core outdoors, away from sources of excessive heat, flame, or sparks and completely deflate the tyre before removing it from the rim for repair.

» Never repair a tyre with less than 2/32nd inch (1.6 millimetres) tread remaining. At this tread depth, the tyre is worn out and must be replaced.

» Never repair a tyre with a puncture larger than 1/4 inch (6.4 millimetres) in diameter. Such tyres cannot be properly repaired and must be replaced.

» Repairs of all tyres (radial and non-radial) must be of the plug and inside patch type. Using plugs alone on any type of tyre is not a safe repair.

» Never repair a tyre with a puncture or other damage outside the tread area (shoulder, sidewall) Such tyres cannot be properly repaired and must be replaced.

» Any tyre repair done without removing the tyre from the rim is improper. Tubes, like tyres, should be repaired only by a qualified tyre service person.

» Never use a tube as a substitute for a proper repair.

REMEMBER!

To avoid damage to your tyres and possible accident:
› Check tyre pressure at least once each month when tyres are cold and before long trips.
› Do not underinflate/overinflate.
› Do not overload.
› Drive at moderate speeds, observe legal limits.
› Avoid driving over potholes, obstacles, curbs or edges of pavement.
› Avoid excessive wheel spinning.
› If you see any damage to a tyre, replace with the spare and visit any Nokian tyre retailer at once.
› If you have any questions, contact your Nokian tyre retailer.

Failure to observe any of the recommended precautions contained in this owner’s manual can lead to erratic vehicle behaviour and/or tyre damage.
Storing a tyre
Proper storage can slow the ageing of tyres

1. Temperature
The tyre storage temperature must remain below +25 °C; storage in premises protected against light, in a temperature below +15 °C is recommended. The properties of rubber may change, affecting the usage properties and service life of the tyre, if the temperature is above 25 °C or below 0 °C. Tyres should not be in direct contact with heat sources such as radiators or boilers.

2. Humidity
Tyres should not be stored in humid premises. The degree of humidity must not be so high that moisture is condensed on the tyre surface/inner rubber layers. Tyres must not be stored in conditions where they might be in contact with rain, splashes of water or other such forms of moisture.

3. Light
During storage, tyres should be protected from light, especially from direct sunlight, powerful lighting or ultraviolet radiation.

4. Radiation
Ozone has a deteriorating effect on tyres. The tyre storage room must not contain any ozone-producing equipment, such as fluorescence lamps or mercury lamps, high-voltage generators, electric motors or any other electrical equipment that may generate magnetic fields or electric discharges.

5. Deformation
Whenever possible, tyres should be stored freely in their natural shape without any pressure or torsional stress. Heavy deformation may cause the tyre to behave abnormally when inflated or even break the tyre structure.

6. Solvents, oils
Tyres must never come into contact with solvents, oils, greases or other substances that harm rubber during storage. Tyres must always be protected from the influence of strong sources of radiation, such as electric welding generators.

7. Tyre handling
Tyres must be handled carefully to avoid bead and tread deformation. Tyres must never be dropped from a height of 1.5 m or higher; the fall may damage the tyre bead. If a tyre’s bead area is damaged, the tyre must not be mounted on a rim.
Limited warranty for Nokian brand tyres

The below terms of this limited warranty apply to defects in the materials and workmanship of tyres (hereinafter referred to as "Tyres") under Nokian's brand manufactured and/or sold by Nokian Tyres plc with the exclusion of retreaded tyres. The limited warranty is valid for three (3) years from the date of purchase or five (5) years from the manufacture of a Tyre, whichever is the earliest. If the manufacturer discovers a defect in the materials or workmanship of a Tyre, Nokian Tyres plc will compensate a customer for unrealised benefit from the use of the Tyre in question in accordance with the terms and conditions set forth hereinafter.

Nokian Tyres plc's limited warranty shall not apply, and Nokian Tyres plc shall not be held liable under it, if a defect to a Tyre is a result of the following:

(a) normal wear and tear;
(b) misuse;
(c) use in motor racing or other exceptional use;
(d) faulty mounting on rim;
(e) faulty storage by a party other than Nokian Tyres plc;
(f) faulty studding after delivery;
(g) alteration or repair by anyone other than Nokian Tyres plc or a third party approved by Nokian Tyres plc,
(h) damage resulting from accident or negligence of anyone other than Nokian Tyres plc;
(i) damage resulting from a chain and/or another device;
(j) faulty or incomplete product advice or instructions given to the customer not confirmed or approved by Nokian Tyres plc;
(k) inferior quality—indicated by the “DA” brand put on a Tyre during quality grading—which reduces the selling price to the customer.

What was stated above concerning Nokian Tyres plc's limited warranty applies only in cases where the tread depth of a Tyre meets the requirements of the vehicular laws of the country where the Tyre was sold. Should a Tyre's tread depth be less than the country-specific requirements, Nokian Tyres plc's limited warranty is not valid and Nokian Tyres plc cannot be held liable under it, even if the above-mentioned time periods have not expired.

Nokian Tyres plc's limited warranty is valid only if the customer notifies Nokian Tyres plc or its authorised dealer (a list of dealers is available to customers) in writing of the alleged defect within two (2) months \( ^* \) of the date the customer discovers it, or reasonably should have discovered it.

The customer must return the allegedly defective Tyre to Nokian Tyres plc or its authorised dealer without delay. Should Nokian Tyres plc find the Tyre defective and the limited warranty applies to it, Nokian Tyres plc's liability shall be limited to compensation for unrealised benefit from use of the Tyre in question. The unrealised benefit from use is calculated on the basis of the Tyre's remaining tread depth. Nokian Tyres plc's liability shall extend to mounting/dismounting and other costs only to the extent required by mandatory consumer protection laws of the country where the Tyre has been sold.

Nokian Tyres plc's liability shall also extend to studding, provided that the studding of the returned Tyre complies with the laws and regulations of the country where it was sold. In case the studding has been done by a third party, Nokian Tyres plc is liable only if that party is approved by Nokian Tyres plc and has done the studding in a manner approved by Nokian Tyres plc and according to Nokian Tyres plc's instructions. Studs are not covered by this limited warranty for Tyres.

Nokian Tyres plc shall not be liable for any failure to perform any of its obligations under this limited warranty due to problems beyond its reasonable control (force majeure events or effects) or problems caused by complications, which affect its business. Such events or effects include for example: war, rioting, fire, industrial action, governmental acts, natural catastrophes, discontinuation of public or private transportation and energy and raw material shortages. In case of any of the mentioned events or effects, Nokian Tyres plc is unconditionally exempt from liability.
under the terms and conditions as set forth herein until the force majeure event or effect terminates.

Nokian Tyres plc’s liability shall be limited to the above and only to the extent mentioned herein. Under no circumstances shall Nokian Tyres plc be liable for indirect, incidental or consequential damage, loss of business income or other revenues, other economic losses, or damage due to not being able to use a Tyre - whatever kind they may be.

This limited warranty is only valid and enforceable in the country where a Tyre has been purchased provided that Nokian Tyres plc has intended the Tyre for sale in that country. However, if the Tyre has been purchased in a member state of the European Union and Nokian Tyres plc originally intended the Tyre for sale in one of these countries, this limited warranty is valid and enforceable in all of these countries of the European Union.

This limited warranty shall neither exclude nor limit any of a customer’s legal (statutory) rights under the applicable national mandatory consumer protection laws.

*) the period of two (2) months concerns only the limited warranty valid in member states of the European Union; the time period outside the European Union is fourteen (14) days.

Exceptions to warranty coverage

This Limited Warranty shall not apply if an eligible tyre is permitted to wear unevenly across the tread down to the treadwear indicators (1.6 mm of tread remaining), or the tyre damage or wear condition is due to any one or more of the following:

» Road hazards, such as puncture, cut, snag, stone drill, impact or bruise break.
» Use of tyre chains or other additional device(s).
» Cutting or wheel spinning.
» Apparent overload or improper inflation pressure.
» Wheel misalignment or tyre/wheel assembly imbalance.
» Use of improper equipment.
» Vehicle conditions, defects, or characteristics.
» Improper mounting or demounting.
» Improper repair, insertion of sealant, improper balancing, or use of filler materials other than air, nitrogen or carbon dioxide.
» Intentional alteration of either the appearance or physical characteristics of the tyre.
» Conditions caused by aging or improper storage.
» Racing, exceptional use, wreck, collision or fire.
» Use on an emergency vehicle.
» Exposure or contact with solvents, oils, greases, excessive heat or ozone generating devices.
» Faulty or incomplete product advice or instruction not confirmed or approved by Nokian Tyres plc.
Glossary
Glossary

ALIGNMENT
The caster, camber and toe angles in a vehicle’s suspension geometry that are set to a specification by the vehicle manufacturer for handling & wear.

ASPECT RATIO
The relationship between the cross-section height and section width of a tyre expressed as a percentage of cross-section width.

AQUAPLANING
The accumulation of water in a film under the tread face footprint which causes a tyre to lift from the road surface, losing traction. Aquaplaning is affected by vehicle speed, tread pattern, and water depth (quite the same as slushplaning).

BALANCE
The equal distribution of the mass of the tyre and wheel assembly for smooth driving. Balance is achieved by fitting weights to the wheel to offset uneven weight distribution of the tyre &/or wheel combination.

BEAD WIRE
An inextensible hoop of high tensile steel wires which effectively forms the backbone of the tyre in order to enable the tyre to hold onto the rim.

CAMBER
The angle between the centreline of the tyre and a vertical line as viewed from the front.

CASING/CARCASS
The tyre body, layered plies which form the tyre’s structure and give it shape.

CASTER
The angle between the vehicle’s steering axis and a vertical line, as viewed from the side.

COMPOUNDING
The combining of five basic ingredients: rubber, carbon black/silica, plasticisers, curing materials, and ozone retardants to form the tread and other “rubber” components of a tyre.

DIRECTIONAL
A tyre designed to rotate in only one direction

FLAT RUN (RUN FLAT)
You can drive Nokian Flat Run tyres without air pressure for 50 km with a full load if needed, and when driving alone the maximum distance is 150 km. The maximum speed is 80 km/h, but in slippery conditions (ice and snow) we recommend a max. speed of 50 km/h. This is possible due to a strengthened structure of a flat run tyre.

FOOTPRINT
The area of the tyre’s tread that is in actual contact with the ground.

INFLATION PRESSURE
The pressure of air inside a tyre, which allows them to carry the vehicle’s load.

INNER LINER
Special thin layer of a tyre within a tyre to act as a safety device i.e. work as a tube.

LOAD INDEX
The load index is a numerical code associated with maximum load a tyre can carry at the speed indicated by its speed symbol under service conditions specified by the tyre manufacturer.

M+S
Tyres specifically designed for mud and snow (mild winter). M+S marking is in the sidewall of the tyre.

MOUNTING TYRES
The act of fitting tyres to wheel rims.
**NON DIRECTIONAL**
A tread pattern designed to rotate in either direction without loss in performance.

**OVERALL DIAMETER**
The diameter of an inflated tyre at the outermost surface of the tread.

**OVERINFLATION**
The condition that exists when a tyre is inflated beyond the pressure that would carry the actual load.

**OVERSTEER**
Occurs when cornering where the rear of a vehicle tends to slip/skid before the front and rotate in the original direction of travel.

**PLIES**
Used to reinforce a tyre’s construction, comprising of layers of cord fabric and rubber to provide the strength that is needed to support a load and resist deflection.

**RADIAL**
Radial describes a pneumatic tyre structure in which the ply cords extend to the beads and are laid substantially at 90° to the centreline of the tread, the carcass being stabilised by an essentially in extensible circumferential belt.

**RIM DIAMETER**
The diameter of the rim bead seats, normally indicated in whole numbers in inches for passenger cars.

**RIM WIDTH**
The distance between the rim flanges.

**SECTION HEIGHT**
The vertical distance from the bead edge to centre of the tread in an unloaded tyre (refers to the aspect ratio to determine the height for each tyre).

**SECTION WIDTH**
The linear distance between the sidewalls of an inflated tyre excluding elevations due to labelling, decorations or protective bands or ribs.

**SERIES**
A designation of a tyre’s aspect ratio. A tyre with an aspect ratio of 60% is a 60-series tyre.

**SHOULDER**
The edge of a tyre’s tread where it joins the sidewall.

**SIDEWALL**
The portion of the tyre between the bead and the tread. It is flexible to soak up bumps yet stiff enough to limit tyre rollover.

**SLIP ANGLE**
The variation in degrees between the directions in which a steering wheel is turned and the actual direction of the tyre/vehicle under a cornering force.

**SPEED SYMBOL**
The speed symbol indicates the maximum speed at which the tyre can carry a load corresponding to its load index under service conditions specified by the manufacture.

**SLUSH PLANING**
The accumulation of wet snow in a film under the tread face footprint which causes a tyre to lift from the road surface, losing traction. Slushplaning is affected by vehicle speed, tread pattern, tyre size and slush depth.

**STEEL BREAKER**
The layers of tyre cords usually of rubberised steel wires beneath the tread and stabilises the tread from distortion when cornering, braking, and overall centrifugal forces. Normally two steel breakers in car tyre construction.

**TOE SETTING**
The difference between the front to rear centreline of a tyre mounted on the same axle. Toe-in means the front centreline has less distance between it and the rear centreline and, therefore, the tyres point inward. Toe-out means the front centreline distance is greater than the rear centreline and, therefore, the tyres will point outward.

**TREAD**
The face of a tyre designed and compounded for high traction and low wear.
| **TREAD DEPTH** | The moulded rubber groove in the tread measured in mm or 32nds/inch from the tread face to the bottom of the tread grooves. |
| **TREAD PATTERN** | The arrangement of blocks, grooves, sipes, and channels designed into the tread to enhance its grip and evacuate water/snow/mud. |
| **TREADWEAR** | The measured life of a tyre's tread. |
| **TUBELESS** | Part of the tyre's construction, which uses a butyl inner liner to prevent air leakage into the tyre carcass and eliminates the need for a tube. |
| **UNDER INFLATION** | The condition that exists when there is not sufficient air pressure in a tyre to support a specific load. This causes the tyre to operate with excessive deflection, mechanical flexing and generates excessive heat and premature wear rates. |
| **UNDERSTEER** | The effect when cornering where the front of a vehicle tends to slide in the direction you were heading before you turned the steering wheel. |
| **“UTQG”** | Uniform Tire Quality Grading is a relative comparison system. Tyres are graded by manufacturers in three areas: treadwear, traction, and temperature. |
| **WHEEL ALIGNMENT** | The measuring, analysing, and setting of angles to a predetermined geometric specification to ensure maximum tyre service life, vehicle handling, and safety. |