

wdk guideline for examination of tyre technology

Test guideline for tyre changers

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Introduction

During the mounting and demounting process of UHP and run-flat tyres with different rims and tyre changers used in the market, in the worst case damage to the bead and inner liner area of the tyre can occur.

Such damage can be linked to the following combinations:

- Tyre brand
- Rim type
- Type of tyre changer and related accessories
- Choice of accessories (e.g. lubricant)
- Knowledge and competence of the staff

The tyre changers and their related special accessories have a major influence on trouble-free mounting of UHP and run-flat tyres.

Basis of the test guideline for tyre changers is the wdk guideline "Mounting/Demounting Instructions for UHP and Run-flat Tyres", which was elaborated by the German Rubber Association (wdk) in co-operation with manufacturers of cars, tyres, rims and tyre changers as well as the German Association of Tyre Trade (BRV) and testing institutes (DEKRA, MPA Darmstadt).

1. Description of the guideline

This guideline covers the requirements of machines and systems, which ensure a safe mounting and demounting of UHP tyres and RFT. It forms the basis for certification of machines.

Implementation and test criteria are defined to allow

- error and damage-free mounting and demounting of UHP tyres and RFT,
- as well as the documentation and the proof of the mounting and demounting of UHP tyres and RFT.

The tyre changer supplied by the customer is tested to ensure the error-free mounting of UHP tyres and RFT. Furthermore, the manufacturer of the tyre changer will provide all necessary information (i.e. handbooks) for the mounting and demounting operations.

The tyre changer and the accessories supplied by the customer are evaluated for compliance with state-of-the-art mounting techniques.

With this guideline the implementation conditions of the processes are defined, which consist of specifications and requirements defined by customers and contractors.

The results are to be processed such that each test step can be understood to allow, if necessary, appropriate improvement by the manufacturer (documentation of deficiencies).

The mounting tests of UHP tyres and RFT can result in technical insights which can lead to technical improvements. However, these are not constituent and primary goal of the examinations to be conducted.

The mounting of UHP tyres and RFT within the scope of the certification measures is carried out according to the following criteria:

- mounting according to wdk instructions "Mounting and demounting instructions of UHP and run-flat tyres"
- according to the user manual of the machine manufacturer
- using accessories provided by the machine manufacturer - standard, UHP and run-flat tyres
- using a lubricant (correctly specified) suitable for UHP and RFT
- UHP tyres and RFT chosen by authorized persons.

A certificate will be issued if the tyre changer has fulfilled all requirements for error-free mounting and demounting of UHP tyres and RFT.

2. Quality requirements to tyre changers

The tyre changers must comply with the legal requirements of those countries in which they are used as well as the conditions and requirements of the Employers' Liability Insurance Association (Germany) or other supervisory authorities and institutions.

1. Concerning the requirements to tyre changers the manufacturer has to guarantee and to ensure that the mounting and demounting process can be always accomplished in constant quality and efficiency.
2. The wdk guideline for the mounting of UHP tyres and RFT is part of the manual of the manufacturer and of the test criteria as well.
3. The manufacturer must designate in his manual all parts that have to be used to ensure error-free mounting and demounting of UHP tyres and RFT.
4. The manufacturer describes in his manual all steps required for error-free mounting and demounting.
5. It must be ensured that the machine operates wear-free. Otherwise wear parts must be specified and replacement criteria or replacement intervals must be advised to the user.
6. In case the tyre changer or parts of the machine must be readjusted or be replaced after a certain period of time/use, the user must be informed accordingly.
7. In case improvements regarding the optimization of mounting and demounting of UHP tyres and RFT are available, the manufacturer should inform the user without delay.

The above mentioned criteria are prerequisites to ensure a constant level of quality during the mounting and demounting processes.

3. Description of the test

The mounting tests will be carried out according to a

- defined
- and**
- reproducible sequence of operations.

The following accessories are also to be tested:

- Tyre levers
- Hold-downs
- Bead clamps
- Holding devices
- Mechanical, hydraulic or pneumatic devices for retaining and/or locking tyres (must not damage nor compress the tyre bead, the belt edge and the tyre).

The machine manufacturer defines the operational condition of the machine that includes all required accessories and mounting instructions of the manufacturer.

The mounting and demounting test documents include the following items:

- Features
- Errors
- Illustration of damage
- Mounting forces.

4. Test procedure and documentation

4.1 Test procedure

The standard procedure for mounting and demounting of tyres is carried out according to the operational procedure defined in the wdk mounting/demounting instructions.

Furthermore the mounting and demounting tests are carried out according to the following definitions:

- The DOT side with the date code is specified as side 1
- The DOT side without the date code is specified as side 2
- The DOT date position is always specified as position 12 o'clock
- The DOT mark is usually placed at the valve

Each tyre in the test series is mounted and dismounted twice each according to the following steps:

Part A

Mounting and demounting of both tyre beads. Bead of side 1 is mounted as second bead.

- Mount the tyres such that side 1 will be positioned on the outer side of the bead seat on the rim.
- Inflate the tyres
- Demount or push down the tyre beads from the bead seats
- During the mounting process record the forces of the bead exerted in direction of the rim using a measuring rim
- Demount the tyre; during this process record the forces of the tyre lever exerted in the direction of the rim.

Immediately after demounting of the tyre bead, **side 1** will be cleaned, checked and the results are recorded.

Part B

Mounting of both tyre beads; the bead of **side 2** is mounted as the second bead.

- Mount the tyres such that **side 2** will be positioned on the outer side of the bead seat of the rim
- Inflate the tyres
- Demount or push down the tyre beads from the bead seats
- During the mounting process record the forces of the bead exerted in direction of the rim using a measuring rim
- Demount the tyre; during this process record the forces of the tyre lever exerted in the direction of the rim.

Immediately after demounting of the tyre bead, **side 2** will be cleaned, checked and the results are recorded.

4.2 Evaluation

The evaluation of the machine is carried out according to the procedure described in the wdk mounting/demounting instructions and according to the test criteria (Appendix 2).

All observations will be classified as follows:

- A** error-free process sequence (no failures in mounting process or on tyres)
- B1** critical process sequence (machine cannot be released without improvement of certain aspects)
- B2** safety-relevant damages (machine or process cycle must be revised in principle)

The tyre evaluation is carried out according to the following scheme in regards to the attributes from the criteria catalog:

- 1** = no failure and damage
small or light mark of DM or TP
- 2** = clearly visible mark or minor failure
no crack or rubber damage
- 3** = deep mark or failure with rubber damage
crack or cut not reaching down to the ply;
tyres with bead cover layer: visible structure without cracks
risk of leakage
- 4** = damaged by small cracks in rubber or cuts in the bead toe,
cover ply slightly torn
risk of leakage which might become detrimental to car safety
- 5** = essential damage by cracks, cuts or injuries down to the ply turn-up / bead core rubber
- 6** = damage - detrimental to car safety - by cracks, cuts or injuries to the ply turn-up, rubber damage, visible bead core, total loss

If machine is classified in category A, it can be certified.
If machine is classified in category B1, retesting of certain aspects is required¹.
If machine is classified in category B2, the entire test process must be repeated.

Recommendations for improvement are not part of the mounting tests.

5. Mounting test of UHP/run-flat tyres - Data record and evaluation

During the mounting and demounting processes, the forces applied on the rim flange by the tensile stress of the bead core will be recorded using a measuring rim.

This method should verify the subjective impressions regarding easy or difficult tyre mounting operations by measuring force values.

The bead forces should not exceed the following values:

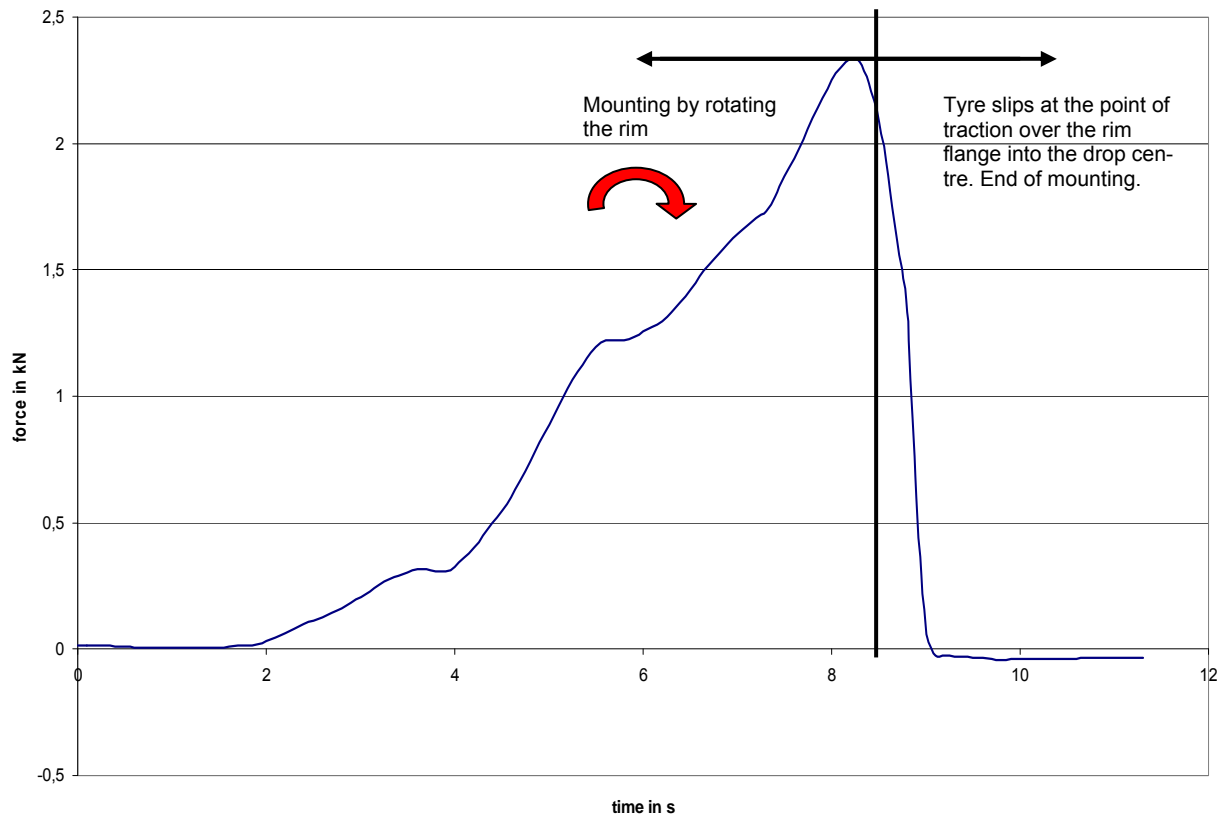
- for mounting: 1.0 kN
- for demounting: 1.5 kN

The measurement of the forces is an additional information for evaluation of the machine, but those forces are not defined as limit values.

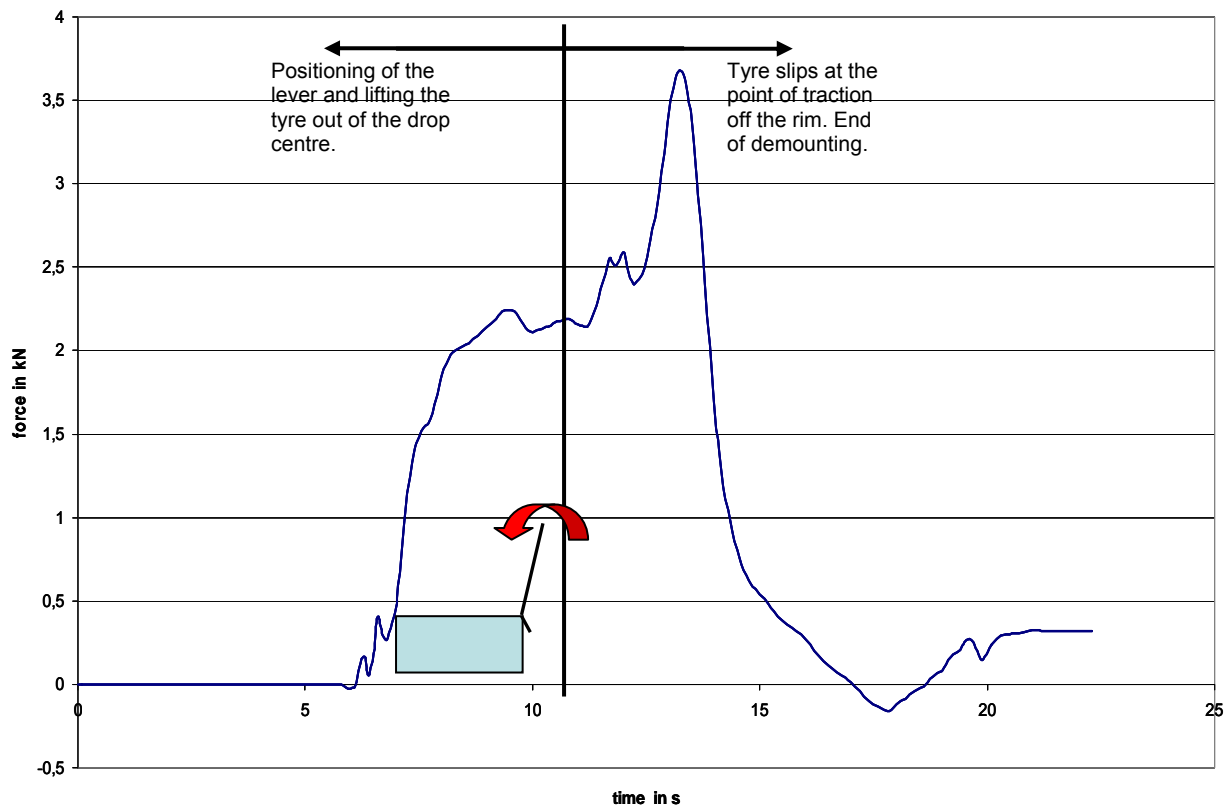


Measuring rim

¹ The requirements for retesting will be defined by the wdk control board (consisting of representatives of the tyre manufacturers, tyre trade, automotive industry and machine manufacturers).



Forces during mounting process



Forces during demounting process

6. Rims

- 7.5x17 EH2 BMW light alloy
- 6.5x16 EH2 MEFRO steel rim

7. Tyres

The following tyre sizes and designs of the manufacturers, who are members of the wdk, are used:

- 205/55 R 16
- 225/50 R 17

4 tyres 16" RFT

4 tyres 17" RFT

2 tyres 21" RFT (325/30 R 21) or 22" *

*The cross section ratio of special size tyres should not be more than 35%.

A separate agreement is required when testing the machine with rims larger than 22".

8. Documentation

The documentation must include:

- Name of the neutral testing agency
- Data record
- Test report

The data record must include:

- Tyre size and design
- Ambient conditions
- Wheel/rim data,
- Rim design / hump design
- Characteristics, categories of damage and failures classified according to the specifications above - detected during the tests
- Mounting and demounting forces

The test report must include:

- A summary of the entire test cycle and annotations, statements, comments, if any, regarding anomalies during the tests

Test result mounting - Handling

Date of test:

Inspector:

Tyre changers:

Manufacturer: <input style="width: 95%; border: 1px solid black;" type="text"/>	Type: <input style="width: 35%; border: 1px solid black;" type="text"/>
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Tyre:

Manufacturer: <input style="width: 95%; border: 1px solid black;" type="text"/>	Size: <input style="width: 35%; border: 1px solid black;" type="text"/>
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Temperature: <input style="width: 95%; border: 1px solid black;" type="text"/>	No.: <input style="width: 35%; border: 1px solid black;" type="text"/>
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Test wheel:

Size: <input style="width: 95%; border: 1px solid black;" type="text"/>	Design: <input style="width: 35%; border: 1px solid black;" type="text"/>
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Material:

Test for side 1

Use of standard accessories

All: <input type="checkbox"/>	Partly: <input type="checkbox"/>	None: <input type="checkbox"/>
Flange protection:	Yes: <input type="checkbox"/>	No: <input type="checkbox"/>
Form of hold-down (e.g. chain): <input style="width: 95%; border: 1px solid black;" type="text"/>		

Test for side 2

Use of standard accessories

All: <input type="checkbox"/>	Partly: <input type="checkbox"/>	None: <input type="checkbox"/>
Flange protection:	Yes: <input type="checkbox"/>	No: <input type="checkbox"/>
Form of hold-down (e.g. chain): <input style="width: 95%; border: 1px solid black;" type="text"/>		

Comments:

Characteristics, errors and forces during mounting

Characteristics, errors and forces during demounting

Appendix

On following pages the general technical data and dimensions of passenger car tyres and rims are shown and described. Source: Technischer Ratgeber PKW Continental

The technical data in the tables comply generally with international standards.

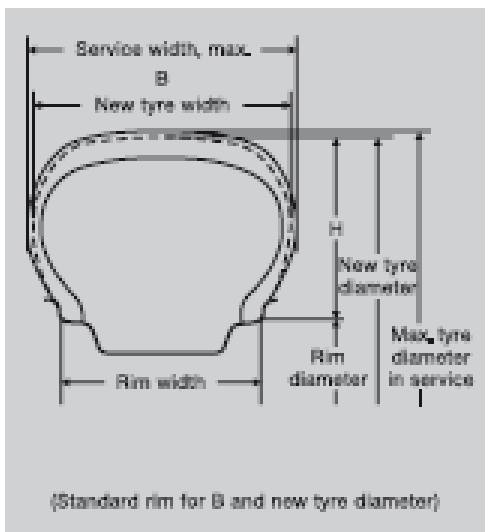
All dimensions in the tables of this databook are given in millimetres (mm), if not indicated in a different way.

The rim diameter is given in inch code. Tyre ranges on new rim types may also be marked in mm.

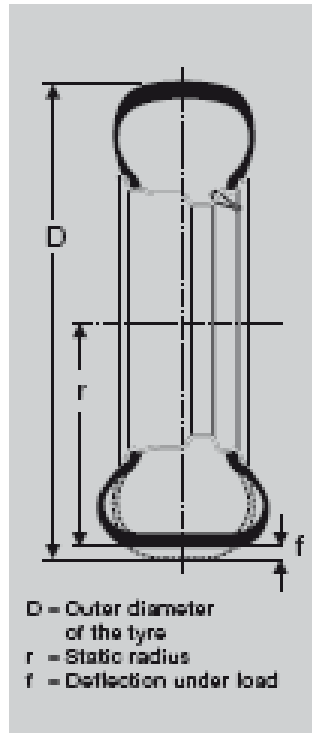
Construction measurements are theoretical values for the design of the tyre: The width is relative to the smooth sidewall, the outer diameter to the tread centre.

Maximum measurements are actual operating measurements of the inflated tyre (operating pressure) in the unloaded state. They include growth but exclude dynamic distortions.

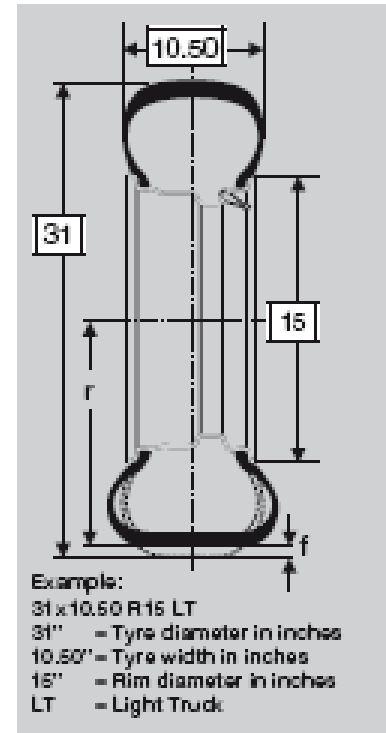
The width is the max. permitted tyre width, including sidewall decorative markings, when the tyre is mounted on the correct rim.



Standard sizes



Flotation sizes (4x4)



The outer diameter is the max. permitted diameter. The max. measurements are binding for vehicle designers.

The static radius is the distance between the wheel centre and the ground contact patch under max. load at the recommended tyre pressure.

The rolling circumference is the distance covered by a point on the circumference when the tyre revolves once at 60 km/h (37 mph).

The load capacity in kilograms (kg) is weight in the sense of a mass.

Tyre pressure (inflation pressure) is given in bar as an overpressure (cold tyre), for driving speeds up to 160 km/h (100 mph).

Vehicle designers should bear in mind the maximum values for tyre outer diameter and width when planning the wheel space of a vehicle, if all standard approved tyres are to fit without any restrictions.

Should this by way of exception not be possible, the safety risk must be eliminated by taking appropriate measures.

The rim is the part of the wheel which supports the tyre.

1. Important elements of the rim

Rim flange = lateral support for the tyre bead

Flange distance = clear rim width

Bead seat = base on which the tyre bead is seated

Well = inner side of the rim

Diameter = specified diameter flange/ bead seat

Hump = continuous raised section of the rim bead seat which enables a better fitting of tubeless tyre beads at low pressure.¹⁾

2. Types of rims

The well-base rim is virtually the only type of rim used on cars, caravans and other car trailers:

Well-base rims = one-piece rims, deepened well for easier tyre fitting, 5° tapered bead seat, "x" in the wheel size designation.

Virtually only J and B versions of the well-base rim are used and these are explained here in more detail.

If rubber valves (snap-in type) are used on rims for higher speeds, these must be fitted with valve supports where necessary. Also refer to the section "Fitting the tyre".

3. Wheel disc (nave)

The wheel disc is the linking element between the rim and the axle hub. Of all the measurements for wheel linking elements – centre bore and bore diameter, bolt hole type and offset depth – the latter is a particularly important factor for the free movement of the tyre in any wheel position.

(Offset depth = 0, when the rim centre and hub contact area of the wheel disc are in line).

4. Wheel strength

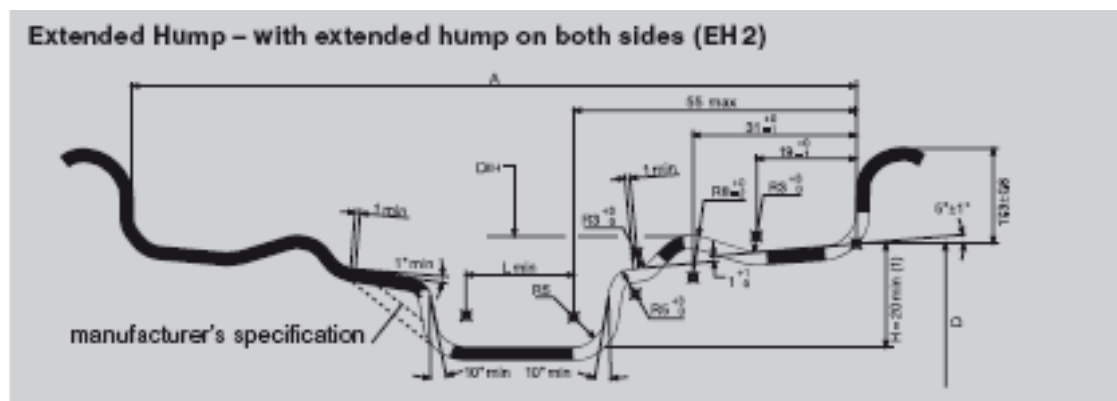
The wheel manufacturer must confirm that the wheel strength is adequate for each particular application.

5. Lateral and true running of the wheels (without tyres)

On cars which are virtually all able to considerably exceed 100 km/h (62 mph), it is particularly important that the wheels of the vehicle are well-centred.

There should be as little radial and lateral run-out as possible on both bead seat/ flange sides of the rim, in order to achieve good smooth running.

The standard shows max. tolerances of 1.20 mm. This dimension is for the centre of the tyre seat area or the centre of the flange height. All measurements, particularly the uniformity, should be well within these tolerances.

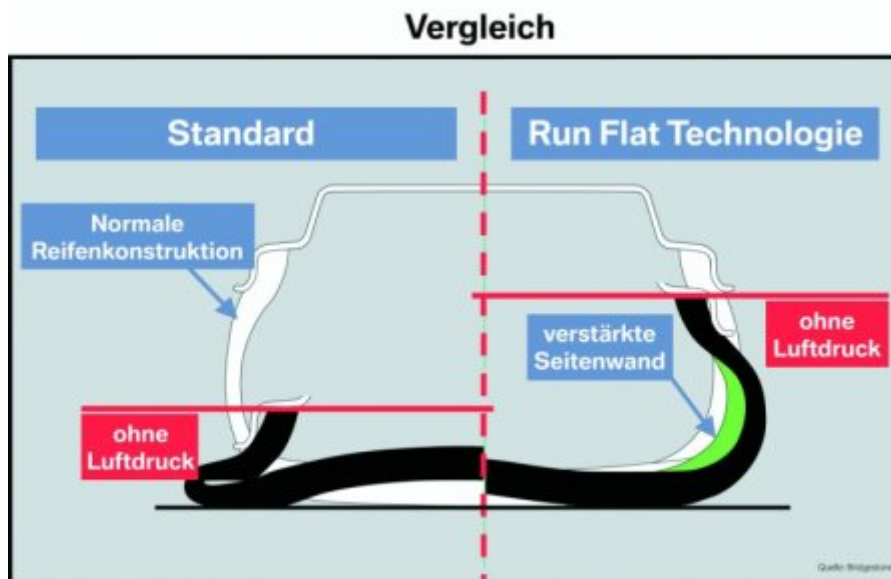


Run-flat tyres

The designations and abbreviations for run-flat tyres (RFT) and run-flat system component (RSC) are both synonyms for the same technology: SST - a self-supporting tyre with run-flat properties.

RSC stands for self-supporting tyre as part of the system of tyre, rim and early-warning system. The label RSC was created by BMW Group together with the tyre industry as a distinctive label for the BMW customer. Since October 2001 the letters RSC are visibly imprinted on all BMW run-flat tyres (Source: BMW).

Due to stiffness of the tyre sidewalls, high forces occur during the mounting process. These forces cannot be transferred completely and affect the bead area directly.



RSC, RPA and EH2

RSC achieves its effectiveness only in combination with another two components:

- Early warning system in form a flat tyre indicator (RPA or optionally a tyre pressure control system (RDC))
- Special formed type of rim, the so-called extended-hump rim.

Only the combination of these three components makes the spare tyre superfluous. RSC is therefore only used in the standardized package of tyre, rim and early-warning system (Source: BMW).

The design of the EH2-rim improves the stability of the tyre rim system. The special features which distinguish the EH2-rim from other rims are modified humps. They are extend further inwards on both sides and are a little bit higher (Source: BMW).

The term UHP tyres is commonly used for a tyre with an aspect ratio of $\leq 45\%$.

Tyre characteristics: e.g. 205/45R16 91 V

- 205 Nominal tyre width (mm)
- 45% Nominal cross-section ratio (tyre height is 45% of the nominal width)
- R Symbol for radial ply tyre ** or RF for run-flat tyres
- 16 Rim diameter (inch code)
- 91 Load-carrying capacity index "91" means the tyre may be charged with a load of 615 kg)
- V Speed symbol for maximum admissible speed: V = 240 km/h

Meaning of the terms used above:

Tyre size	See sidewall
Tyre type	Radial - see sidewall
Tyre design	RFT and UHP - see sidewall
Bead	Part of the tyre that is connected with the rim
DOT	Tyre code according to the Department of Transport (DOT) of the USA; the identification with the date of manufacture is always designated as side 1 in the tests; date of production = 12 o'clock position
Rim width	Distance in inch, measured inside from rim flange to rim flange = size A - see fig. on page 14
Hump	Circumferential part on the rim shoulder, prevents the tyre bead from slipping into the drop centre if tyre pressure is not sufficient
EH2 and EH2+	Different designs of rims for RF tyre; dimensions in the range of the rim shoulder (EH2 = max. 55mm / EH2+ = max. 38 mm)