1. SCOPE

This Regulation covers new replacement wheels designed for vehicles of categories M_1, M_1G, N_1, N_1G, O_1 and O_2.[1]

It does not apply to original equipment wheels or vehicle manufacturer's replacement wheels as defined in paragraphs 2.3. and 2.4.1. It does not apply to "Special wheels", as defined in paragraph 2.5., which shall remain subjected to national approval.

It does not apply to wheels with less than three-wheel fixing components (studs or nuts) which are not identical replacement wheels.

This Regulation comprises requirements for wheel manufacture and installation.

2. DEFINITIONS

For the purpose of this Regulation:

2.1. "Wheel" means a rotating load-carrying member between the tyre and the axle. It usually consists of two major parts:

(a) the rim;

(b) the wheel disc.

The rim and wheel disc may be integral, permanently attached, or detachable.

2.1.1. "Disc wheel" means a permanent combination of a rim and wheel disc.

2.1.2. "Wheel with demountable rim " means a wheel so constructed that the demountable rim is clamped to the wheel disc.

2.1.3. "Rim" means that part of the wheel on which the tyre is mounted and supported.

2.1.4. "Wheel disc" means that part of the wheel which is the supporting member between the axle and the rim.

2.1.5. "*PCD*", means the pitch circle diameter of bolt holes.

2.2. "Wheel type" means a wheel which does not differ in the following essential characteristics:

2.2.1. the wheel manufacturer;

1/ Categories M, N, and O as defined in Annex 7 to the Consolidated Resolution on the Construction of Vehicles (R.E.3) (document TRANS/WP.29/78/Rev.1/Amend.2).wheel or rim size designation (according to ISO 3911:1998);

2.2.3. construction materials;

2.2.4. wheel attachment holes;

2.2.5. maximum load capacity;

2.2.6. recommended maximum inflation pressure;

2.2.7. method of production (welded, forged, cast,…).

2.2.8. "*Styling*", the wheel's geometric shape, including basic contour and ratio between voids and material.

2.3. "OE-wheels" means wheels which are authorized to be fitted, to the vehicle model, by the vehicle manufacturer during the production of the vehicle.

2.4. "Replacement wheels" means wheels which are intended to replace the OE wheels during the service life of the vehicle. Replacement wheels may belong to one of the following category:

2.4.1. "Vehicle manufacturer's replacement wheels" being wheels supplied by the vehicle manufacturer;

2.4.2. "Identical replacement wheels" being wheels which are manufactured using the same manufacturing equipment and material as that used for replacement wheels supplied by the vehicle manufacturer. They differ from vehicle manufacturer's replacement wheels only by the absence of vehicle manufacturer's trademarks and part number;

2.4.3. "Replica replacement wheels" being wheels which are replicas of vehicle manufacturer's replacement wheels but produced by a manufacturer who is not a supplier of the vehicle manufacturer with the specified wheel. With regard to the design (basic contour, dimensions, inset/outset, material type and quality and so on) and service life they fully correspond to vehicle manufacturer's replacement wheels;

2.4.4. "Pattern part replacement wheels" being wheels produced by a manufacturer who is not a supplier of the vehicle manufacturer with the specified wheel. With regard to the design, inset/outset, rim designation wheel fixing PCD and spigot mounting diameter, correspond to that of an OE-wheel, but wheel contour, material and so on, may be different.

2.5. "Special wheels" means wheels which are not OE-wheels and which do not fulfil the criteria for wheels described in paragraph 2.4. (for example wheels with different rim width or diameter).

2.6. "Inset/outset /zeroset" means the distance from the attachment face of the disc to the centre line of the rim (positive for inset as shown in Figure 1 below; negative for outset ; zero for zeroset).

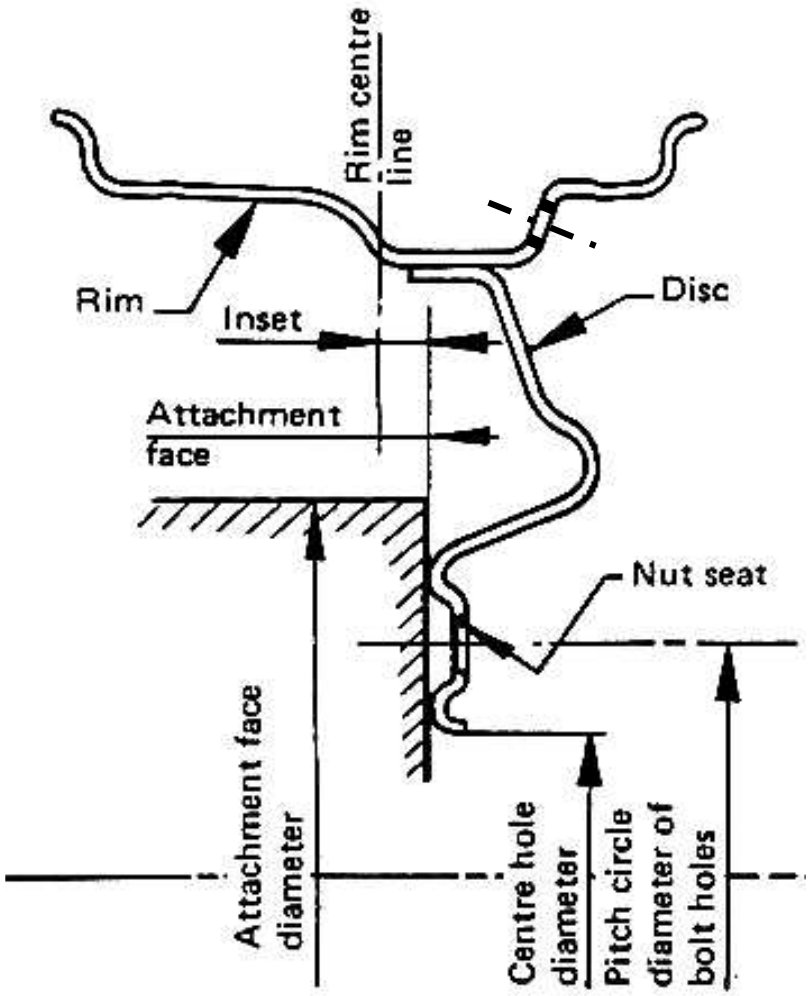


Figure 1

2.7. "Dynamic radius" means the dynamic loaded radius defined as the theoretical rolling circumference divided by 2Π of the largest tyre to be used on the wheel as specified by the wheel manufacturer.

2.8. "International Tyre and Rim Standards" mean documents concerning wheel standardization issued by the following Organizations:

(a) The International Organization for Standardization (ISO) 2/;

(b) The European Tyre and Rim Technical Organization (ETRTO) 3/: "Standards Manual";

(c) The European Tyre and Rim Technical Organization (ETRTO) 3/: "Engineering Design Information - obsolete data";

(d) The Tyre and Rim Association Inc. (TRA) 4/: "Year Book";

(e) The Japan Automobile Tyre Manufacturers Association (JATMA) 5/: "Year Book";

(f) The Tyre and Rim Association of Australia (TRAA) 6/: "Standard Manual";

(g) The Associação Latino Americana de Pneus e Aros (ALAPA) 7/: "Manual de Normal Technicas";

(h) The Scandinavian Tyre and Rim Organisation (STRO) 8/: "Data Book".

2.9. "Technical crack" is a material separation with a propagation of more than 1 mm occurring during a dynamic test (defects caused by the production process are not to be taken into account).

2.10. "Wheel calliper" is the rotating profile shape, formed by the internal wheel contour (see Annex 10, figure 1).

The tyre standards can be obtained from the following addresses:

2/ ISO, 1, rue de Varembé, Case postale 56, CH-1211 Genève 20 – Switzerland.
3/ ETRTO, 32 Av. Brugmann - Bte 2, B-1060 Brussels, Belgium.
4/ TRA, 175 Montrose West Avenue, Suite 150, Copley, Ohio, 44321 USA.
5/ JATMA, NO.33 MORI BLDG. 8th Floor 3-8-21, Toranomon Minato-Ku, Tokio 105-0001, Japan.
6/ TRAA, Suite 1, Hawthorn House, 795 Glenferrie Road, Hawthorn, Victoria, 3122 Australia.
7/ ALAPA, Avenida Paulista 244-12° Andar, CEP, 01310 Sao Paulo, SP Brazil.
8/ STRO, Älggatan 48 A, Nb, S-216 15 Malmö, Sweden.

2.11. "Tyre size designation" means a designation showing the nominal section width, the nominal aspect ratio and the conventional number that denotes the nominal rim diameter (these terms are further defined in Regulation No. 30).

2.12. "Wheel family", are in case of light alloy, wheels of the same type; however, with different inset/outset values, PCD and centre bore.

3. APPLICATION FOR APPROVAL

3.1. The application for approval of a wheel type shall be submitted by the manufacturer, or by his duly accredited representative, and shall be accompanied by:

3.1.1. Drawings, in triplicate, sufficiently detailed to permit identification of the type. They shall also show the position intended for the approval mark and for the wheel markings;

3.1.2. Technical description including at least the following characteristics:

3.1.2.1. Category of replacement wheels – see paragraphs 2.4.2., 2.4.3. and 2.4.4.;

3.1.2.2. rim contour designation - wheel inset/outset - wheel attachment details;

3.1.2.3. tightening torque for studs and nuts;

3.1.2.4. fixing method of balancing weights;

3.1.2.5. necessary accessories (i.e. additional mounting components);

3.1.2.6. International Standard reference;

3.1.2.7. suitable for tubeless tyre mounting;

3.1.2.8. suitable valves types;

3.1.2.9. maximum load capacity at rolling circumference;

3.1.2.10. maximum inflation pressure;

3.1.2.11. detail of material including chemical composition (see Annex 4);

3.1.2.12. tyre size designations specified for original equipment by the vehicle manufacturer.

3.1.3. Documentation in accordance with paragraph 1. of Annex 10 to this Regulation:

(a) vehicle characteristics (Annex 10, paragraph 1.2.);
(b) additional characteristics (Annex 10, paragraph 1.3.);
(c) fitting instructions details (Annex 10, paragraph 1.4.); and
(d) additional requirements (Annex 10, paragraph 2.).

3.1.4. Sample wheels representative of the wheel type necessary for the execution of laboratory tests or test reports issued by the Type Approval Authority.

3.2. In case of application for approval of an identical wheel, the applicant shall satisfy the type approval authority that the wheel is indeed an "identical replacement wheel" as defined in paragraph 2.4.2.

4. APPROVAL

4.1. If the wheel submitted for approval in accordance with paragraph 3. above meets the requirements, then approval for this type of wheel shall be granted.

4.2. An approval number shall be assigned to each type approved. The first two digits (at present 00 for the Regulation in its original form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same number to another type of wheel.

4.3. Notice of approval or refusal or extension of approval of a type of wheel under this Regulation shall be communicated to the Parties to the 1958 Agreement which apply this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

4.4. Every wheel conforming to a type approved under this Regulation shall bear, in addition to the markings prescribed in paragraph 5., a clearly legible and indelible international approval mark consisting of:

4.4.1. a circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval (see Annex 2). 9/

9/ 1 for Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for the Czech Republic, 9 for Spain, 10 for Serbia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 for Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32 for Latvia, 33 (vacant), 34 for Bulgaria, 35 (vacant), 36 for Lithuania, 37 for Turkey, 38 (vacant), 39 for Azerbaijan, 40 for The former Yugoslav Republic of Macedonia, 41 (vacant), 42 for the European Community (Approvals are granted by its Member States using their respective ECE symbol), 43 for Japan, 44 (vacant), 45 for Australia, 46 for Ukraine, 47 for South Africa, 48 for New Zealand, 49 for Cyprus, 50 for Malta, 51 for the Republic of Korea, 52 for

Malaysia, 53 for Thailand, 54 and 55 (vacant) and 56 for Montenegro. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

4.4.2. the number of this Regulation, followed by the letter "R", a dash and the approval number according to paragraph 4.2.

4.5. The approval mark shall be permanent, visible, and clearly legible on the outward facing side of the wheel, when the wheel is fitted on the vehicle.

4.6. Annex 2 to this Regulation gives an example of the arrangement of the approval mark.

4.7. The wheel manufacturer's facilities may be used for test purposes provided that the Type Approval Authority or a designated representative witnesses the tests.

5. WHEEL MARKINGS

5.1. The wheel shall be permanently and legibly marked as follows, in a position chosen by the manufacturer, but visible when the tyre is fitted on the wheel:

5.1.1. manufacturer name or trade mark;

5.1.2. the wheel or rim contour designation;

5.1.2.1. It shall be expressed according to the prescription of one International Tyre and Rim Standards and includes at least:

rim size designation comprising:

rim contour designation nominal rim diameter,

the symbol "x" if one piece rim,

the symbol "-" if multipiece rim,

letter "A" if the well is located asymmetrically (optional),

the letter "S" if the well is located symmetrically (optional).

5.1.3. the wheel inset/outset (positive for inset; negative for outset);

5.1.4. date of manufacture(at least the month and year);

5.1.5. part number of the wheel / rim (optional wheel type).

5.2. Annex 3 to this Regulation gives an example of the arrangement of the wheel markings.

6. GENERAL REQUIREMENTS

6.1. Rim contour shall conform to the International Standard specified by the wheel manufacturer.

6.2. Rim contour shall ensure the correct fitting of tyres and valves.

6.2.1. Wheels designed for use with tubeless tyres shall ensure air retention.

6.3. Materials used for the construction of the wheel shall be analysed according to Annex 4.

6.4. In the case of identical replacement wheel as defined in paragraph 2.4.2., there shall not be any requirement for physical testing as given in paragraph 6.5. or vehicle fitment checking as given in paragraph 2. of Annex 10 to this Regulation.

6.5. The replica replacement wheels and pattern part replacement wheels shall satisfy the following tests:

As an alternative to the test specifications in paragraph 6.5.1.1., the endurance life of replica replacement wheels can be proven in comparison to the endurance life of the vehicle manufacturer's replacement wheels.

The rotation bending tests on two load levels have to be performed according Annex 6 as well as rolling test according to Annex 7. These tests have always to be performed in comparison of the replica replacement wheels to the vehicle manufacturer's replacement wheels until the required limits or failure of the wheels.

Replica replacement wheels must achieve in every level at least the results or better of the vehicle manufacturer's replacement wheels.

The tests requirements of the vehicle manufacturer regarding vehicle manufacturer's replacement wheels can be applied instead of test requirement 6.5.1.1. These testing requirements have to be disclosed in order to enable the verifiability. The assignment to the wheel load released by the vehicle manufacturer must be given.

6.5.1. Steel wheels

6.5.1.1. Disc wheels

(a) rotating bending test as per Annex 6;

(b) rolling test as per Annex 7.

6.5.2. Aluminium alloy wheels

6.5.2.1. One piece wheels

(a) Corrosion test as per Annex 5. If the process within a production line is always the same, only one representative test is to be carried out;

(b) Rotating bending test as per Annex 6;

(c) Rolling test as per Annex 7;

(d) Impact test as per Annex 8.

6.5.2.2. Demountable rim wheels

(a) Corrosion test as per Annex 5;

(b) Rotating bending test as per Annex 6;
(c) Rolling test as per Annex 7;

(d) Impact test as per Annex 8;

6.5.3. Magnesium alloy wheels

6.5.3.1. One piece wheels

(a) Corrosion test as per Annex 5;

(b) Rotating bending test as per Annex 6;

(c) Rolling test as per Annex 7;

(d) Impact test as per Annex 8.

6.5.3.2. Demountable rim wheels

(a) Corrosion test as per Annex 5;

(b) Rotating bending test as per Annex 6;

(c) Rolling test as per Annex 7;

(d) Impact test as per Annex 8;

6.6. Where a wheel manufacturer submits an application for type approval for a wheel family, it is not necessary to carry out tests for each wheel version. Worst case selection may be made at the discretion of the type approval Authority or the designated Technical Service (see Annex 6 paragraph 4. of this Regulation).

6.7. Pattern part replacement wheels shall satisfy the following requirements to guarantee proper fitment on the vehicle:

6.7.1. The nominal rim diameter, nominal rim width and nominal inset/outset of ECE-approved wheels shall be the same as the manufacturer's replacement wheel.

6.7.2. Wheels shall be suitable for tyres of the tyre size designations specified initially by the vehicle manufacturer for the particular model concerned.

6.7.3. The checks and documentation relevant to the wheel/vehicle fitment are described in Annex 10.

6.8. When the replacement wheel is mounted on the vehicle, the requirements of paragraphs 5.2.1.11.2.1. or 5.2.2.8.2.1. of Regulation No. 13 or paragraph 5.2.11.2.1. of Regulation No. 13-H shall be fulfilled.

7. MODIFICATIONS AND EXTENSION OF APPROVAL FOR WHEEL

7.1. Every modification of the wheel type shall be notified to the Approval Authority which granted the type approval. The Approval Authority may then:

7.1.1. either consider that the modifications made are unlikely to have appreciable adverse effects and that in any case the type of wheel still complies with the requirements;

7.1.2. or require a further test.

7.2. Confirmation or refusal of approval, specifying the alterations, shall be notified by the procedure specified in paragraph 4.3. above to the Parties to the Agreement applying this Regulation.

7.3. The Competent Authority issuing the extension of approval shall assign a series number to each communication form drawn up for such an extension.

8. CONFORMITY OF PRODUCTION

8.1. The conformity of production procedures shall comply with those set out in Appendix 2 to the Agreement (E/ECE/324-E/ECE/TRANS/505/Rev.2).

8.2. The authority which has granted type approval may at any time verify the conformity control methods applied in each production facility. The normal frequency of these verifications shall be once every two years.

9. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

9.1. The approval granted in respect of a type of wheel pursuant to this Regulation may be withdrawn if the requirements set forth above are not met or if a wheel bearing the approval mark does not conform to the type approved.

9.2. If a Contracting Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the model in Annex 1 to this Regulation.

10. PRODUCTION DEFINITELY DISCONTINUED

If the holder of an approval completely ceases to manufacture a wheel approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform the other Parties applying this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

11. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS AND OF ADMINISTRATIVE DEPARTMENTS

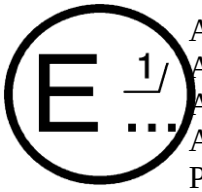
The Contracting Parties to the Agreement applying the Regulation shall communicate to the United Nations secretariat the names and addresses of the Technical Services responsible for conducting approval tests and of the Administrative Departments which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval, or production definitely discontinued issued in other countries, are to be sent.

Annex 1

COMMUNICATION

(Maximum format: A4 (210 x 297 mm))

issued by: Name of administration:
....
.....

concerning: 2/ 

APPROVAL GRANTED
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
PRODUCTION DEFINITELY DISCONTINUED

of a wheel type, pursuant to Regulation No. 124

Approval No. ..... Extension No. .....

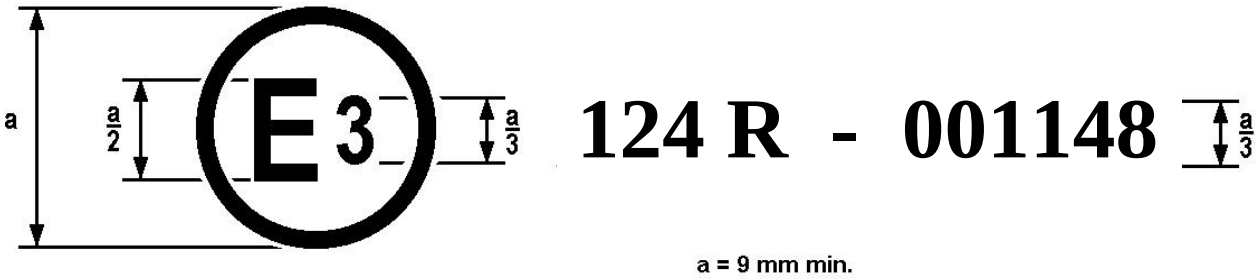
1. Wheel manufacturer: .....
2. Wheel type designation:.....
2.1. Category of replacement wheels:.....
2.2. Construction material:.....
2.3. Method of production: .....
2.4. Rim contour designation: .....
2.5. Wheel inset/ outset: .....
2.6. Wheel attachment: .....
2.7. Maximum wheel load and respective theoretical rolling circumference .....
3. Address of the manufacturer: .....
4. If applicable, name and address of manufacturers' representative: .....
5. Date on which the wheel was submitted for approval tests: .....
6. Technical Service responsible for carrying out the approval test: .....
7. Date of test report issued by the Technical Service: .....
8. Number of test report issued by the Technical Service: .....
9. Remarks: .....
10. Approval granted/refused/extended/withdrawn 2/:.....
11. Reason(s) for the extension (if applicable): .....
12. Place: .....
13. Date: .....
14. Signature/Name: .....
15. Annexed is a list of documents making up the approval file, deposited with the Competent Authority which granted approval, a copy can be obtained on request.

1/ Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see the provisions of the Regulation concerning approval).

2/ Strike out what does not apply.

Annex 2

ARRANGEMENT OF THE APPROVAL MARK



The wheel bearing the above approval mark is a wheel that has been approved in Italy (E3) under approval number 001148.

The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No. 124 in its original form.

The marking of approval mark, the Regulation number and approval number may be at a distance from each other respecting the sequence.

Annex 3

ARRANGEMENT OF THE WHEEL MARKINGS

Example of markings which shall be applied to a wheel conforming to this Regulation:

ABCDE 5 ½ J x 14 FH 36 01 99 ab123

This example of marking defines a wheel:

manufactured by ABCDE

having a rim contour designation (5½ J)

having a one piece construction(x)

having a nominal rim diameter code (14)

having a non symmetrical location of the well (no mark)

having a flat hump configuration of the bead-seat area on one side only (FH) – optional marking

having a wheel inset of 36 mm

manufactured in January 1999 (0199)

the manufacturer's part number (ab123).

The rim designation shall include in the following order the rim contour designation, the construction, the nominal rim diameter code, the location of the well and the bead-seat configuration, as in the example 5½ J x 14 FH. It is also permitted to reverse the order for the first three elements as in the example 14 x 5½ J FH.

The marking shall be at a position selected by the manufacturer. It shall be easily visible and clearly legible after the tyre has been mounted to the wheel.

Annex 4

MATERIAL TEST

The following metallurgical analysis shall be carried out and reported:

Material	Tests
Aluminium alloy	a, b, c, e
Magnesium alloy	a, b, c, e
Steel	a, b, d

(a) Chemical analysis of the raw-material.

(b) Check of the following mechanical characteristics ($R_{p0,2}$, R_m, and A) relevant to the materials:

(i) percentage elongation after fracture (A): Permanent elongation of the gauge length after fracture ($L_u - L_o$), expressed as a percentage of the original length (L_o).

Where:

original gauge length (L_o): Gauge length before application of force.

final gauge length (L_u): Gauge length after rupture of the test piece.

(ii) proof strength, non-proportional extension (R_p): Stress at which a non-proportional extension is equal to a specified percentage of the extensometer gauge length (L_e). The symbol used is followed by a suffix giving the prescribed percentage of the extensometer gauge length, for example: $R_{p0,2}$.

(iii) tensile strength (R_m): Stress corresponding to the maximum force (F_m).

(c) Check of the material characteristics (Rp0,2 , Rm and A) of specimen taken from critical zones (such as the spoke, for example) as well as the inner and the outer rim flange. The take-off points and position of the samples must be depicted in the drawing.

(d) Analysis of the defects and of the new material structure.

(e) Analysis of the metallurgic defects and structure taken from the transition zone of the wheel disc and rim or from the fracture zone, if applicable."

Annex 5

CORROSION TEST

1. Carry out a salt-spray test as per ISO 9227 for 384 hours.

1.1. Sample preparation

A surface treated sample, taken from the production, shall be damaged by cross engraving (ISO 2409:2007) and stone impact (ISO 20567-1:2005) to represent damaging situations during the normal usage of vehicle (damage shall be in the area of the rim flange and inside the wheel).

1.2. Test development

The surface treated sample shall pass a salt-spray test, in which the sample and any components with which is normally in contact are put in upright position into the salt-spray test equipment. The wheel is turned through 90° every 48 hours.

1.3. Evaluation

Individual measures which may affect the corrosion are to be evaluated (covers, crews, zinc or cadmium buses, alloy insulating covers, etc.)

The test documentation shall include photos showing the main corrosion points which have been mechanically washed in order to show the material defects.

There shall not be any significant corrosion after a test duration of 192 hours. After 384 hours the wheel functionality, the mounting components and the tyre bead seat shall not be adversely affected by corrosion. This shall be confirmed by a rotating bending test as per Annex 6 or by a rolling test as per Annex 7, depending on the location of the corrosion.

Annex 6

ROTATING BENDING TEST

1. Test Description

During the rotating bending test, the lateral forces acting on wheel in driving around a curve are simulated. Four wheel samples shall be tested, two at 50 per cent and two at 75 per cent of the maximum side force. The wheel rim is fixed rigidly to the test bench, and a bending moment M_b is applied to the hub mounting area (i.e. through a loading arm with a flange having the same pitch circle diameter as the vehicle for which the wheel is intended). Light alloy wheels are fixed using the internal rim flange by two semicircular flanges.

Should other fixing devices be used, it is necessary prove their equivalence.

Screws or fixing nuts are tightened to the torque stated by the vehicle manufacturer and retightened after 10,000 cycles approximately.

2. Formula for the bending moment calculation

Cars and off-road vehicles: $M_{bmaX} = S * F_V (\mu * r_{dyn} + d)$

M_{bmaX} = maximum reference bending moment [Nm]

F_V = maximum load capacity of wheel [N]

r_{dyn} = dynamic radius of largest tyre recommended for wheel [m]

d = inset/outset (positive for inset ; negative for outset) [m]

μ = coefficient of friction

S = factor of safety

3. The test is carried out with two percentage values (50 per cent and 75 per cent) of the max moment and on the basis of the following standards

Coefficient of friction	0.9
Factor of safety	2.0
Nominal cycles per minute	The number of cycles per minute can be the maximum possible but outside the testing rig resonance frequency.

4. Test schedule for wheel families

	Aluminium / Magnesium		Steel	
Vehicle category	M_1, M_1 G, N_1, and N_1 G	O_1 and O_2	M_1 and M_1G	O_1 and O_2
Min cycles with 75 per cent M_{bmaX}	$2.0*10^5$	$0.66*10^5$	$6.0 * 10^4$	$2.0*10^4$
Min cycles with 50 per cent M_{bmaX}	$1.8*10^6$	$0.69*10^6$	$6.0*10^5$	$2.3*10^5$
Acceptance limits	Shaft displacement less than 10 per cent greater than the displacement measured after approximately 10,000 cycles.			
	Technical cracks are not accepted.		-	
Allowable loss of tightening torque initially applied to the wheel fixing studs and nuts 1/	Maximum 30 per cent			

Wheels of a wheel type with the same number of wheel attachment holes, same styling, different PCD and/or different inset/outset values can be grouped at the same or at a lower value of test bending moment taking into account the test schedule to follow. Wheels with the largest centre hole diameter shall be included in the test.

In the case of a negative test, due to material failures, it can be compensated by two positive tests of the same wheel version. If either or both of the final two samples fail, then the application for approval of the replacement wheel shall be rejected.

Necessary tests:

Number of wheels to be tested	*Rotating bending test*	
	Short test	*Long test*
Minimum PCD Maximum PCD If only one PCD	1 1 2	1 1 2
If a type comprises more than two versions with different PCD, additional tests on each version with PCD different to tested version: PCD difference to a tested version ≤ 6,5 mm PCD difference to a tested version > 6,5 mm	 - 1	 - 1
Insert variation up to 2 mm From 2 mm to 5 mm > 5 mm	- 1 1	- - 1

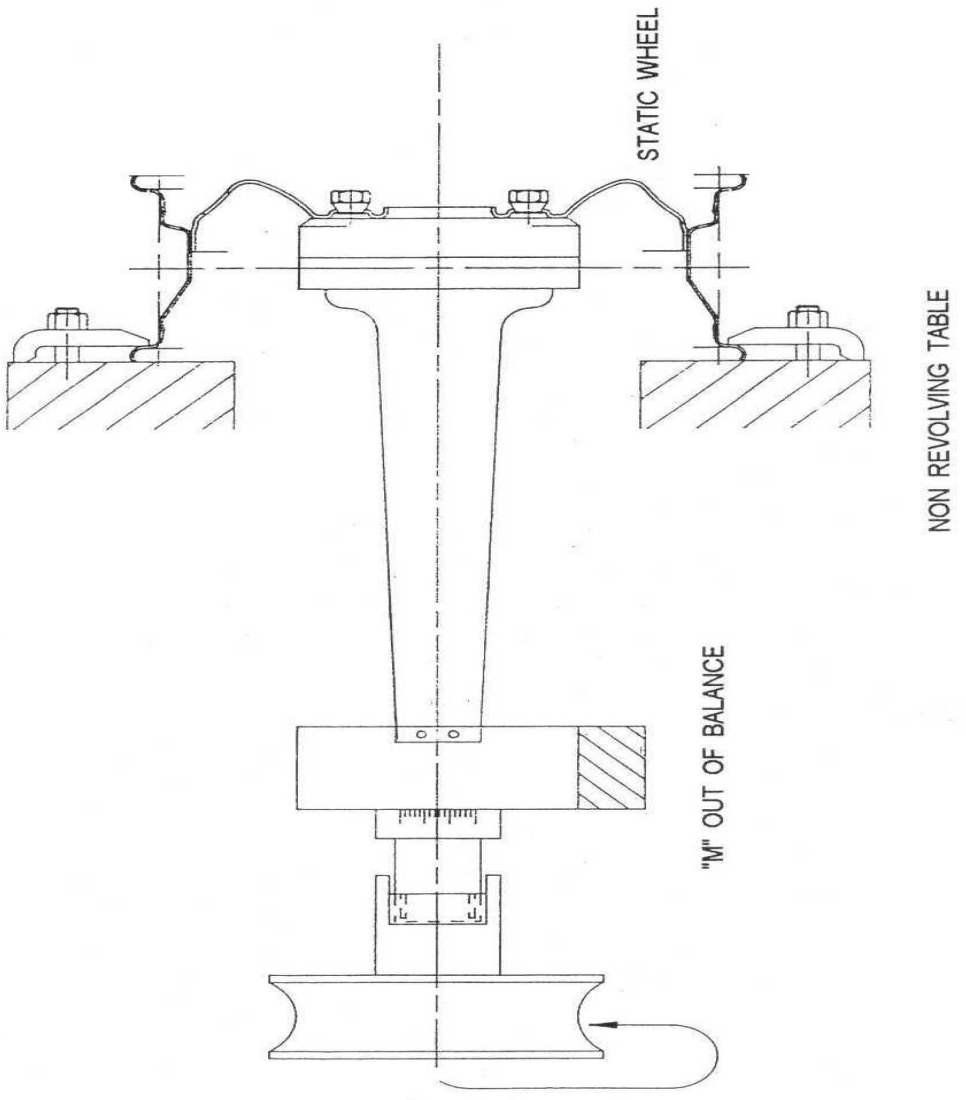
Tests to be carried out should the maximum permitted wheel load subsequently increase:

1/ Check loss of tightening torque of wheel fixings by retightening, not by measuring torque to loosen fixings.

If the resulting test bending moment increases up to 10 per cent max.	1	1

Short test = rotating bending test with 75 per cent of l M_{bmax}
(calculated for the max wheel load)
Long test = rotating bending test with 50 per cent of M_{bmax}

Should the testing moment be increased of more of 10 per cent, when compared to the first approval, the whole programme shall be repeated.



Example of a rotating bending test rig.

Annex 7

ROLLING TEST

1. Test Description

In the rolling test the stress on the wheel when driving straight ahead is simulated by testing a wheel rolling against a drum which has a minimum outside diameter of 1.7 m, in the case of an external rolling test, or a minimum internal diameter equal to the dynamic radius of the tyre divided by 0.4 in the case of an internal rolling test. Two wheels shall be tested.

In the case of a negative test, due to material failures, it can be compensated by two positive tests of the same wheel version. If either or both of the final two samples fail, then the application for approval of the replacement wheel shall be rejected.

2. Formula for calculation of the test load

All types of vehicles	$F_P = S * F_V$

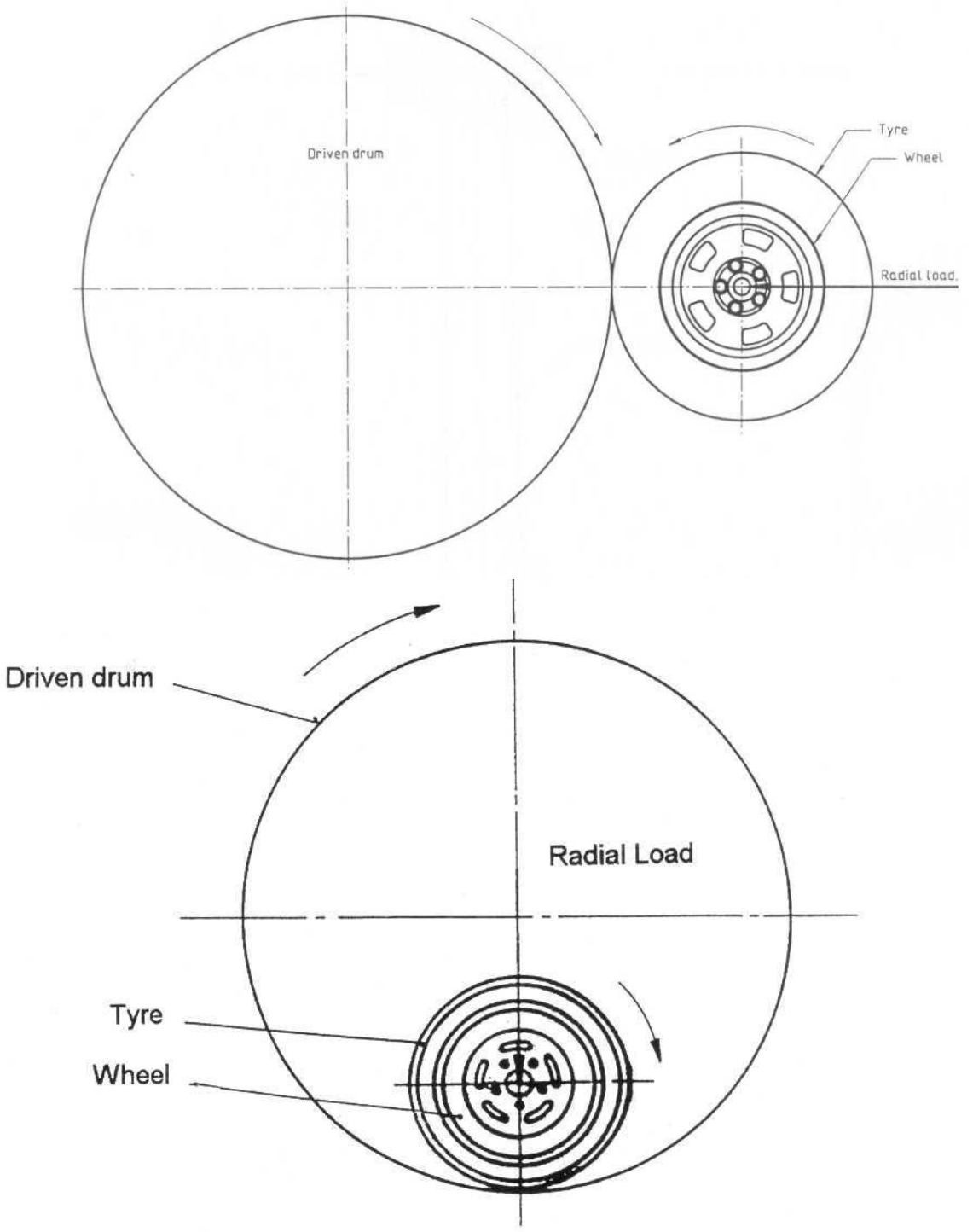
F_P = testing load [N]
F_V = wheel maximum load capacity of the wheel [N]
S = factor of safety

3. Tests Procedure and Requirements
Tests are carried out on the basis of the following specifications:

	M_1, M_1 G, N_1 and N_1 G	O_1 and O_2
Rolling direction	Straight	
Factor of safety - S	2.5 2.25 1/	2.0
Tyres	Taken from normal (series) production and, if possible, of the maximum nominal section width recommended for the wheel	
Testing speed in km/h	The max. allowed by the tyre given by the speed index, usually 60-100 km/hour	
Equivalent rolling distance	2,000 km 1,000 km 1/	2,000 km 1,000 km 1/
Tyre pressure at start of test (nor checked or controlled during the test)	Normal usage: rolling test pressure Up to 160 kPa 280 kPa More than 160 kPa min. 400 kPa	
Limits of acceptance	Technical cracks and/or air leakage are not accepted.	
Allowable loss of tightening torque initially applied to the wheel fixing studs and nuts 2/	≤ 30 per cent	

_____

1/ Only for steel disc wheels.
2/ Check loss of tightening torque of wheel fixings by retightening - not by measuring torque to loosen fixing.



Examples of rolling test rigs.

Annex 8

IMPACT TEST

1. Test Description

The fracture behaviour of the wheel striking an object at the outer rim flange shall be checked at critical positions. For proof of adequate fracture behaviour, an impact test according to ISO 7141:2005 shall be carried out.

In the case of a negative test, due to material failures, it can be compensated by two positive tests of the same wheel version. If either or both of the final two samples fail, then the application for approval of the replacement wheel shall be rejected.

2. Formula for the calculation of test load

$D = 0.6 * F_V / g + 180$ [kg]

D = value of falling mass [kg]

F_V = maximum wheel load capacity [N]

g = acceleration due to gravity 9.81 m/s^2

3. Test Procedure and Requirements

	M_1 , N_1 , M_1 G and N_1G
Procedure and requirements	ISO 7141: 2005
Tyre pressure	The tyre pressure recommended by the tyre manufacturer based on the load index and the max. vehicle speed, but at least 200 kPa.
Tyres	Tyres taken from normal (series) production with the minimum nominal section width and minimum rolling circumference on the range of tyres recommended for the particular wheel.
Acceptance criteria	The test shall be considered satisfactory if there is not any visible fracture penetrating through the wheel surface and if there is not total loss of inflation pressure due to tyre depressurization within one minute of completing the test. Fractures and indentations caused by the direct contact with the falling weight are acceptable. In the case of wheels with demountable rims or other components that can be dismantled, if threaded fastenings that are close to the spoke or ventilation holes fail the wheel is to be considered as having failed the test.
Number of samples to be tested	One for each impact position.
Impact positions	One in the area connecting spokes to rim and further one in the area between two spokes, very close to the valve hole. If possible, the impact direction shall not coincide with the radial line between a fixing hole and the wheel centre.

4. Tests schedule for wheel families

Wheels to be tested	Impact test
Smallest pitch test diameter	One for each impact position
Largest pitch circle diameter	One for each impact position
deviation of inset value	
up to -15 mm	--
more than -15 mm and larger than +2 mm	one for each impact position

5. Failure criteria

The wheel will not pass the test if one of the following criteria applies:

(a) visible incipient crack in a zone of the wheel disc of wheel assembly;

(b) the centre member separates from the rim;

(c) total loss of pressure within one minute.

The wheel is not considered to have failed the test by deformation of the wheel assembly or by fractures in the area of a rim section struck by the face plate of the striker.

Annex 9: Reserved

Annex 10

VEHICLE FITMENT CHECKS AND DOCUMENTATION

1. Application and fitting information

The type approval authority shall be supplied with a copy of following information which shall also be supplied to the consumer with the wheel.

1.1. Wheel characteristics

ECE approval number, wheel type and variant, international rim designation (for example, 15 H2 x 5 ½ J) and inset/outset.

1.2. Vehicle characteristics

Those vehicle characteristics should be listed that distinctly describe the vehicle type and version for which the wheel will be used. Thereby, depending on the restriction of the range of application of various markets with respect to certain vehicle versions and variants, various specification characteristics are possible.

Absolutely required are the data of:
(a) Vehicle manufacturer;
(b) Vehicle type:

Additional optional data, e.g.:
(c) Vehicle approval number; (if applicable variant/ version)
(d) Engine performance (also possible range of performance).

Other specification characteristics / restrictions may also be used.

1.3. Additional characteristics

Any particular requirements, special fittings and so on that are specified when using the manufacturer's replacement wheels or specific requirements for the ECE approved wheel.

1.4. Fitting instruction detail

Recommendations and safety precautions when fitting the wheel;

Use of any additional or substitute wheel fixing components, for example, longer wheel bolts or studs with alloy wheels;

Wheel fixing tightening torque; drawing attention to the importance of this aspect and the need to preferably use a calibrated torque wrench;

Instruction regarding the necessity to re-tighten the wheel fixing after 50 km of driving;

References to the use and mounting of hubcaps, if applicable.

1.5. Example of possible structures of the application and fitting information table

Wheel characteristics (mandatory fields in bold characters)

Approval Number				
Wheel Type				
Size	Fixing holes / pcd (mm)		Inset/outset[2] (mm)	Max. wheel load (N)
6 Jx15 H2				
Wheel marking (Variant/Version)	centering marking	Centering (mm)	date of manufacture (week/year)	at circumference (mm)

Vehicles' characteristics as well as additional conditions and advice

Fitting parts e.g. special bolts delivered by the wheel manufacturer M14x1.5, conical angle 60°, length of piston skirt xx mm

Vehicle Type			
Approval No.			
Performance (kW from – to)	Vehicle Model name	Permissible tyre size front and rear axle	Additional conditions and advice
			A01)A02)A03) E01)

Conditions and Advice

A01) e.g. kind of balancing weights and their place of fitting;

A02) e.g. kind of possible valves;

A03) e.g. for using manufacturer's replacement wheels only the standard fitting parts are allowed;

E01) e.g. not allowed on 4x4 vehicles.

1/ Use of vehicle manufacturer brake component profiles and wheel caliper is recommended. However in-service monitoring is necessary because of possible change of brake parts and/or OE-wheel calliper during the vehicle production run.

[2] Positive for inset; negative for outset

2. Additional requirements

2.1. Wheel calliper check

The design of the inner contour of the wheel (wheel calliper see Figure 1) must provide sufficient space for the brake, suspension and steering components.

In the case where the wheel calliper is outside of the vehicle manufacturer's replacement wheel calliper, no verification is necessary.

In the case where the calliper is inside the vehicle manufacturer's replacement wheel calliper, a check shall be carried out of wheel operating clearance with respect to brake, suspension and steering components and general under body components, taking into account the effect of wheel balance weights.

As a rule, the following criteria have to be fulfilled:

(a) minimum clearance for brake components (worst case, for example with new brake linings): 3 mm 1/),
(b) minimum clearance for suspension components (e. g. upper and lower suspension arms): 4 mm,
(c) minimum clearance for steering components (e.g. track rod and steering joints): 4 mm, and
(d) minimum clearance between balance weights and vehicle components: 2 mm.

The check may be carried out statically or dynamically. If the various clearances on the vehicle manufacturer's replacement wheel are less than those given above, then these can be accepted.

2.2. Ventilation holes check

An approved wheel shall not reduce the brake efficiency in comparison with a manufacturer's replacement wheel.

The heat transfer from the brakes into steel wheels is regarded as being more severe than that with of light alloy wheels. In the case where the vehicle manufacturer's replacement wheel is designed for a defined air circulation from the brake through the wheel ventilation holes (for example by "windmilling" effect) and where the area of the ventilation holes, in a pattern part replacement wheel, is smaller than the corresponding vehicle manufacturer's replacement wheel, a comparison test shall be carried out to evaluate the brake efficiency.

The test shall follow the requirements of Regulation No. 13, Appendix 4, paragraph 1.5. Type I - Fade test procedure. The criterion is the brake temperature. The maximum temperature measured (discs, drum) using the vehicle manufacturer's replacement wheel must not be exceeded with the wheel to be approved.

Any hubcaps normally fitted are to be taken into account.

2.3. Wheel fixing

The use of vehicle manufacturer's replacement wheel fixing components is recommended. Any special wheel fixing components shall allow fitting of the pattern part replacement wheel without requiring any additional change. The basic number of wheel fixings, for example 4 holes, 5 holes and so on, shall not be changed. Wheel fixings shall not foul other components, for example, brake components. Regarding wheel bolts, nuts and studs, the length of thread engagement shall be the same as achieved by the vehicle manufacturer's replacement wheel and wheel fixings. The profile of the bolts / nuts shall be compatible with the profile of the location hole in the approved wheel. The material used for the wheel fixing components shall be at least equivalent to the vehicle manufacturer's replacement wheel fixing components. In the case where wheel accessories are provided, any necessary special tools for mounting and demounting shall also be provided.

Where different wheel fixing components are supplied, they shall be detailed in the information required by paragraph 1.2., and any necessary special fitting tools shall be provided.

2.4. External projections

The approved wheel when fitted to the vehicle, together with any necessary wheel accessories, shall not create any danger. The requirements of Regulation No. 26 shall be respected.

2.5. Miscellaneous

The test report shall contain the details and results of the tests carried out. It shall confirm that the tested wheel meets the requirements.

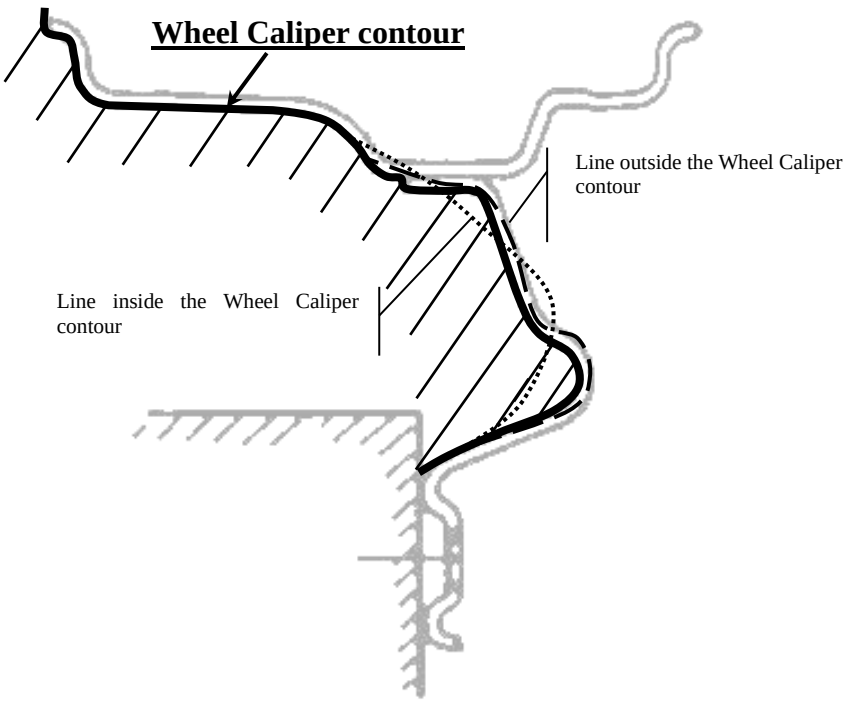


Figure 1: Wheel inner contour including examples of inside and outside situations.
