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Tyres — Electrical resistance — Test method for measuring electrical resistance of tyres on a test rig

Pneumatiques — Résistance électrique — Méthode d'essai pour mesurer la résistance électrique des pneumatiques sur une installation d'essai

Reference number
ISO 16392:2007(E)

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Foreword

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ISO 16392 was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*.

Tyres — Electrical resistance — Test method for measuring electrical resistance of tyres on a test rig

1 Scope

This International Standard describes a test method to measure the electrical resistance of pneumatic and solid tyres, under load, on a test rig. Static charges on a vehicle sometimes need to be dissipated by way of the tyre. Electrical resistance inversely measures the ability of the tyre to dissipate static charge from the vehicle.

The method specifies procedures and equipment such that electrical resistance can be accurately determined for tyres with values up to 10^{12} ohms.

Annex B specifies additional conditions for measurement on a vehicle. Annex C specifies simplified test conditions for production control routine.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4223 (all parts), *Definitions of some terms used in the tyre industry*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4223 and the following apply.

3.1
connecting point
any point on the wheel or metal loading plate where the leads of the resistance-measuring instrument are connected

3.2
test load
force applied to the tyre through the rim, normal to the metal loading plate onto which the tyre is loaded

3.3
tyre electrical resistance
resistance measured between the wheel of a mounted and inflated tyre-wheel assembly and a metallic plate onto which the tyre is loaded at a specified load

NOTE Tyre electrical resistance is measured in ohms (Ω).

4 Measurement

4.1 Description

The electrical resistance of an inflated tyre-wheel assembly is measured between the wheel and the conducting surface against which the tyre is loaded.

4.2 Measuring equipment

Resistance shall be measured by a commercial instrument capable of measuring electrical resistance in ohms and having a power source capable of 1 000 V. The voltage shall be controlled as described in Table 1 and shall not dissipate more than 3 W in the test sample. The instrument shall be capable of determining the resistance up to a value of 10^{12} Ω with an accuracy of ± 10 %. It is recommended that the input impedance shall be at least 10^{14} Ω.

The metal loading plate shall be flat and sufficient in dimensions to encompass the entire contact surface of the tyre under test, and with sufficient thickness to support the test loads described in 4.4 without visible deformation. The plate shall be made of a conductive corrosive-resistant metal, e.g. brass or stainless steel, and free from coating or obvious surface contamination, such as oxidation or corrosion. Aluminium shall not be used for the plate because of its high susceptibility to the rapid development of surface oxides, which may adversely affect reading accuracy.

The loading fixture (see Figure 1) shall be capable of applying the tyre load to the metal in a radial direction, against the metal loading plate. Test load measurement accuracy shall be ± 1 % of the full scale.

The sheet insulating material, such as polyethylene, PTFE (polytetrafluoroethylene) or equivalent, shall have sufficient strength to support the test loads described in 4.4 without visible deformation. The insulating material should have dimensions on all sides at least 50 mm greater than the metal loading plate. With insulating sheet installed between the metal loading plate and the loading apparatus base (see Figure 1), it is recommended that the electrical resistance between the plate and the loading apparatus be at least 10^{14} Ω. In any case, the electrical resistance of the plate relative to loading apparatus shall be at least two orders of magnitude higher than the resistance of the tyre being measured.

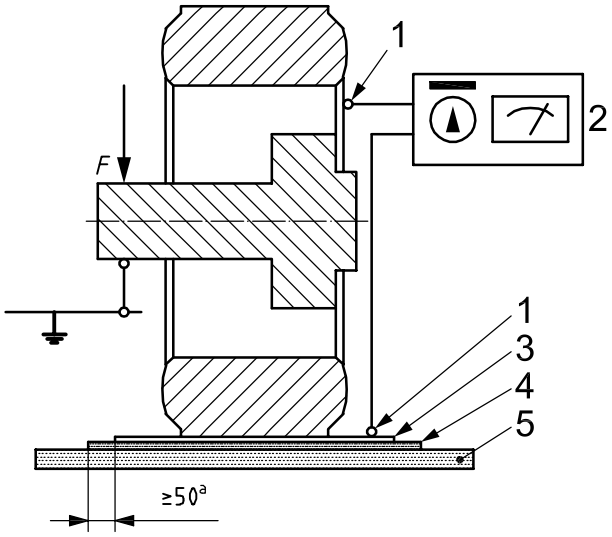
Table 1 — Test voltage resistance

Resistance range Ω	Test voltage V
10^3 to 10^4	1
10^4 to 10^5	10
10^5 to 10^6	100
10^6 to 10^{12}	1 000

4.3 Conditioning

For at least 8 h prior to measurement of passenger, light truck and motorcycle tyre applications (24 h for all other tyres: industrial, agricultural and EM tyres), the tyre to be tested shall be kept at an ambient temperature of (23 ± 5) °C, and a relative humidity less than 60 %.

Dimensions in millimetres



Key

1 connecting point
2 measuring instrument
3 metallic plate
4 insulating material
5 loading base

F test load

[a] Offset.

Figure 1 — Apparatus

4.4 Measurement conditions

The test load applied during the measurement is (80 ± 5) % of the maximum tyre load capacity marked. The inflation pressure is equal to (80 ± 5) % of the pressure corresponding to the maximum tyre load. The inflation pressure to be registered in the test report shall be appropriate for the test load applied. Ambient temperature during the measurement shall be maintained at (23 ± 5) °C. Relative humidity shall be lower than or equal to 60 % during the measurement procedure.

The approved wheel (preferably steel) shall be stripped clean in the bead seat area, as well as at the connecting point. It is necessary to make sure the tyre is dry before taking the measurement. Dry mount the tyre if possible. To avoid damage to tyre in the case of difficult mounting conditions, a water-soluble mounting solution can be used. Any mounting solution on the sidewall or tread of the tyre shall be cleaned and dried. Mark a reference point on the tyre sidewall with a non-conductive material.

Set up the apparatus as shown in Figure 1. Clean the metal loading plate with isopropyl alcohol or a similar agent and allow to dry. Conductive or non-conductive substances on the tyre which could affect the result, such as mould release agents, paints or both, shall be removed. The use of organic solvent, which is likely to attack the rubber, is prohibited. Connect the ohmmeter leads to the metal loading plate and the wheel.

Load the tyre-wheel assembly at the reference point to the value as specified in 4.4, hold for 1 min, and then remove the load. Repeat the load-unload cycle a second time.

If the resistance is less than $10^{10}\ \Omega$, the current should be not less than 10^{-7} A and the voltage not more than 1 000 V (see Table 1). Load the tyre a third time to the test load and immediately apply the test voltage. Record the resistance measurement 3 min ± 10 s after the voltage has been applied. The voltage and the load shall be applied continuously to the tyre until the final measurement is recorded. Unload the tyre. Repeat the preload cycle and measurement for at least two other additional circumferential locations approximately evenly spaced around the tyre.

5 Interpretation of results

The resultant electrical resistance of the tyre is the highest value of the electrical resistance measurements of all circumferential measurement points.

6 Report

6.1 The report should contain the following information:

— individual measurements (Ω);

— highest value of measurements (Ω);

— applied voltage (V);

— products for cleaning the tyre and the plate;

— material of the test wheel;

— ambient temperature during the test (°C);

— relative humidity during the test (%);

— tyre size;

— test load (N);

— test inflation pressure (kPa);

— rim width/contour.

6.2 The report can also contain the following additional information:

— manufacturer;

— brand name (commercial name);

— service description (load index, speed symbol or other load capacity);

— load capacity (kg);

— date of production;

— location of reference point.

Annex A
(normative)

Limit values

A.1 General

The resultant electrical resistance of the tyre is the highest value of the electrical resistance measurements of all circumferential measurement points.

A.2 Limits

A.2.1 Normal applications

Tyres tested according to this International Standard are considered to be capable of safely dissipating electrical charge if the resistance measured does not exceed $10^{10}\ \Omega$. This applies to all types of tyres, except those mentioned in A.2.2.

A.2.2 Applications in areas with risk of explosion

The applications of tyres in areas likely to contain inflammable gases, vapours, dust or powders in an indoor space necessitate the use of deflagration-proof equipment.

Tyres tested according to this International Standard are considered to be capable of safely dissipating electrical charge in such environments if the resistance measured does not exceed $10^{6}\ \Omega$[1)].

1) This value corresponds to the designation “antistatic class 1” commonly used for industrial tyres.

Annex B
(informative)

Measurement of the electrical resistance of pneumatic and solid tyres on the vehicle

B.1 General

The annex describes a test method to measure the electrical resistance of pneumatic and solid tyres, under load, on a vehicle under working conditions.

B.2 Measurement

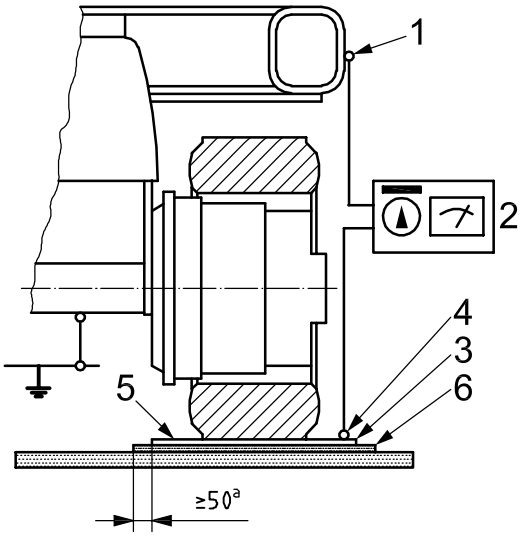
B.2.1 Description

The electrical resistance of an inflated tyre, mounted on a vehicle that is placed with one tyre on a metal loading plate is measured between the vehicle frame and the conducting surface against which the tyre is loaded.

B.2.2 Measurement equipment

The vehicle should be placed with one tyre on a metal loading plate covered by a piece of damp blotting paper to minimize errors caused by contaminations (see Figure B.1). The frame should be clean in the connecting area.

Dimensions in millimetres



Key

1 connecting point-frame
2 measuring instrument
3 insulating material (e.g. polyethylene PTFE or equivalent materials)
4 connecting point
5 blotting paper
6 metallic plate

[a] Offset.

Figure B.1 — Apparatus

Annex C
(informative)

Measurement of the electrical resistance of pneumatic and solid tyres: production control

C.1 General

The annex describes a test method to measure the electrical resistance of a tyre for the purpose of production control.

C.2 Measurement

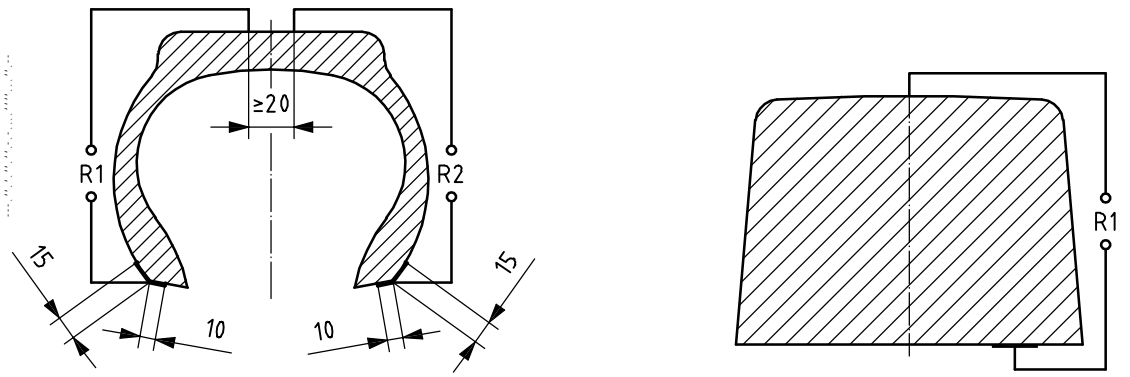
C.2.1 Description

The electrical resistance of a tyre is measured between two conductive plates.

C.2.2 Measurement

The metal plates should be positioned as shown in Figure C.1.

Dimensions in millimetres



a) Pneumatic tyre **b) Solid tyre**

Figure C.1 — Pneumatic and solid tyre

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[9] ISO 4251 (all parts), *Tyres (ply rating marked series) and rims for agricultural tractors and machines*

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2) Now withdrawn.

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