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Road wear test of studded tyres

Essai d'usure des routes par des pneumatiques cloutés/cramponnés

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Contents

Page

Foreword

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The road wear test of studded tyres is used to determine the road wear effect of a stud-tyre combination.

Road wear test of studded tyres

1 Scope

This document establishes a test method for evaluating the wear caused to the road surface by passenger car tyres and light truck tyres that are equipped with studs.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 4000-1, *Passenger car tyres and rims — Part 1: Tyres (metric series)*

ISO 4209-1, *Truck and bus tyres and rims (metric series) — Part 1: Tyres*

ISO 4223-1, *Definitions of some terms used in the tyre industry — Part 1: Pneumatic tyres*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4223-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
evaluation stone
test stone (3.11) that is used in the test method of ISO 24469 for evaluating the road wear based on its mass loss caused by the test runs

3.2
ground frame
rigid structure that holds the stone tray robustly and rigidly at the same level of the track surface

3.3
Kuru grey granite
fine-grained granite quarried in Kuru in the central part of Finland

3.4
light truck tyre
pneumatic tyre designed primarily, but not only, to equip light commercial vehicles

Note 1 to entry: Such tyres belong to a group prescribed in the “LT” Light Truck or “C-type” Commercial or “CP-type” Commercial Tyre section of the applicable standards manuals and are normally marked with “LT”, “C”, “ST”, “CP”.

3.5
passenger car tyre
pneumatic tyre designed primarily, but not only to equip passenger cars

3.6
reference stone
test stone (3.11) from the same production batch of the *evaluation stones* (3.1) and subjected to the same treatment as the evaluation stones, except for being mounted in the *stone tray* (3.7)

Note 1 to entry: Reference stones are used to define the mass loss caused by measuring process.

3.7
stone tray
rigid structure used for mounting the *test stones* (3.11) in a defined matrix formation and for connecting the test stones rigidly to the *ground frame* (3.2)

3.8
stud
piece of equipment consisting of a centre pin made of hard material protruding above a body made of softer material designed to equip the tread of a tyre to improve the traction on icy surfaces

3.9
stud protrusion
radial distance between the top of the pin of the *stud* (3.12) and the outer surface of the tyre's tread

3.10
test run
pass over the *evaluation stones* (3.1) with the *test tyres* (3.12)

3.11
test stone
stone made of *Kuru grey granite* (3.3) in defined form by sawing

3.12
test tyres
pair of identical studded tyres to be mounted on the driver's side of the test vehicle

4 Principle

The test method simulates the road wear effect of a studded tyre. In the test, a test vehicle is driven in total 200 times over the evaluation stones, which means total 400 passes of tyres. After the vehicle test, the road wear effect is derived from determining the mass reduction of the evaluation stones.

5 General test conditions and requirements

5.1 Test track

The whole test track shall be covered with an asphalt mixture commonly used for building public roads. The length of the track shall be sufficient to achieve all the conditions described in 7.3. for carrying out the road wear test.

The gradient of the track allows excess water from watering system to flow away from the test location.

The ground frame shall be embedded in the test track to allow mounting the stone tray in a straight-line section of the test track, at the point where the needed test speed can be achieved and kept.

Within a distance of 2 m perpendicular from the ground frame to the driving directions, the surface level of the test track shall not deviate more than 7 mm when measured by placing a straight edge of at least 2 m length on the ground frame pointing to the driving direction. The measurement head of the straight edge should be at least 20 mm in diameter to exclude the effect of surface porosity. Alternative method of same or better precision and repeatability to define track wear and ground frame assembly can be used.

The ground frame shall be installed in the test track so that the top surface of the test stones is within +0,5 mm and 0 mm above the surface of the test track.

In case of track wear, relevant coating can be used to fill wear areas. It is recommended to use such coating that will not influence the mass change of evaluation stones.

5.2 Test vehicle

The test shall be conducted with a standard production vehicle in good running order which is capable of mounting the test tyres and fulfil the loading conditions of each four tyre.

The number of driven axles, propulsion and transmission type can be chosen freely.

5.3 Test tyres

Two test tyres from the same batch with the same stud type are required for the test. Tyre pressure shall be set according to Table 1. Stud protrusion referred to in this subclause shall be measured according to Clause 8.

In case the manufacturer indicated a target stud protrusion, the test tyres shall meet the following requirements:

a) the protrusion of an individual stud shall not differ by more than ±0,3 mm from the target stud protrusion;

b) the average stud protrusion shall not differ by more than ±0,1 mm from the target stud protrusion.

Tyres on the test vehicle shall be mounted on an approved rim as specified in ISO 4000-1 or ISO 4209-1. If a tyre designation is not listed in these standards, reference may be made to a publication of a renowned tyre standards organization, for example, the European Tyre and Rim Technical Organization (ETRTO), The Tire and Rim Association (TRA) or the Scandinavian Tyre and Rim Organization (STRO).

The following applies when performing the test on unused tyres. Test tyres shall be manufactured at least two weeks prior to the beginning of test. Studding shall have been carried out at least 48 h prior to the test. The studding process does not have to be monitored by the testing entity.

Other tyres (not test tyres) used in the test vehicle should be appropriately studded and of same type and model with tyres to be tested. These tyres should be manufactured not more than 1 year before the test run and should be in good condition, not more than 3 % of missing studs per tyre.

Table 1 — Tyre inflation pressure requirements in different load class

Load class	Inflation pressure kPa	Tolerance kPa
Passenger car tyres with load index ≤ 89	250	±10
Passenger car tyres with load index 90 ≤ LI ≤ 100	250	±10
Passenger car tyres with load index ≥ 101	250	±10
Light truck tyres	350	±10

Adjust the inflation pressure of the tyres just before the testing at ambient temperature.

5.4 Required equipment

The test shall be conducted with the equipment as specified in Table 2.

Table 2 — Required equipment for the test

Instrument	Specification	Resolution
Stud protrusion gauge	Accuracy: ±0,1 mm	0,01 mm
Test stone scale	Accuracy: ±0,01 g	0,001 g
Oven	Temperature range: ≥110 °C	1 °C
Humidity sensor	Accuracy: ±1 %	0,1 %
Vehicle scales	Accuracy: ±10 kg	0,5 kg
Outdoor thermometer	Accuracy: ±1 °C	0,1 °C
Road thermometer	Accuracy: ±1 °C	0,1 °C
Inflation pressure gauge	Accuracy: ±10 kPa	1 kPa
Speedometer	Accuracy: ±1 km/h	0,1 km/h

Measurement equipment shall be duly calibrated.

5.5 Atmospheric conditions

Air temperature shall be between +2 °C and +20 °C, shall be measured at a shade place nearby the test track at the beginning, at the middle and, at the end of the test.

Test track temperature shall be between +2 °C and +25 °C, which shall be measured as near as possible to the ground frame, before, in the middle and at the end (and, if possible, at a dry place).

No requirement for wind speed is set because the test is performed by driving equally to opposite directions.

6 Preparation of test stones prior to road wear test

6.1 Test stone requirements

Kuru grey granite shall be used as a material for test stones.

If another material than Kuru grey granite is used, a comparison test shall be done to provide the evidence of the correlation of wear to that of the Kuru grey granite.

For this test method, fifteen (15) evaluation stones and five reference stones from the same production batch are required.

Test stones shall be sorted into batches in which individual test stones have no more than 0,5 mm difference in height to each other in order to be able to adjust them in, or above, a stone tray and test their track surface. Visual control should be done within test stones selection: external structure, quality of surface and possible presence of external fissures.

The evaluation stones' dimensions shall be according to the Figure 1.

Dimensions in millimetres

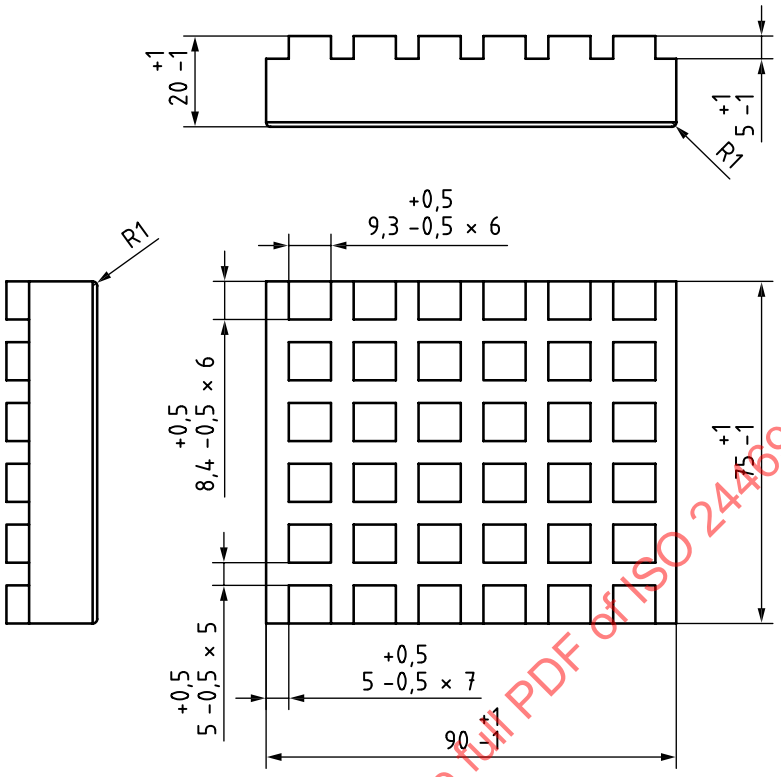


Figure 1 — Test stone dimensions

Test stones for the measuring operations shall be stored in a warm and dry place to avoid fluctuations in test stone material characteristics. Test stones shall be used only once.

6.2 Test stone numbering

Each test stone shall be individually numbered, using a permanent water-resistant marker.

6.3 Weighing process of the test stones

The weighing process for the test stones shall be done in the same order prior to and after the test.

First, test stones shall be cleaned. This is done under a tap water, using light brushing with a plastic brush. Use clean compressed air to remove excess water.

Second, the test stones shall be dried in a convection oven for 72 h ± 2 h at 110 °C ± 1 °C. The test stones shall not touch each other and shall be placed in the oven with the same orientation and at the same place. The oven should be fully loaded with test stones. Any free space could be loaded with used test stones.

Third, the test stones are then cooled in a desiccator during 120 min ± 5 min. During that time the humidity in the desiccator shall stay less than 10 %. The test stones in the desiccator shall not touch each other and are placed with the same orientation and disposition.

Proceed to weighting within less than 5 min after desiccator cycle and report test stone masses in a report sheet.

If a test stone is damaged during the preparation process, it cannot be used for testing. If this happens after the test (during the process of determining mass after test), then the whole test shall be repeated, and results from the remaining test stones cannot be used.

Weighting process shall be performed in normal ambient room conditions.

6.4 Evaluation of stone mounting in the stone tray

The stone tray shall be carefully cleaned before installing the evaluation stones, and after each test.

The evaluation stone height shall be adjusted so that their top surface is within +2,0 mm and 0 mm above the upper surface of the stone tray. The height difference can be compensated by metallic shim plates.

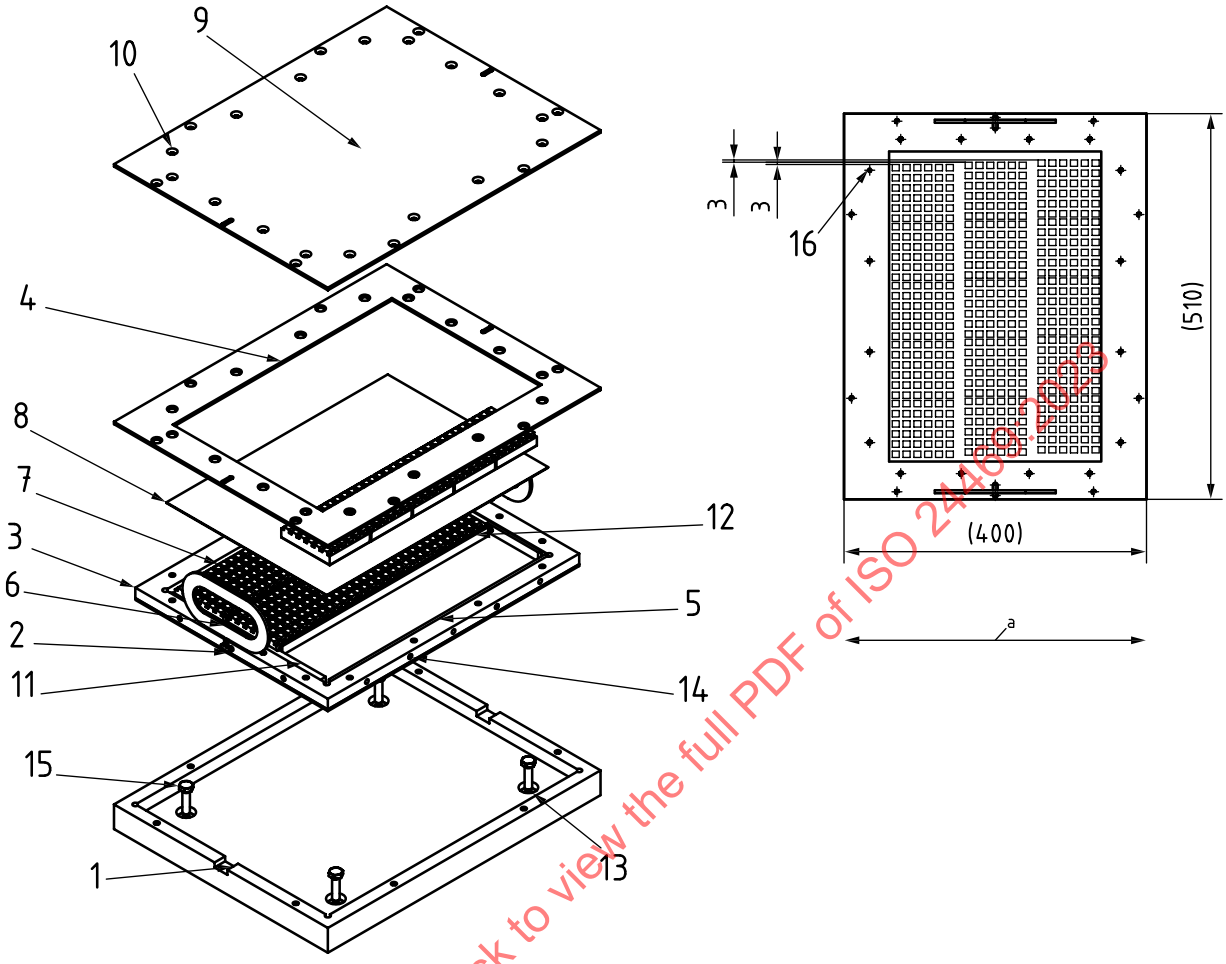
The evaluation stones shall be arranged in three rows of five test stones each, with rubber separators between them according to Figure 2. The thickness of separators between the evaluation stones in each row shall be 3,0 mm ± 0,5 mm.

The rows of evaluation stones shall be staggered at distances of 3,0 mm ± 0,5 mm perpendicular to the driving direction in relation to evaluation stones in the adjacent row. The evaluation stones shall be arranged in a way that grooves on them reaching through rows do not comprise straight lines in the direction of the test vehicle crossing test stones.

The thickness of material between the rows shall be 5 mm ± 2 mm, and the material in contact with the evaluation stones shall be rubber. There shall be a rigid metal support in order to secure the evaluation stones into the ground frame.

The evaluation stones shall be tightened so that they remain rigidly in place during the test.

Dimensions in millimetres



Key

1	ground frame (anchored to ground)	9	cover
2	stone tray bottom plate	10	cover body
3	stone tray	11	tightening piece 2 (graded)
4	stone tray top plate	12	evaluation stone row separator piece
5	tightening piece 1 (straight)	13	washer
6	handle	14	retain screw
7	evaluation stone	15	hexagon bolt
8	height adjustment plate	16	countersunk hexagon bolt
a	Driving direction.		

Figure 2 — Stone tray and evaluation stone assembly

7 Road wear test

7.1 Preparing the road wear test track

The prepared stone tray is installed on the track according to drawing in Figure 2.

The water flow is switched on before starting the test and the stone tray shall be watered continuously throughout the test, keeping the evaluation stones thoroughly wet during the test. Five reference stones shall be submerged in a container near the test location at the same time when the stone tray is watered

and they shall be kept in water for the duration of the test. Each set of reference stones shall only be used once and to correct only the results of that test during which they have been watered.

The test stones shall be watered with tap quality water, and a flow comprised between 100 l/h and 150 l/h.

7.2 Preparing the test vehicle

The test vehicle shall be weighted and, if needed, additional weights are mounted on it. The weight distribution on a single tyre shall be between 60 % to 80 % of the indicated load index. The total weight of the test vehicle, including any possible additional weights and the driver, shall be between 65 % to 75 % of the tyres' combined carrying capacity according to their load indices.

Tyre loads are recorded in the road wear test report. Weight difference between left and right sides, as well as front and rear axle tyres, shall be less than 5 %. Tyre loads shall be measured prior to the test.

7.3 Carrying out the vehicle test

Before starting and during the test runs, the air and road surface temperatures are recorded in the road wear test report (the requirements on air temperature and track surface temperature are provided in 5.5).

The test vehicle is driven in total of 200 times the test tyres (drivers' side of the vehicle) passing the evaluation stones. Driving is done in both directions, 100 times each direction. The driver is responsible for ensuring the number of valid test runs. If in any test run the test tyres miss the evaluation stones, the failed test runs will be replaced by carrying out equivalent number of valid extra test runs until the total number of 200 valid test runs has been reached.

The test speed shall be 100 km/h ± 2 km/h for passenger car tyres and 80 km/h ± 2 km/h for commercial minivan or light truck (C/LT) tyres. The vehicle shall be fitted with a sensor suitable for measuring speed.

The vehicle is smoothly accelerated until it reaches the test speed at least 50 m before the evaluation stones. This speed shall be maintained until the ground frame is reached. The evaluation stones shall be rolled over in free-rolling condition, for example, with the clutch pressed for a vehicle with manual transmission and gear selector in neutral position (if feasible) for a vehicle with automatic transmission. The vehicle is then decelerated, turned to opposite direction, and accelerated again to the test speed of at least 50 m before the evaluation stones for another passing

The evaluation stones shall remain correctly placed in the stone tray throughout the test.

8 Stud protrusion

The stud protrusion of studded tyres shall be measured before and after the test run and stud force before the test run. The arithmetic means of the average stud protrusions of the test tyres after the vehicle test shall not differ by more than ±25 % with respect to the arithmetic means determined before the vehicle test.

Stud protrusion is measured with a device, which has a support plate of Ø20 mm in diameter and Ø12 mm hole (Figure 3), where the measurement head is located. The measurement device shall be zeroed on a flat surface. The measurement device should be pressed perpendicular to the tread surface with a force of 15 N to 20 N to trigger the measurement. The stud protrusion is measured clockwise on every test tyre, starting near the location of the first character of the date of manufacture marking, on 20 random consecutive studs across the tread from side to side. The measured studs shall be the same individual studs in both measurements.