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Motorcycle tyres — Test methods for verifying tyre capabilities

Pneumatiques pour motocycles — Méthodes d'essai pour la vérification de l'aptitude des pneumatiques

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10231 was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*, Subcommittee SC 10, *Cycle, moped, motorcycle tyres and rims*.

This third edition cancels and replaces the second edition (ISO 10231:1997), which has been technically revised.

Motorcycle tyres — Test methods for verifying tyre capabilities

1 Scope

This International Standard specifies test methods for verifying the capabilities of tyres for motorcycles. Of the test methods presented, only some may be required depending on the type of tyre to be tested.

The tests are carried out in the laboratory under controlled conditions.

It includes a strength test for assessing the capability of the tyre structure, with respect to breaking energy, in the tread area.

A second test, the endurance test, assesses the resistance of the tyre with respect to service at full load and moderate speed over long distances.

The third test, the high-speed test, assesses the capability of the tyre as related to service at the maximum speed capability of the tyre. It is not applicable to tyres with a speed capability below 130 km/h.

The centrifugal growth test assesses the maximum growth of the tyre under the influence of centrifugal forces at the maximum speed capability of the tyre. This is applicable only to road tyres with speed symbols P and above.

The test methods presented in this International Standard are not intended for gradation of tyre performance or quality levels.

This International Standard is applicable to all motorcycle tyres.

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 4223-1:1989, *Definitions of some terms used in the tyre industry — Part 1: Pneumatic tyres*

ISO 5751-1:2001, *Motorcycle tyres and rims (metric series) — Part 1: Design guides*

ISO 5751-2, *Motorcycle tyres and rims (metric series) — Part 2: Tyre dimensions and load-carrying capacities*

3 Terms and definitions

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

3.1
bead separation
breakdown of bond between components in the bead area

3.2
belt separation
parting of rubber compound between belt layers or between belts and plies

3.3
chunking
breaking away of pieces of the tread

3.4
cord separation
cord parting from adjacent rubber compounds

3.5
cracking
any parting within the tread, sidewall or innerliner of the tyre extending to cord material

3.6
innerliner separation
parting of innerliner from cord material in the carcass

3.7
open splice
any parting at any junction of tread, sidewall or innerliner that extends to cord material

3.8
ply separation
parting of rubber compound between adjacent plies

3.9
sidewall separation
parting of the rubber compound from the cord material in the sidewall

3.10
tread separation
pulling away of the tread from the tyre carcass

3.11
test rim
any rim on which the tyre may be fitted that conforms to the dimensions of the recommended rims for the particular tyre designation and type

3.12
test drum speed
speed of the outer surface of the steel test drum

3.13
tyre speed
peripheral speed of the tread surface

3.14
maximum load rating
maximum load the tyre is rated to carry at the maximum speed

NOTE *Maximum speed* means the speed corresponding to the speed symbol on the tyre or the maximum tyre speed capability specified by the tyre manufacturer.

4 Test equipment and its requirements

The test equipment consists of items 4.1 to 4.5.

For the tyre centrifugal growth test (see 5.4), the measurement equipment accuracy shall be within ± 1 % of full scale.

4.1 Test drum, cylindrical driven flywheel (drum) having a diameter of 1,7 m ± 1 % or 2 m ± 1 %.

The surface of the drum shall be of smooth steel. The width of the test surface shall exceed the overall width of the test tyre.

For the test drum, the loading device may be a dead-weight cantilevered system with a hydraulic system or with any other equivalent system. The loading capacity shall be adequate for the requirements of the procedure and the accuracy shall be within ± 1,5 % of the full scale.

For the test drum, the speed capability of the equipment shall be adequate for the requirements of the test methods. The accuracy of the test drum speed shall be within ± 3 % of the full scale.

4.2 Plunger, cylindrical steel plunger of sufficient length with a hemispherical end and a diameter of 8 mm ± 0,6 mm.

For the plunger equipment, the loading device shall be of hydraulic type or an equivalent system with a maximum load capacity adequate for the requirements of the test methods. Indicators of displacement and of force shall be provided with an accuracy within ± 1 % of full scale.

For the plunger equipment, the speed of the displacement shall be controlled with an accuracy within ± 3 % of the full scale.

4.3 Inflation pressure gauges, with a maximum scale value of at least 400 kPa and an accuracy within ± 10 kPa.

4.4 Test axle, for the tyre centrifugal growth test, the test axle and the rim shall be controlled in order to ensure a radial run-out of less than ± 0,5 mm and a lateral run-out of less than ± 0,5 mm when measured respectively at the bead seat and the vertical part of the inner flange of the rim immediately above the bead seat radius.

4.5 Contour outline device, such as a projecting grid or camera, which permits the distinct outlining of the external contour of the tyre cross-section normal to the tyre equator, at the point of the maximum deformation of the tread.

The device shall reduce to a minimum any distortion and ensure a constant (known) ratio between the plotted contour and the actual dimensions.

The device shall permit the reference of the tyre contour to the wheel axis.

5 Testing

5.1 Strength test

5.1.1 Preparation of tyre

5.1.1.1 Mount the tyre on a test rim and inflate it to the pressure specified in relation to the maximum load rating.

5.1.1.2 Maintain the assembly at test room temperature for at least 3 h.

5.1.2 Test procedure

5.1.2.1 Readjust the tyre pressure to that specified in 5.1.1.1 before or after the mounting of the assembly on a fixture.

5.1.2.2 Position the plunger as near to the centreline as possible, avoiding penetration into the tread grooves, and force the plunger perpendicularly into the tread at a rate of 50 mm/min ± 2,5 mm/min.

5.1.2.3 Record the force and penetration at the moment of breaking (see also 5.1.2.7) at each of five test points approximately equally spaced around the circumference of the tyre. In the case of tyres mounted on rim diameter codes 10 and smaller, test the tyre at three points.

5.1.2.4 If the tyre fails to break before the plunger is stopped on reaching the rim, then the tyre is deemed to have passed the test at that point.

5.1.2.5 Compute the breaking energy, W, in joules for each test point, except those considered by 5.1.2.4, by means of the following formula:

$$W = \frac{F \times P}{2\,000}$$

where

F is the force, in newtons;

P is the penetration, in millimetres.

5.1.2.6 Determine the breaking energy value for the tyre by computing the average of the values obtained.

5.1.2.7 When an appropriate device which automatically evaluates the value of the energy W is available, the penetration may be stopped shortly after having achieved the prescribed value.

5.1.2.8 In the case of tubeless tyres, means may be provided to ensure the retention of the inflation pressure for the duration of the test.

5.2 Endurance test

5.2.1 Preparation of tyre

5.2.1.1 Mount the tyre on a test rim and inflate to the pressure corresponding to the maximum load rating.

5.2.1.2 Maintain the assembly at a temperature not less than 35 °C for at least 3 h.

5.2.2 Test procedure

5.2.2.1 Readjust the tyre pressure to the value specified in 5.2.1.1 immediately before testing

5.2.2.2 Mount the tyre and rim assembly on a test axle and press it against the outer face of a test drum.

5.2.2.3 During the test, the ambient temperature at a distance of not less than 150 mm and not more than 1 m from the tyre shall be at least 35 °C. No provision shall be made for cooling the tyre during the test.

5.2.2.4 Conduct the test without interruptions at a speed of not less than 80 km/h and with loads and test periods in accordance with Table 1.

Table 1 — Test parameters for endurance

Test period	Minimum duration h	Minimum load as a percentage of tyre maximum load rating %
1	4	100
2	6	108
3	24	117

5.2.2.5 Throughout the test, the inflation pressure shall not be corrected and the test loads shall be kept constant.

5.3 High-speed test

5.3.1 Preparation of tyre

5.3.1.1 Mount the tyre on a test rim, and inflate it to a pressure related to its speed symbol and version in accordance with Table 2.

The tyre manufacturer may request, giving reasons, the use of a different test inflation pressure. In such a case, the tyre shall be inflated to that pressure.

Table 2 — Inflation pressures for high speed

Tyre version	Speed symbol	Inflation pressure kPa
Standard load	M to P inclusive	250
	Q, R, S	300
	T, U, H, V	350
	W	320
Reinforced/extra load	M to P inclusive	330
	Q to H inclusive	390

5.3.1.2 Maintain the tyre and rim assembly at test room temperature for not less than 3 h.

5.3.2 Test method

5.3.2.1 Before or after mounting the tyre and rim assembly on a test axle, readjust the tyre pressure to that specified in 5.3.1.

5.3.2.2 Press the tyre and rim assembly against the outer face of the test drum.

5.3.2.3 Apply a load equal to 65 % of the maximum load rating of the tyre to the test axle.

NOTE For speed symbol V tyres, the maximum load rating is 85 % of the rated load (load index). For speed symbol W tyres, the maximum load rating is 75 % of the rated load (load index) (see ISO 5751-1). See Annex B for related high-speed tests.

In the case of tyres designed for heavyweight touring motorcycles, i.e. tyres with a rim diameter code 15 and above and a load capacity Index 65 and above in reinforced/extra-load version, the applied load shall be 75 % of the maximum tyre load rating.

5.3.2.4 Throughout the test, the tyre pressure shall not be corrected and the test load shall be kept constant.

5.3.2.5 During the test, the temperature in the test room shall be maintained at between 20 °C and 30 °C, or at a higher temperature if the tyre manufacturer agrees.

5.3.2.6 Carry the test through without interruptions, as follows, in relation to the tyre speed symbol and the test drum diameter.

a) The initial test speed is equal to the tyre's speed category:

   — less 40 km/h on a 1,7 m drum;

   — less 30 km/h on a 2 m drum.

b) Accelerate the equipment at a constant rate such that the initial test speed is reached at the end of 20 min from start-up.

c) Operate the equipment with the test drum speed at the initial test speed for 10 min;

   — then, at the initial test speed plus 10 km/h for 10 min;

   — then, at the initial test speed plus 20 km/h for 10 min;

   — finally, at the initial speed plus 30 km/h for a further 10 min.

5.4 Centrifugal growth test

5.4.1 Preparation of tyre

5.4.1.1 Mount the tyre on a test rim and inflate it to the pressure related to its speed symbol, in accordance with Table 3.

Table 3 — Inflation pressures for centrifugal growth

Speed symbol	Inflation pressure kPa
P	225
Q to S inclusive	250
T to H inclusive	280
over 210 km/h	290

5.4.1.2 Maintain the tyre and rim assembly at test room temperature for not less than 3 h.

5.4.2 Test procedure

5.4.2.1 Readjust the tyre pressure to the value specified in 5.4.1.1.

5.4.2.2 Mount the tyre and rim assembly on the test axle and ensure that the assembly rotates freely.

5.4.2.3 Position the contour outline device and ascertain that it is perpendicular to the rotation of the test tyre tread.

5.4.2.4 Accelerate the assembly without interruption to reach the maximum speed capability of the tyre within 5 min.

The tyre may be rotated either by means of a drive motor acting on the tyre axis or by pressing it against a test drum (4.1).

5.4.2.5 Check that the tyre speed is within ± 2 % of the maximum speed capability of the tyre.

Maintain the equipment at constant speed for at least 5 min and then check the tyre contour.

5.4.2.6 During the test, the temperature in the test room shall be maintained at between 20 °C and 30 °C, or at a higher temperature if the tyre manufacturer agrees.

6 Requirements

6.1 Test sample

Three tyres with identical characteristics, e.g. size designation and service description or maximum load rating and speed capability, shall comprise a test sample:

a) one tyre shall be used for the measurement of strength;

b) a second tyre for the endurance test;

c) a third for the high-speed performance test and/or the centrifugal growth test.

The pressures, loads and speeds shall be as specified for each test method.

Each test sample shall conform to the requirements specified in 6.2 to 6.5, as appropriate.

6.2 Strength test

6.2.1 Each test sample shall meet at least the requirements for minimum breaking energy specified in Table 4, when tested in accordance with 5.1.

Table 4 — Minimum breaking energy

Tyre version	Minimum breaking energy J
Light	17
Standard	34
Reinforced/extra load	45

6.2.2 For tyres with a design section width of less than 62 mm, the required energy value shall be reduced by 15 %.

6.3 Endurance test

6.3.1 After completion of the laboratory endurance test specified in 5.2 using a test rim and a valve which undergo no permanent deformation and allow no loss of air, there shall be no visual evidence of tread, ply, cord, belt or bead separation, chunking, open splices, cracking or broken cords.

6.3.2 If the final pressure measured immediately after the test is less than the initial pressure, repeat the test with another sample.

6.4 High-speed test

6.4.1 After completion of the laboratory high-speed test specified in 5.3 using a test rim and a valve which undergo no permanent deformation and allow no loss of air, there shall be no visual evidence of tread, ply, cord, belt or bead separation, chunking, open splices, cracking or broken cords.

6.4.2 If the final pressure measured immediately after the test is less than the initial pressure, repeat the test with another sample.

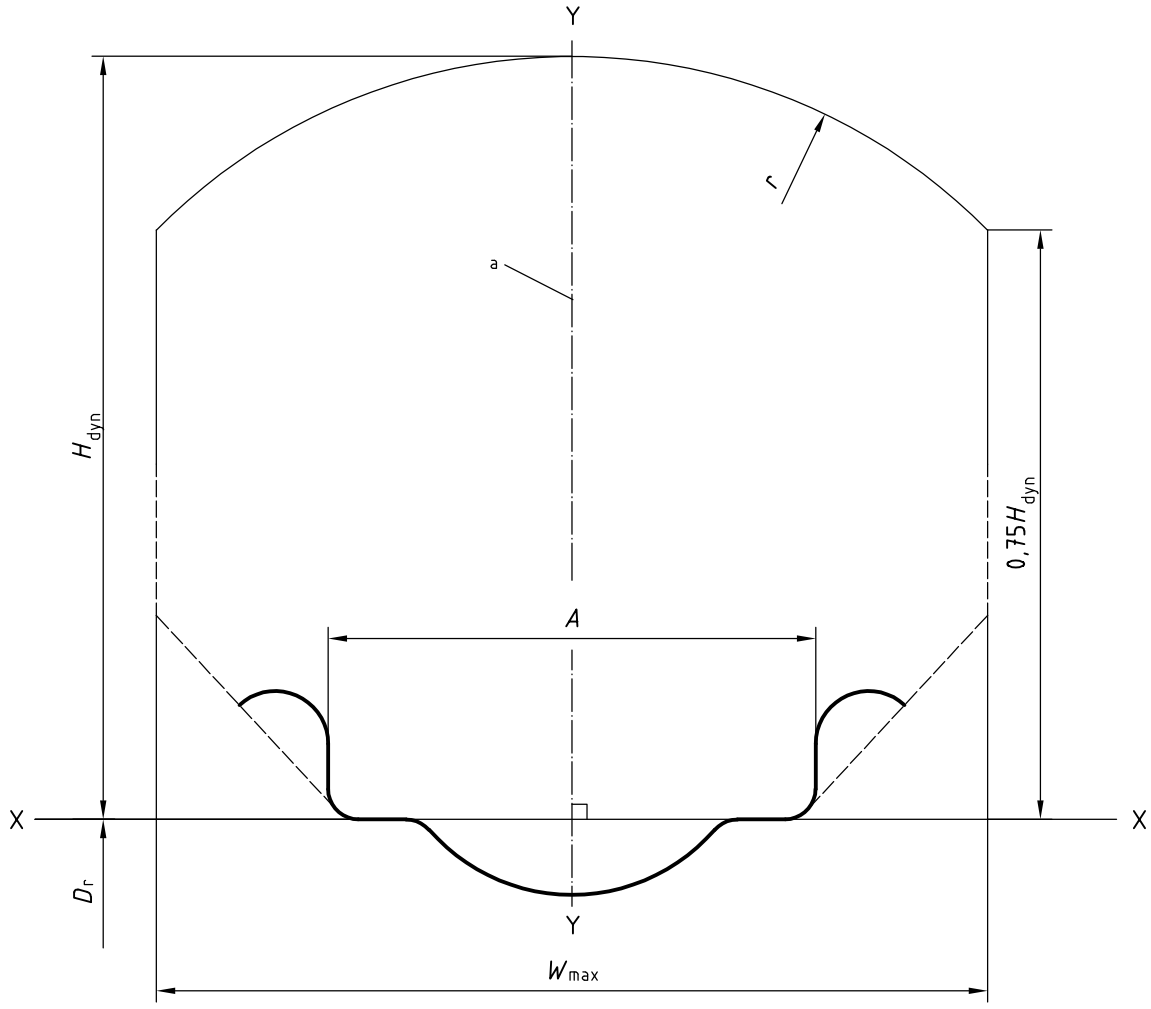
6.5 Centrifugal growth test

6.5.1 The tyre to be tested shall have passed the high-speed test (see 6.4) or, alternatively, it shall be a new tyre adequately broken-in.

6.5.2 The contour of the tyre found at the maximum speed shall not exceed the enveloping curve defined in Figure A.1 with reference to the tyre axis (i.e. the lines XX and YY of the curve shall coincide with those of the plotted tyre contour).

Annex A
(normative)

Enveloping curve for contour of tyre for centrifugal growth test



D_r rim diameter

H_{dyn} dynamic tyre section height[b]

A rim width

W_{max} maximum overall width in service (see ISO 5751-1:2001, 5.2.2)

r radius

The Y-axis is perpendicular to the X-axis and to the wheel axis.

In the case of tyres that have a special profile at the rim flange area, consult the tyre manufacturer for additional clearance.

a Centreline.

b $H_{dyn} = H^*c$, where H is the design tyre section height (see ISO 5751-1:2001, 5.1.4) and c is the coefficient (see ISO 5751-1:2001, Table 5).

Figure A.1

Annex B
(informative)

Tyres suitable for speeds over 240 km/h

B.1 High-speed tests

B.1.1 Some tyres are not marked with a speed symbol but with speed category code V or Z within the size designation (e.g. 130/60 V 16, 130/60 VR 16, 130/60 VB 16, 130/60 ZR 16 or 130/60 ZB 16) and are certified by the tyre manufacturer for speeds higher than 240 km/h. There are two, separate high-speed tests appropriate for such tyres, as follows.

B.1.2 The first test shall be performed in accordance with 5.3:

— for V speed symbol tyres in case of tyres marked with speed category code V (e.g. 130/60 V 16, 130/60 VR 16 or 130/60 VB 16);

— for W speed symbol tyres in case of tyres marked with speed category code Z (e.g. 130/60 ZR 16 or 130/60 ZB 16).

The reference rated load shall be that specified in ISO 5751-2 for the size designation.

B.1.3 The second test shall be performed on a second tyre of the same type, in accordance with 5.3, except that 5.3.2.6 c) is replaced by the following procedure.

Operate the equipment with the test drum at the initial test speed (see Table B.1) for 20 min;

— then, accelerate the equipment at a constant rate such that the maximum test speed specified by the tyre manufacturer is reached at the end of 10 min;

— finally, at the maximum test speed for 5 min.

Table B.1 — Initial test speeds

Test drum diameter	Initial test speed	
	V/VB/VR tyres	ZR/ZB tyres
1,7 m	200 km/h	230 km/h
2,0 m	210 km/h	240 km/h

The test load shall be equal to 65 % of the maximum load capacity specified by the tyre manufacturer for application at the maximum speed certified for the tyre.

B.2 Speed category

The tyre's speed category shall be the maximum speed specified by the tyre manufacturer and may be clearly marked on the tyre side walls (e.g. V 260 to identify a maximum speed of 260 km/h).

Bibliography

[1] ISO 3877-1, *Tyres, valves and tubes — List of equivalent terms — Part 1: Tyres*

[2] ISO 4249-1, *Motorcycle tyres and rims (Code designated series) — Part 1: Tyres*

[3] ISO 4249-2, *Motorcycle tyres and rims (Code designated series) — Part 2: Tyre load ratings*

[4] ISO 4249-3, *Motorcycle tyres and rims (Code designated series) — Part 3: Rims*

[5] ISO 5751-3, *Motorcycle tyres and rims (metric series) — Part 3: Range of approved rim contours*

[6] ISO 6054-1, *Motorcycle tyres and rims (code-designated series) — Diameter codes 4 to 12 — Part 1: Tyres*

[7] ISO 6054-2, *Motorcycle tyres and rims (code-designated series) — Diameter codes 4 to 12 — Part 2: Rims*

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