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**Truck and bus tyres — Verifying tyre  
capabilities — Laboratory test methods**

*Pneumatiques pour camions et autobus — Vérification de l'aptitude des  
pneumatiques — Méthodes d'essai en laboratoire*



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## Foreword

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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.

International Standard ISO 10454 was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*, Sub-Committee SC 4, *Truck and bus tyres and rims*.

Annexes A and B of this International Standard are for information only.

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# Truck and bus tyres — Verifying tyre capabilities — Laboratory test methods

## 1 Scope

This International Standard specifies test methods for verifying the capabilities of truck and bus tyres. 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 a laboratory under controlled conditions.

It includes a strength test for assessing the capability of the tyre structure, with respect to braking 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 test methods presented in this International Standard are not intended for gradation of tyre performance or quality levels.

This International Standard applies to all truck and bus tyres.

## 2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

## 3 Definitions

For the purposes of this International Standard, the definitions given in ISO 4223-1 and the following definitions 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 thread.

**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 maximum load rating:** Maximum load that the tyre is rated to carry in single formation at the reference speed.

**3.8 open splice:** Any parting at any junction of tread, sidewall or innerliner that extends to cord material.

**3.9 ply separation:** Parting of rubber compound between adjacent plies.

**3.10 sidewall separation:** Parting of the rubber compound from the cord material in the sidewall.

**3.11 special tread tyre (ET):** Tyre whose tread pattern is primarily designed to provide satisfactory performance under special service conditions (e.g. mixed use, on- and off-road, city bus, etc.).

**3.12 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.

**3.13 test drum speed:** Peripheral speed of the steel test drum.

**3.14 tread separation:** Pulling away of the tread from the tyre carcass.

## 4 Test equipment

The test equipment consists of items in 4.1 to 4.3.

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

The surface of the drum shall be smooth steel. The width of the test surface shall be equal to or 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 or pneumatic system. The accuracy shall be within  $\pm$  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  $^{+2}_0$  km/h at the full scale.

**4.2 Plunger,** cylindrical steel plunger of sufficient length with a hemispherical end and a diameter as shown in table 1, with reference to the tyre load index.

For the plunger equipment, the loading device shall permit gradual application of the force. Indicators of displacement and of force shall be provided with an accuracy within  $\pm$  1 % of full scale.

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

**Table 1 — Plunger diameter**

Dimensions in millimetres

Load index in single formation	Plunger diameter $\pm$ 0,5
$\leq$ 121	19
122 - 134	32
$\geq$ 135	38

**4.3 Inflation pressure gauges,** with a maximum scale value of at least 1 000 kPa with an accuracy within  $\pm$  20 kPa.

## 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 for the maximum load rating in single formation, or maximum dual load, where they differ.

**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 and mount 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  $\pm$  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. Check the pressure before moving to the next test point.

**5.1.2.4** If the tyre fails to break before the plunger is stopped on reaching the rim and the required minimum breaking energy is not achieved, 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 can 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 tyre and rim assembly at ambient temperature, which shall be at least 20 °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 so that the tyre may be pressed radially against the outer face of the test drum.

**5.2.2.3** During the test the ambient temperature shall be maintained at between 20 °C and 30 °C, or at a higher temperature if the tyre manufacturer agrees.

**5.2.2.4** Conduct each successive phase of the test, without interruptions, at the test speed with loads and test periods as shown in:

- table 2 a) for tyres with load index (single) up to 121 inclusive and speed symbol up to P;
- 5.2.3 for tyres with load index (single) up to 121 inclusive and speed symbols Q and above;
- table 2 b) for tyres with load index (single) 122 and above.

**5.2.2.5** Throughout the test, the inflation pressure shall not be corrected and the test load shall be maintained constant.

### 5.2.3 Specific conditions for tyres with speed symbol Q and above

**5.2.3.1** The load applied shall be:

- 90 % of the maximum load rating on 1,7 m drum diameter;
- 92 % of the maximum load rating on 2 m drum diameter.

**5.2.3.2** The initial test speed shall be equal to the tyre's speed category minus 20 km/h.

**5.2.3.3** Operate the equipment to bring the test drum speed up to the initial test speed over a period of 10 min.

**5.2.3.4** 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 at least 10 min.

Finally, operate the equipment for 30 min at the tyre's speed category.

**5.2.3.5** The total duration of the test is 1 h.

Table 2 — Endurance test parameters

Speed symbol	Test drum speed <sup>1)</sup> r/min		Load as percentage of maximum load rating		
	Radial tyres	Diagonal tyres	7 h (period 1)	Duration 16 h (period 2)	24 h (period 3)
<b>a) Tyres with load index (single) ≤ 121</b>					
F	100	100	66	84	101
G	125	125			
J	150	150			
K	175	175			
L	200	175	70	88	106
M	250	200	75 <sup>2)</sup>	97 <sup>2)</sup>	114
N	275	—			
P	300	—			
<b>b) Tyres with load index (single) ≥ 122</b>					
F	100	100	66	84	101
G	125	100			
J	150	125			
K	175	150			
L	200	—			
M	225	—			
<p>1) Special tread tyres shall be tested at a speed equal to 85 % of the speed prescribed for equivalent normal tyres.</p> <p>2) The load application times for periods 1 and 2 are 4 h and 6 h respectively.</p>					

## 6 Requirements

### 6.1 Test sample

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

- one tyre shall be used for the measurement of strength;
- a second tyre for the endurance test.

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

Each test sample shall conform to the requirements specified in 6.2 and 6.3.

### 6.2 Strength test

Each test sample shall meet at least the requirements for minimum breaking energy specified in table 3, when tested in accordance with 5.1.

### 6.3 Endurance test

**6.3.1** When the tyre has been subjected to 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, sidewall, ply, cord, innerliner, belt or bead separation, chunking, open splices, cracking or broken cords.

**6.3.2** The tyre pressure measured immediately after the test shall not be less than the initial pressure specified in 5.2.1.1.

Table 3 — Minimum breaking energy

Inflation pressure corresponding to maximum load rating kPa	Breaking energy min. J	
<b>a) Tyres with load index (single) <math>\leq 121</math></b>		
	Nominal rim diameter code < 13	Nominal rim diameter code $\geq 13$
up to 250 251 to 350 351 to 450 451 to 550 551 to 650 over 650	136 203 271 — — —	294 362 514 576 644 712
<b>b) Tyres with load index (single) <math>\geq 122</math></b>		
up to 550 551 to 650 651 to 750 751 to 850 851 to 950	972 1 412 1 695 2 090 2 203	

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## Annex A (informative)

### Test conditions for tyres with non-standard marking

For an interim period, it is permissible for tyres not to be marked with a load index, but with a "load range" or equivalent ply rating "PR" marking. Tables A.1, A.2 and A.3 apply in place of tables 1, 2 and 3 respectively.

**Table A.1 — Plunger diameter**

Dimensions in millimetres

Tyre type	Plunger diameter ± 0,5
Tyres marked "LT" Tyres with rim diameter code ≤ 12 Tyres with rim diameter code ≤ 17.5 and marked "TUBELESS"	19
Other than above: — Tyres marked LOAD RANGE F (or 12PR) and below — Tyres marked LOAD RANGE G (or 14PR) and over	32 38

**Table A.2 — Endurance test**

Marking of speed restricted service	Load range	PR	Test drum speed r/min	Percentage of maximum load rating		
				7 h (period 1)	Duration 16 h (period 2)	24 h (period 3)
50 mile/h	all	all	125	66	84	101
50 mile/h	C, D E to F	6; 8 10 to 20	150 100	75 66	97 84	114 101
35 mile/h	all	all	75	66	84	101
(no markings)	A to D E F G H to N	2 to 8 10 12 14 16 to 24	250 200 200 175 150	75 <sup>1)</sup> 70 66 66 66	97 <sup>2)</sup> 88 84 84 84	114 106 101 101 101
1) 4 h for tyres with rim diameter code 14.5 or less. 2) 6 h for tyres with rim diameter code 14.5 or less.						

Table A.3 — Minimum breaking energy

Load range	PR	Breaking energy min. J				
		Rim diameter code $\leq 12$	Rim diameter code 13 and 14	Other tyres marked "LT"	Other tyres	
			Tube type marked "LT"	Tubeless with rim diameter code 13 to 17.5 inclusive	Tube type	Tubeless
A	2	68	—	226	—	—
B	4	136	192	294	—	—
C	6	203	271	362	768	576
D	8	271	384	514	893	734
E	10	339	—	576	1 412	972
F	12	407	—	644	1 785	1 412
G	14	—	—	712	2 282	1 695
H	16	—	—	768	2 599	2 090
J	18	—	—	—	2 825	2 203
L	20	—	—	—	3 051	—
M	22	—	—	—	3 220	—
N	24	—	—	—	3 390	—

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