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**Road vehicles — Compressed-air braking  
systems — Test procedures**

*Véhicules routiers — Dispositifs de freinage à air comprimé — Modes  
opératoires d'essai*

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# Contents

Page

Foreword.....	v
<b>1</b> <b>Scope.....</b>	<b>1</b>
<b>2</b> <b>Normative references .....</b>	<b>1</b>
<b>3</b> <b>Terms and definitions.....</b>	<b>1</b>
<b>4</b> <b>Symbols .....</b>	<b>2</b>
<b>5</b> <b>Test site conditions .....</b>	<b>5</b>
<b>5.1</b> <b>General.....</b>	<b>5</b>
<b>5.2</b> <b>Road surface conditions .....</b>	<b>5</b>
<b>5.3</b> <b>Ambient conditions.....</b>	<b>6</b>
<b>6</b> <b>Vehicle preparation.....</b>	<b>6</b>
<b>6.1</b> <b>Towing vehicle .....</b>	<b>6</b>
<b>6.2</b> <b>Instrumentation .....</b>	<b>6</b>
<b>6.3</b> <b>Provision for failure simulation .....</b>	<b>7</b>
<b>6.4</b> <b>Loading condition .....</b>	<b>7</b>
<b>6.5</b> <b>Tyre condition .....</b>	<b>7</b>
<b>6.6</b> <b>Adjustment of brakes .....</b>	<b>7</b>
<b>6.7</b> <b>Braking system condition .....</b>	<b>8</b>
<b>6.8</b> <b>Additional towing vehicle.....</b>	<b>8</b>
<b>7</b> <b>All tests .....</b>	<b>8</b>
<b>7.1</b> <b>General provisions.....</b>	<b>8</b>
<b>7.2</b> <b>Additional checks on vehicles with ABS.....</b>	<b>9</b>
<b>8</b> <b>Road tests .....</b>	<b>9</b>
<b>8.1</b> <b>General .....</b>	<b>9</b>
<b>8.2</b> <b>Cold effectiveness Type 0 test .....</b>	<b>9</b>
<b>8.3</b> <b>Type I fade test (Category O<sub>2</sub>/O<sub>3</sub> trailers).....</b>	<b>11</b>
<b>8.4</b> <b>Type III fade test (Category O<sub>4</sub> vehicles).....</b>	<b>13</b>
<b>8.5</b> <b>Failure of the load-sensing device .....</b>	<b>15</b>
<b>8.6</b> <b>Determination of adhesion with unladen trailer on high-adhesion surface — Vehicles with ABS.....</b>	<b>15</b>
<b>8.7</b> <b>Determination of peak coefficient of adhesion on high-adhesion surface — Vehicles with ABS.....</b>	<b>16</b>
<b>8.8</b> <b>Additional checks on ABS with trailer unladen .....</b>	<b>19</b>
<b>8.9</b> <b>Energy consumption of ABS on high-adhesion surface with trailer unladen .....</b>	<b>20</b>
<b>8.10</b> <b>Check of braking performance with ABS disabled .....</b>	<b>22</b>
<b>9</b> <b>Dynamometer tests — Alternative to vehicle tests .....</b>	<b>22</b>
<b>9.1</b> <b>General .....</b>	<b>22</b>
<b>9.2</b> <b>Alternative Type I tests .....</b>	<b>22</b>
<b>9.3</b> <b>Alternative Type III tests for brakes of Category O<sub>4</sub> trailers .....</b>	<b>24</b>
<b>10</b> <b>Stationary tests .....</b>	<b>26</b>
<b>10.1</b> <b>Service braking system check.....</b>	<b>26</b>
<b>10.2</b> <b>Parking braking system tests .....</b>	<b>26</b>
<b>10.3</b> <b>Response time.....</b>	<b>29</b>
<b>10.4</b> <b>Failure tests .....</b>	<b>30</b>
<b>10.5</b> <b>Energy depletion test.....</b>	<b>31</b>
<b>10.6</b> <b>Automatic braking.....</b>	<b>31</b>
<b>10.7</b> <b>Tests on vehicle equipped with spring brake actuators.....</b>	<b>31</b>

<b>11</b>	<b>Transfer of results of Type I or Type III tests to other vehicles .....</b>	<b>32</b>
<b>11.1</b>	<b>General .....</b>	<b>32</b>
<b>11.2</b>	<b>Presentation of results .....</b>	<b>33</b>
<b>Annex A</b>	<b>(normative) Test vehicle data.....</b>	<b>36</b>
<b>Annex B</b>	<b>(normative) Test report.....</b>	<b>39</b>
<b>Annex C</b>	<b>(informative) Figures.....</b>	<b>42</b>
<b>Bibliography</b>	<b>.....</b>	<b>45</b>

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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 7634 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 2, *Braking systems and equipment*.

This second edition cancels and replaces the first edition (ISO 7634:1995), which has been technically revised.

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# Road vehicles — Compressed-air braking systems — Test procedures

## 1 Scope

This International Standard specifies procedures for testing the compressed-air braking systems of full trailers, semi-trailers and centre-axle trailers, with and without antilock braking system (ABS), corresponding to road vehicles of Category O as defined in UNECE R.E. 3. The values given in square brackets are taken from ECE Regulation No. 13 for information.

## 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 611, *Road vehicles — Braking of automotive vehicles and their trailers — Vocabulary*

ISO 1176, *Road vehicles — Masses — Vocabulary and codes*

ISO 3583, *Road vehicles — Pressure test connection for compressed-air pneumatic braking equipment*

ISO 3833, *Road vehicles — Types — Terms and definitions*

ISO 7638 (all parts), *Road vehicles — Electrical connectors for braking systems*

ISO/PAS 12158, *Road vehicles — Braking systems — Temperature measuring methods*

DIN 72570-4, *Road vehicles; electrical connection between towing and towed vehicles; 12-V version for brake antilock devices*

ECE Regulation No. 10, *Uniform Provisions Concerning the Approval of Vehicles with Regard to Electromagnetic Stability*

ECE Regulation No. 13:1996, *Uniform Provisions Concerning the Approval of Vehicles of Categories M, N and O with Regard to Braking*, incorporating the 09 series of amendments without supplements

UNECE<sup>1)</sup> R.E. 3:1997, *Consolidated Resolution on the Construction of Vehicles*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 611, ISO 1176, ISO 3833 and Annex 7<sup>2)</sup> of UNECE R.E. 3:1997 and the following apply.

1) United Nations Economic Commission for Europe

2) *Classification and definition of power-driven vehicles and trailers*

**3.1 compressed-air braking system**

system in which the energy-supplying device and the transmission device work exclusively by compressed air

See Figures C.1 and C.2.

**3.2 Antilock braking system (ABS)**

**3.2.1 directly controlled wheel**

wheel whose braking force is modulated according to data provided by at least its own sensor

**3.2.2 indirectly controlled wheel**

wheel whose braking force is modulated according to data provided by the sensor or sensors of another wheel or wheels

NOTE Antilock braking systems with select-high control are deemed to include both directly and indirectly controlled wheels. In devices with select-low control, all sensed wheels are deemed to be directly controlled wheels.

**3.3 Vehicle loading**

**3.3.1 laden vehicle**

vehicle laden so as to reach its maximum design total mass (Code: ISO-M07)

See ISO 1176.

NOTE In the case of semi-trailers and centre-axle trailers being road-tested, excluding the parking brake system (see 10.2), the loading may be such that the maximum design axle load (Code: ISO-M11) is reached without loading the fifth wheel for semi-trailers or the mechanical coupling for centre-axle trailers

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**3.3.2 unladen vehicle**

vehicle at its complete vehicle kerb mass (code: ISO-M06) plus the mass of the required instrumentation

See ISO 1176.

**4 Symbols**

**Table 1 — Symbols used in this International Standard**

Symbol	Unit <sup>a</sup>	Description	Symbol used in ECE Reg. No. 13
$d_{mC}$	m/s <sup>2</sup>	Achieved mean fully developed deceleration of vehicle combination	
$C$	N · m	Brake camshaft input torque	C
$C'$	N · m	Converted camshaft input torque (see 11.2.3.4)	—
$C_0$	N · m	Threshold camshaft input torque (i.e. minimum camshaft input torque necessary to produce a measurable braking torque)	$C_0$
$C_{adm}$	N · m	Technically admissible camshaft input torque at a pressure in the brake actuator lower than the maximum pressure (see 11.2.3.4)	—
$C_{max}$	N · m	Maximum technically admissible camshaft input torque	$C_{max}$
$E$	m	Wheelbase	E



Table 1 (continued)

Symbol	Unit <sup>a</sup>	Description	Symbol used in ECE Reg. No. 13
$E_R$	m	Distance between kingpin and the centre axle or axles of semi-trailer (or distance between drawbar coupling and centre of axle or axles of centre-axle trailer)	$E_R$
e		Index indicating the reference axle	
$\varepsilon$		Adhesion utilization of the trailer	$\varepsilon$
$\varepsilon_H/\varepsilon_L$		$\varepsilon$ value on the high/low friction surface	$\varepsilon_H/\varepsilon_L$
$F_A$	N	Average output thrust of one brake actuator at a pressure $p_A$ corresponding to $p_m = 6,5 \text{ bar} (= 0,65 \text{ MPa})$	$Th_A$
$F'_A$	N	Converted brake actuator output thrust (see 11.2.3.4)	
$F_{A0}$	N	Threshold brake actuator output thrust (i.e. minimum output thrust necessary to produce a measurable braking torque)	
$F_{Aadm}$	N	Technically admissible brake actuator output thrust at a pressure in the brake actuator lower than the maximum pressure (see 11.2.3.3)	
$F_{Amax}$	N	Maximum technically admissible brake actuator output thrust	
$F_B$	N	Braking force at the periphery of the wheel(s) (if no other indication is given)	T
$F_{Ba}$	N	Braking force resulting at the periphery of the wheel(s) for hot braking	T
$F_{BaR}$	N	Sum of braking forces resulting at the periphery of all wheels of the trailer for hot braking	$T_R$
$F_{Bh}$	N	Braking force at the periphery of the wheel(s) for heating the brake(s)	
$F_{BR}$	N	Sum of braking forces at the periphery of all wheels of the trailer	$T_R$
$F_{bR}$	N	Braking force of the trailer with the ABS inoperative	
$F_{bRAL}$	N	Braking force of the trailer with the ABS operative	
$F_{bRmax}$	N	Maximum value of $F_{bR}$	
$F_{Cd}$	N	Total normal static reaction of road surface on those axles of the combination which are both unbraked and driven	
$F_{Cnd}$	N	Total normal static reaction of road surface on those axles of the combination which are unbraked yet non-driven	
$F_{dyn}$	N	Normal dynamic reaction of road surface on the trailer axles, with the ABS operative	
$F_i$	N	Normal static reaction of road surface on axle $i$	
$F_{idyn}$	N	$F_{dyn}$ on axle $i$ of a full trailer	
$F_K$	N	Normal static vertical reaction at a tractor fifth wheel on semi-trailer kingpin, or at mechanical coupling of a towing vehicle on drawbar of a centre-axle trailer	
$F_L$	N	Longitudinal force on a mechanical coupling	D
$F_M$	N	Total normal reaction of road surface on all wheels of the motor (towing) vehicle	$P_M$
$F_{Md}$	N	Total normal static reaction of road surface on the unbraked, driven axles of the motor (towing) vehicle	
$F_{Mnd}$	N	Total normal static reaction of road surface on the unbraked, non-driven axles of the motor (towing) vehicle	
$F_R$	N	Total normal static reaction of road surface on all wheels of the trailer	$P_R, F_R$
$F_{Rb}$	N	Total normal static reaction of road surface on all braked wheels of the trailer	$P_2$
$F_{Rdyn}$	N	Normal dynamic reaction of road surface on all wheels of the trailer	$P_{R \text{ dyn}}$

Table 1 (continued)

Symbol	Unit <sup>a</sup>	Description	Symbol used in ECE Reg. No. 13
$F_{Ru}$	N	Total normal static reaction of road surface on all unbraked wheels of the trailer	$P_1$
$F_{wM}$	N	Rolling resistance of the motor (towing) vehicle: $0,01 F_{Mnd} + 0,015 F_{Md}$	
$g$	m/s <sup>2</sup>	Acceleration due to gravity	G
$h_D$	m	Height of drawbar (hinge point on trailer)	
$h_K$	m	Height of fifth wheel coupling (kingpin)	$h_S$
$h_R$	m	Height of centre of gravity of the trailer	$h_r$
$k$	1	Coefficient of adhesion between tyre and road	
$K_C$	1	Correction factor, semi-trailer laden <sup>b</sup>	
$k_f$	1	k-factor of one front axle	
$k_r$	1	k-factor of one rear axle	
$k_R$	1	k-factor of the trailer	
$l$	m	Lever length	l
$m_M/m_R$	kg	Mass of the individual motor vehicle/trailer	P
$p_A$	bar	Pressure in brake actuator(s)	
$p_m$	bar	Pressure in the trailer control line	$p_m$
$p_{res}$	bar	Pressure in the energy reservoir(s) of the service braking system of the trailer, when the control device of the service braking system is fully applied for the first time	
$p'_{res}$	bar	Pressure in the energy reservoir(s) of the service braking system of the trailer, when the control device of the service braking system has been fully applied 9 times	
$p_s$	bar	Pressure in the trailer supply line	$p_m$
$R$	mm	Dynamic tyre rolling radius	R
$r_{BD}$	mm	Normal effective radius of brake drum or disk	R
$s_A$	mm	Stroke of brake actuator	S
$s_{Ap}$	mm	Stroke of brake actuator at which output thrust is $0,9 F_A$	$s_p$
$t$	s	Time interval	
$t_m$	s	Mean value of $t$	
$t_{min}$	s	Minimum value of $t$	
$v$	km/h	Vehicle speed	V
$v_{air}$	km/h	Velocity of air flow	
$v_f$	km/h	Final vehicle speed at the end of a braking test	$v_2$
$v_s$	km/h	Vehicle speed at beginning of a braking test	V, $v_1$
$z$	1	Braking rate [total braking force of vehicle divided by the normal static reaction of road surface (Can be calculated for the whole vehicle, a single axle or a single wheel.)]	z
$z_a$	1	Achieved braking rate	
$z_{aA}$	1	Achieved braking rate of an axle, evaluated by calculation	
$z_{aC}$	1	Achieved braking rate of the vehicle combination	$Z_{R+M}$
$z_{aR}$	1	Achieved braking rate of trailer, evaluated by calculation	$Z_R$

Table 1 (continued)

Symbol	Unit <sup>a</sup>	Description	Symbol used in ECE Reg. No. 13
$z_{BaR}$	1	Calculated braking rate of vehicle with hot brakes	D
$z_C$	1	Braking rate of vehicle combination with the trailer only braked and the antilock braking system inoperative (towing vehicle engine disconnected)	
$z_{CAL}$	1	Braking rate of vehicle combination with the trailer only braked and antilock braking system operative	
$z_{CALs}$		$z_{CAL}$ on the split-adhesion surface	
$z_{Cmax}$	1	Maximum value of $z_C$	
$z_{pW}$	1	Prescribed braking rate for one wheel	
$z_{paW}$	1	Prescribed hot braking rate for one wheel	
$z_{phR}$	1	Prescribed braking rate for heating the brakes of the trailer	X
$z_{pR}$	1	Prescribed trailer service braking rate	X
$z_{RAL}$	1	Braking rate of the trailer obtained by calculation from $z_{CAL}$	
$z_{RALH}$	1	$z_{RAL}$ on the high friction surface	$Z_{RALH}$
$z_{RALL}$	1	$z_{RAL}$ on the low friction surface	$Z_{RALL}$
$z_{RALS}$	1	$z_{RAL}$ on the split-surface	$Z_{RALS}$
$z_r$	1	Total braking rate as a result of rolling resistance <sup>c</sup>	R
<p>For some calculations, the following additional indices may be used:</p> <ul style="list-style-type: none"> <li>— subscripts 1, 2, 3 ... to indicate Axles 1, 2, 3 ..., respectively;</li> <li>— I or III to indicate the fade test type (Type I or Type III test, respectively);</li> <li>— subscript <math>e_i</math> to indicate the reference axle for the calculation of the values for the axle <math>i</math>.</li> </ul>			
<p><sup>a</sup> In accordance with ISO 31-3.</p> <p><sup>b</sup> See ECE Regulation No. 13:1996, Annex 10, Diagram 4B.</p> <p><sup>c</sup> Value is 0,01 (see ECE Regulation No. 13:1996, Annex 4, 1.4.5.3)</p>			

## 5 Test site conditions

### 5.1 General

The conditions specified here represent reasonable limits at which the braking tests may be conducted. Testing beyond these limits shall meet the conditions in 7.1.2.

### 5.2 Road surface conditions

#### 5.2.1 Road

The road shall be suitable for the dimensions and mass of the vehicle under test.

#### 5.2.2 Surface

The road surface shall be a dry, smooth, hard-surface roadway of Portland cement concrete, or another surface with equivalent coefficient of tyre-to-road adhesion (see, for example, 10.2.2.1).

A straight and level *test area road* with a surface providing a coefficient of adhesion about 0,8 shall be used. For some antilock braking system (ABS) tests, the system is required to operate so as to be modulating the braking pressures. To achieve this, surface adhesion may be reduced below the 0,8 value by wetting the surface.

For trailers with ABS of Category A which have to meet a split-adhesion surface performance, an adequate straight level test area road in accordance with 8.8.2.2 shall be used.

### 5.2.3 Gradient

The road surface shall be substantially level: a tolerance of  $\pm 1\%$  average gradient, measured over a minimum distance of 50 m, is permitted.

Type I or Type III tests, or both these tests, and the parking braking system hill-holding test (see 10.2), may be conducted on a specified gradient.

### 5.2.4 Camber

The camber (transverse gradient) across the road surface should not exceed 2 %.

## 5.3 Ambient conditions

### 5.3.1 Wind speed

The wind speed during road tests shall not exceed an average of 5 m/s.

### 5.3.2 Air temperature

The air temperature shall not exceed 35 °C.

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## 6 Vehicle preparation

### 6.1 Towing vehicle

A towing vehicle is needed to carry out the road tests. The ratio of the mass of this towing vehicle to the mass of the trailer, semi-trailer or centre-axle trailer to be tested (test vehicle) should be as small as practicable.

In addition, the braking rate of this towing vehicle in relation to the pressure,  $p_m$ , in the trailer control line shall comply with the requirements of ECE Regulation No. 13:1996, Annex 10, 3.1.3.

The towing vehicle shall be prepared such that, when coupled to the test vehicle, it is possible to brake the test vehicle alone or to brake both vehicles and measure the longitudinal force  $F_L$  on the mechanical coupling.

### 6.2 Instrumentation

The combination of vehicles shall be prepared for testing by the addition of the following instruments or calibration of existing standard instruments, or both, as needed. Other instruments may be useful in providing accurate data, but care shall be exercised to ensure that any instrument added to the standard vehicle braking equipment does not significantly affect the braking system performance.

#### 6.2.1 Control force gauge for parking braking system

**6.2.2 Coupling force measuring means**, required if tests according to 8.2.1.3 are carried out, and for Types I and III road tests, which should include an information display for the benefit of test personnel.

**6.2.3 Decelerometer**

**6.2.4 Speed-measuring device or calibrated speedometer** (for ABS, 6.2.9.1).

**6.2.5 Brake temperature indicating system** (see ISO/PAS 12158 for recommendations on brake temperature measurement methods).

**6.2.6 Response time measuring means**, in conjunction with a towing vehicle air system simulator (see Figure C.3).

**6.2.7 Line pressure gauges and pressure transducers**, for measuring and recording, where necessary, reservoir, control line and actuator pressures during the following test procedures.

**6.2.8 Pressure test connections in accordance with ISO 3583**, for checking the setting of load-sensing devices (see 10.1.2), the response time (see 10.3) and the energy depletion tests (see 10.5).

**6.2.9 Additional instrumentation for vehicles with ABS**

**6.2.9.1 Vehicle speed-measuring equipment** capable of producing a permanent record of speed and time during braking.

**6.2.9.2 Suitable equipment for ascertaining** when and for what period the wheels directly controlled by the antilock braking system actually lock during the test.

**6.2.9.3 Suitable valves and regulators** for enabling the supply to the trailer reservoir to be cut off or to allow the trailer brakes to be operated without corresponding operation of those on the towing vehicle. The installation shall be such that it is possible to graduate the control-line pressure to the trailer yet also to allow at least five maximum control-line pressure applications.

**6.3 Provision for failure simulation** [ISO 7634:2003](https://standards.iteh.ai/catalog/standards/sist/67ff87a4-11af-4b6f-821c-9e4e45570000)

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The vehicle shall be equipped with the added devices and piping necessary to provide the required failure simulations (see 7.1.8). Such added devices and piping shall not interact with the standard vehicle braking equipment such as to significantly affect either the intact or the failed system performance or both.

NOTE In the pneumatic part of the braking system, a leakage failure is easily simulated by disconnecting the appropriate pipe.

**6.4 Loading condition**

The loading condition of the towing vehicle, test vehicle, test axle or test wheel shall be that indicated in each test procedure.

Mass distribution on the axles shall be that stated by the vehicle manufacturer. In the case of several possible mass distribution patterns, the distribution of the load among the axles is proportional to the maximum permissible mass for each axle.

**6.5 Tyre condition**

All tyres shall be inflated to the vehicle manufacturer's recommended pressure levels.

Tyre tread wear should not exceed 50 % of the new condition.

**6.6 Adjustment of brakes**

Manual adjustment of brakes, even including automatically adjusted brakes, may be performed during testing, in accordance with 7.2.5.

## 6.7 Braking system condition

Braking system components shall be new or capable of functioning as new, and within the vehicle manufacturer's specifications. The brakes shall be bedded in accordance with the vehicle manufacturer's requirements.

## 6.8 Additional towing vehicle

An additional towing vehicle for towing combination of normal towing vehicle and test vehicle may be required for the Type I or Type III heating test (see 8.3.3 and 8.4.3). This additional vehicle needs no special instrumentation.

## 7 All tests

### 7.1 General provisions

**7.1.1** During all phases of these test procedures, any unusual braking performance characteristics, such as undue deviation from the intended vehicle course or abnormal vibration, shall be noted and reported.

**7.1.2** Tests may be carried out under adverse conditions to avoid delays, but with due consideration for safety. Any such adverse conditions shall be reported. A test that fails under such conditions may be repeated under the correct conditions. Only the failed test need be repeated, however.

**7.1.3** Re-testing in the course of the full procedure shall be avoided, although one or two extra stops are unlikely to prejudice subsequent road test results.

**7.1.4** Full or partial re-tests, after a test failure or to approve alternative brake components, shall repeat these procedures, with particular emphasis on vehicle preparation and lining bedding procedures.

**7.1.5** Control forces shall be applied rapidly, but without significant overshoot, and shall then be either maintained constant during the stop or varied progressively as required.

**7.1.6** Skilled test drivers should be used for determining the optimum vehicle braking performance without wheel-locking (except immediately before stopping). They should be allowed some runs to familiarize themselves with the combination.

**7.1.7** Unless otherwise stated, all braking tests shall be carried out with cold brakes, i.e., when the initial temperature of the hottest brake, measured on the disc or on the outside of the drum, is  $\leq 100$  °C.

**7.1.8** If the test vehicle is equipped with one or more load-sensing devices, the tests for failure of its control element (see 8.5 and 10.4.1) are deemed to be equivalent and the manufacturer may choose which test to apply.

**7.1.9** The pressure  $p_s$  in the trailer supply line at the start of each test, shall be [7] bar (= 0,7 MPa)<sup>3)</sup> and the control-line pressure  $p_m$  at each full service brake application, shall not exceed [6,5] bar (= 0,65 MPa).

The energy depletion test of 10.5 has special extended limits of:  $p_s = [8,5]$  bar (= 0,85 MPa) and  $p_m = [7,5]$  bar (= 0,75 MPa).

**7.1.10** For identification purposes of the test vehicle, test axle or test brake, and for the purposes of test result transfer to other vehicles or axles (see Clause 11), the data listed in Annex A are required and shall be recorded.

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3) 1 bar = 0,1 MPa =  $10^5$  Pa; 1 MPa = 1 N/mm<sup>2</sup>

**7.1.11** With the towed vehicle both unladen and laden, weigh each axle of the combination in all the configurations to be tested (see 8.6.3 and 8.7.3).

**7.1.12** The tests should be performed in the order given in this International Standard, but tests according to 10.1, 10.3, 10.4, 10.5, 10.6, and 10.7 shall be performed first.

## 7.2 Additional checks on vehicles with ABS

**7.2.1** Verify that the ABS includes provisions to activate an optical warning signal in towing vehicles via Pin 5 of the ISO 7638 connector. Further check that the system will signal to the driver any electrical break in the supply of electricity to the ABS or in the wiring external to the ABS-controller controllers. Check that this signal becomes active once the system is energized and that it is extinguished after a verification phase only if none of the above-mentioned defects is present.

With no such defect present the warning signal may be activated again in some systems, but it shall be extinguished before the vehicle reaches 10 km/h.

**7.2.2** In addition, check during the initial verification phase (before the warning signal goes out) that all electrically controlled modulator valve or valves cycle at least once.

For trailers of Categories O<sub>3</sub> and O<sub>4</sub>, confirm that the electrical connections linking the ABS to the towing vehicle are made via an ISO 7638 connector. The ISO 7638 wiring specifications may be reduced if the vehicle is installed with its own independent fuse. The rating of the fuse shall be such that the current rating of the conductors is not exceeded.

With the exception of vehicles of Category O<sub>4</sub>, the electrical connection between towing vehicle and trailers equipped with a 12 V electrical system should conform to ISO 7638-2.

**7.2.3** Check that the operation of the ABS is not adversely affected by electromagnetic fields. This shall be demonstrated by testing as prescribed in ECE Regulation No. 10.

**7.2.4** Install the test instruments ensuring that it is possible to cut off the supply to the trailer energy reservoir as required and that it is possible then to operate the service braking system a number of times with both maximum and reduced control-line pressures.

**7.2.5** Manually adjust the brakes, including automatically adjusted brakes if necessary, prior to the static and dynamic tests, and prior to the energy consumption test, in accordance with the vehicle manufacturer's recommendations for type approval testing.

## 8 Road tests

### 8.1 General

All road tests shall be carried out with the test vehicle laden. The cold effectiveness test specified in 8.2 shall additionally be carried out with the test vehicle unladen. The relation of the masses of the towing vehicle and test vehicle is as given in 6.1.

### 8.2 Cold effectiveness Type 0 test

#### 8.2.1 Test procedure

##### 8.2.1.1 General

The service braking system performance of the test trailer  $z_{aR}$  may be calculated either

- a) from the achieved braking rate  $z_{aC}$  of the vehicle combination with only the test trailer being braked (see 8.2.1.2), or